Old Growth in the East

A Survey

Revised edition

Mary Byrd Davis

Appalachia-Science in the Public Interest
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Old Growth in the East: A Survey. Revised edition
by Mary Byrd Davis

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To the memory of Toutouque, companion to the Wild Earthlings

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INTRODUCTION

For the revision of *Old Growth in the East*, as for the original text, we define old growth loosely as forest, woodland, or savanna that looks largely as it would appear had not Europeans settled North America and that has experienced little or no direct disruption by EuroAmericans. Thus we are more concerned with the amount of anthropogenic disruption an area has apparently experienced than with the size or the age of trees per se. Sites that have been continuously forested but in which the trees are young or small because of natural disturbances meet our definition.

Our selection guidelines for both editions closely resemble David Duffy's and Albert Meier's application in 1992 of the term "primary" to "forests that have never been clear cut and that have little or no evidence of past human activity. Such forests may have been grazed, they may have experienced limited exploitation of valuable tree species, and their floors may have been burned by Amerinds and European pioneers." "Secondary forests" are "those that have developed after the previous forest was extensively logged or clear cut." (1) We rate most highly forest that has never to our knowledge been logged, grazed by domestic animals, or burned by Europeans. Nevertheless, we make the distinction between primary or original and secondary that Duffy and Meier make. We avoid including as old growth, sites known to have been heavily logged or clear cut even though they may now show old-growth characteristics; and we include many sites that have experienced selective logging or grazing.

For site evaluations, we are dependent on oral and written reports from field researchers. They do not all agree about what constitutes "light" logging or grazing or "minimal" disruption. Therefore we have to be somewhat inclusive in our approach to sites. Within the boundaries of our definition, we present sites that one or more researchers have stated are old growth and also sites that may be old growth. To help readers determine whether a site meets their own standards, we state the nature of any disruption about which we have been able to learn. If the status of a given site appears to be generally uncertain, we include limiting terms such as "probable" or "possible."

As a general rule, the larger a natural area, the more likely it is to be able to sustain itself. We usually therefore devote full, individual descriptions only to sites that are 40 or more acres in size. We mention briefly many old-growth sites smaller than 40 acres in our introductions; and we may present full descriptions of small sites that are embedded in forests or that occur in states with little old growth.

We have organized the revision as we did the original version. The geographic area that we cover again includes Minnesota and eastern Kansas, Oklahoma, and Texas, but excludes Nebraska, North Dakota, South Dakota, and Canada. We regret particularly excluding Canada but eastern Canada has so many old-growth sites that we could not begin to do Canada justice. We again arrange sites by geographic region and within each region by state. The order of sites for a given state is roughly based on size with the areas supporting the most extensive old growth first.

Our catalog is incomplete. The number of known old-growth sites has become too large and the changes in these sites (under the onslaughts of climate change, exotic species, acid deposition, and timber sales) too frequent to allow one person to keep track of all of them. In order to stay abreast of developments in regard to old growth, a reporter in each region if not in each state, would be necessary. These reporters would ideally forward information to one point for compilation and distribution. In revising the survey, we searched the literature and went directly to individual researchers, organizations, and agencies. We doubtless failed to contact some people whom we should have contacted. Some we simply could not reach. Also, we frequently found that those whom we contacted were too busy to give us much assistance.

The Natural Heritage offices in each state could be expected to be sources of information on old growth, and some were very helpful. However, none that we talked with, track sites in relation to old growth, ie they cannot type the word "old growth" into their data bases and retrieve a list of relevant sites. Furthermore, many of the Natural Heritage offices are apparently so understaffed that they cannot answer questions from researchers or conduct the field work that would enable them to identify "new" old-growth sites and keep track of the status of known sites. Often when we inquired about a specific site we were told that no field worker had visited it since we did the research for our 1993 edition.

Our 2003 edition describes more old-growth sites than did our 1993 edition. (We mark with asterisks those that we describe for the first time.) We owe the increase in large measure to individual researchers working alone or with regional or local non-profit organizations, often with little or no financial remuneration. With a few notable

exceptions, federal and state agencies managing forests have carried out little inventorying of old growth in the field since 1993. They and The Nature Conservancy have located various significant old-growth sites while searching for exemplary communities in general. Nevertheless, much research on old growth remains to be done.

Many of the National Forests in the East are revising their management plans. For the National Forests in the Southeast in particular, preparation for the revision in respect to old growth has been woefully inadequate. Still, we are forced to ask ourselves, how much difference in regard to preservation would identification make? With all the so-called natural disasters threatening our old growth, conservationists need to work to protect from logging every acre that still exists; but, from our vantage point, the battle remains uphill.

In closing, we want to thank the many people who made this report possible by contributing their time and their information. We owe a great debt to the staffs of many Natural Heritage programs and other state agencies, The Nature Conservancy and other land-preservation organizations, members of the US Forest Service, US Fish and Wildlife Service, and National Park Service, and to many individual researchers and conservationists. Special thanks go to Bruce Kershner and Robert Leverett, who kindly allowed us to draw on the manuscript of their forthcoming book "Ancient Forests of the Northeast" to be published by Sierra Club Books, and to the following researchers, each of whom updated us on one or more entire states or reviewed a section of the manuscript: Tom Breden, Daren Carlson, Guy Denny, Amy Eagle, Rick Enser, Eric Epstein, Gary Fleming, Thomas Foti, Ken Hotopp, John Krause, Michael J. Leahy, Jim Manolis, Rob Messick, Kenneth Metzler, Jim Neal, Carl Nordman, Ernest Ostuno, Peter Martin, Linda Parker, John Pearson, Jess Riddle, Robin Roecker, Al Schotz, Jim Senter, Bill Shepherd, Stephen R. Shifley, Jason Singhurst, Latimore Smith, Eric Sorenson, Martin Spetich, Bill Sweeney, and Ronald Wieland. We are indebted to John Davis of the Foundation for Deep Ecology for editing the manuscript. His comments as well as those of other readers were valuable, but any errors that remain are my responsibility not theirs, all the more so, because, in certain cases I added information, after they had completed their work.

The report was made possible with the generous assistance of the Foundation for Deep Ecology and, for the North Carolina portion, Fred Stanback Jr., to whom we are grateful.

--Mary Byrd Davis
Lexington, Kentucky
August 19, 2003

1) David Duffy and Albert Meier. 1992. Do Appalachian Herbacious Understories Ever Recover from Clearcutting? Conservation Biology 6 (2) 196-201.

Northeast

CONNECTICUT

Connecticut does not include any sites greater than 40 acres that researchers are now agreed are old growth. We describe below one controversial site and several sites with lesser old-growth acreage.

Metzler speculates that the trap ridges in Connecticut's central valley likely support old-growth Eastern Red-cedar. The trap ridges were created from basaltic rock by volcanic eruptions during the Triassic period, 200 million years ago. "Trap" means "stair," and describes the step-like arrangement of the very dry, exposed rock. Some of the trees are quite gnarled, yet only two inches in diameter. As of early 2002, nobody had cored the trees to determine their age (Metzler 2002).

A cedar swamp in North Madison supports a stand of some thirty acres of closed-canopy, dense, almost pure Atlantic White-cedar. The cedar is 150 years in age or older. The stand has been owned by the regional water authority since the 1920s (Siccama 2002).

Cathedral Pines, northwest Connecticut (Litchfield County)

A 42-acre preserve of uncertain status. Thirty-four acres were leveled by a tornado in 1989. The Nature Conservancy, which owns the site, wisely refused to salvage cut the acreage, and it is gradually recovering. The 8 acres that were not blown down have a super-canopy of White Pine under which hemlocks and hardwoods grow. Metzler has described Cathedral Pines as the "result of old field succession" (1990). Kershner and Leverett characterize it as a mixture of second growth and old growth. They note that the oldest hemlocks and pines at the site were growing before settlement around Cornwall, but that most of the pines that survived the tornado are only 200 to 225 years old. They believe that these pines grew up after fire, blowdown, or logging in the late 18th century (2002). Tom Siccama reports that Yale School of Forestry has studied the site and has sections from three pines that were 300 years old and that experienced "a huge release" 200 years ago. Other trees that the researchers examined were 200 years or younger (2002). If the origin of the younger trees were known to be natural fire or blowdown, we would regard the site as old growth; but if the trees grew up after logging, we would not. The hemlock adelgid has reached the site (Siccama 2002).

Sage's Ravine, northwestern Connecticut (Litchfield County)

In the Taconic range, a ravine with old-growth hemlock, oaks, and other species. Tom Wessel estimates the old growth in the ravine as 100 or more acres. However, the ravine straddles the Connecticut/Massachusetts border, and much, if not all, of the old growth is actually in Massachusetts. Additional ravine systems in the Taconic range that Wessel has seen from a distance appear to contain old growth. The Taconic range has experienced a great deal of fire, but the fire did not reach into the ravines; and at least some of them were too steep to log (Wessel 1993, Kershner and Leverett 2002).

Great Mountain Forest, northwestern Connecticut (Litchfield County)

--**North Forty**. Some 10 acres of old growth within a 45-acre area of hemlock and northern hardwoods with White Pine, within the Great Mountain Forest, 6500 acres of land owned by Starling Childs. The entire 45 acres have generally been regarded as old growth (Winer and Childs 1956, Metzler 2001). However, Childs gave us the 10-acre figure in 2002. The Arctic Three-toed Woodpecker (*Picoides arcticus*) winters in the 45-acre area.

--**Bigelow Pond**. A hemlock stand on about 5 acres "on the lower part of a very rocky site, sloping westerly to Bigelow Pond, a former swamp that has been flooded by damming" (Winer and Childs 1956).

Logging takes place outside the old growth, on a sustainable basis; but the Childs family has long protected the forest from development and uses it as an area for research and public education (Childs 1993). In return for

officially giving up development rights, the family received two grants through the federal Forest Legacy fund in 2000 (Spokesperson for Johnson 2001).

Mount Riga Incorporated, northwestern Connecticut (Litchfield County)

A stand of 8 acres of White Pine, Eastern Hemlock, American Beech, and Yellow Birch that Curtis Rand believes was never logged because of inaccessibility. The stand is within an extensive tract owned by private individuals who are collectively known as Mount Riga Incorporated (Rand 1993, Combes 1993). The 8-acre stand appears to be the same as a Mount Riga stand described by Metzler as on a plateau in an area that was a boulder field. The corporation has granted a conservation easement to The Nature Conservancy (Metzler 2001).

Bear Mountain, northwestern Connecticut (Litchfield County)

Three small stands of old-growth hemlock with scattered Sweet Birch on the 2322-foot high Bear Mountain. The old growth is located in a ravine on the southeast slope. Kershner and Leverett have not completed their research on Bear Mountain, but give 5 acres as a preliminary total for the old growth. Tiny, twisted Pitch Pine, presumably ancient, grow on exposed rock ledges on the mountain (2002).

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MAINE

The only systematic inventory of old growth across Maine was conducted during the early 1980s. In 1980-82 the Maine Critical Areas Program in the State Planning Office conducted a statewide inventory of old-growth forests. The staff sought information from timber corporations, government foresters, and the general public. Researchers field checked 104 of the leads received and recommended 68 of the sites for evaluation for Critical Area status. Most of the sites were less than fifty acres in size.

The publication describing the inventory, Natural Old-Growth Forest Stands in Maine (1993), stated that "additional work remains to complete the documentation of old-growth forests throughout Maine." The Critical Areas Program made up for some of the lacks in the variety of communities that it presented in Natural Old-Growth Stands, with subsequent reports on uncut stands on public lands, old growth in northern Maine, Jack Pine, and Pitch Pine-scrub oak. However, the Program never reported on floodplain forests (Cogbill 1993a).

In the later 80s and early 90s, field researchers stopped seeking out new old-growth sites, in part because of a reduction of funding for inventories. Most of the research underway involved studying in greater detail the sites already identified. Inventorying recommenced in 1995 but the target was ecologically significant areas "on public and private lands in Maine," not old growth in particular. The inventory was part of the Biodiversity Project, directed by individuals from a wide variety of backgrounds.

Drawing on the inventory, the Biodiversity Project designed thirteen Ecological Reserves on public land. The Maine legislature authorized their designation, and the Maine Department of Conservation's Bureau of Public Lands set them aside in January 2001. The reserves, which totaled 68,974 acres, are designed to protect "natural ecosystems that are relatively undisturbed" and "to retain plant and animal communities native to Maine in their natural condition" (Bureau 2001). Although the reserves are scattered across the state, significant portions are subalpine spruce-fir or wetlands (Cutko 2001). In fact, 69% of the reserved land is not suitable for commercial logging "because of elevation, slope or wetlands and water" (Bureau 2001). The reserves include old growth of as yet undetermined extent (Cutko 2002).

In the reserves, fishing and hunting are allowed, but commercial extraction of resources and construction of new all-terrain vehicle and snowmobile trails and use of existing trails that cause environmental damage are banned. The reserves will remain in place for at least ten years, but unfortunately are not permanent. A key part of the reserve program will be monitoring. The Maine Natural Areas Program (MNAP), working with the Department of Inland Fisheries and Wildlife and the state's scientific community, has established a monitoring plan (Bureau 2001).

The Maine Natural Resources Information Center sent us fact sheets on the reserves but declined to make available to us other results from the natural ecosystems inventory, on the grounds that the database does not keep track of old-growth sites (Pinkham 2001). We hope that information from the monitoring of the Ecological Reserves will be made available as monitoring progresses. In the meantime, we present a few old-growth areas in the Ecological Reserves as described to us by individual researchers, land managers, and the fact sheets.

Many of our listings are drawn from the Maine Critical Areas publications of the early 1980s. The Critical Areas Program is no longer in existence, and the stands identified through the Critical Areas Program enjoy no formal protection. The field staff of the Maine Natural Areas Program told us that they think that, nevertheless, the old-growth stands described in the Natural Old-Growth Forest Stands of Maine still exist (Cutko 2001, Cameron 2001).

The Maine Natural Areas Program is, however, aware that property owners have sometimes clearcut around old-growth stands. Confidentiality agreements with landowners prevent the Program from making known which stands have lost their buffers (Cutko 2001). However, the logging of the periphery of Big Reed Pond in the late 1980s and early 1990s is well known. The logging, in fact, caused such a public uproar that property owners became unwilling to state that they owned old growth. "A lot of it is being cut," Mitch Lansky, author of *Beyond the Beauty Strip,* reported in 1993.

The field staff of the Maine Natural Areas Program tell us that they come across scattered stands of old growth in their field work. Don Cameron has noted numerous stands of what appear to be old growth on talus slopes in southern Maine. The stands are small, ranging from a few acres to perhaps 20 acres and are generally red oak. They occur from roughly the northern part of York County to south of White Mountain National Forest (2001). Andy Cutko finds apparently unlogged stands of spruce-fir--5, 10, or 15 acres—scattered here and there at elevations of 1000 to 2000 feet. Because of the poor growing conditions, a 6" or 8" tree may be 180-200 years old. He also

occasionally comes upon Red Spruce stands in which a tree that he bores turns out to be as much as 150 years in age; and he finds in northern Maine, unlogged Northern White-cedar swamps (Cutko 2001).

The Critical Areas Program took up one large special group of communities prior to and separate from the 1983 report, peatland areas. Maine has an estimated 490,677 acres of peatland. According to Ian Worley, who studied the peatlands for the Critical Areas Program, these peatlands, which constitute 2-3% of the state's land area, seem to be "the least disturbed of [the state's] principal ecosystems, with an exceptionally high proportion of the sites in essentially natural condition." Since the arrival of the colonists, peatlands in southern and central Maine have been logged for personal use or for commercial purposes, usually selectively. Apparently the species most often cut have been White Pine, Northern White-cedar, and Black Spruce, although all species have been cut for one use or another. Yet, given that, except for Northern White-cedar and Atlantic White-cedar, trees growing on peatland are generally smaller and sparser than those growing on mineral soils and given the remoteness of parts of Maine, it appears likely that the peatlands as a whole support considerable old-growth forest and savanna.

Worley divides the peatlands into six classes, the first two of which are wooded: 1) low shrub class, including Black Spruce less than 20 feet tall and 2) forest class and low forest class. The forest and low forest class is subdivided, according to dominant species, into Atlantic White-cedar, scarce in Maine; Northern White-cedar, heavily logged; Black Spruce; Tamarack; Red Maple; Black Ash; and American Elm; and three types that may occur in Maine only as parts of peatlands of other types rather than as entire peatlands: White Pine, Balsam Fir, and birch. Spruce-Tamarack peatlands are relatively frequent throughout Maine. Due to logging, draining, and other disturbances, much peatland with deciduous hardwoods is now in succession (Worley 1981).

Forest is more common on peatlands in central inland and southern inland Maine than it is on peatlands in the coastal region. In the coastal region any peatland forest area is likely to be adjacent to and smaller than open peatland areas. Nevertheless, most of eighteen coastal peatlands that Worley recommends for evaluation for Critical Area status include wooded areas (1980). Three of these peatlands are described below.

Small old-growth sites in Maine include **Tunk Mountain**, also known as Wizard Pond (Hancock County): old-growth Red Spruce, perhaps 20 or 30 acres in extent within the 5950-acre Tunk Lake Area Ecological Reserve (Cogbill 1993a, MNAP 2001); **Prentiss Woods White Pine-Hemlock Stand** (Penobscot County): 30 acres of old-growth White Pine-Eastern Hemlock and associated species from which only diseased pine have been cut (MCAP 1983a); **No. 3 Pond Hemlock Stand** (Penobscot County): an uncut 26-acre stand of pure Eastern Hemlock with trees up to 326 years of age in 1980, surrounded by a spruce-fir forest (MCAP 1983a); **Pleasant Lake Red Oak** (Aroostook County): a 30-acre stand dominated by small Northern Red Oak, aged 60 to 100+ years, apparently small and young because of natural disturbances (Pinette and Rowe 1987); **Bonney Woods Preserve*** (Franklin County): a 20-acre preserve with towering Eastern Hemlocks among other species, owned and protected by The Bonney Woods Corporation (Kershner 2002); **May Mountain--White Pine** (Piscataquis County): a 20-acre stand of White Pine (40% of the cover) and Red Spruce (40%) with Red Pine (4%) (Pinette and Rowe 1987); **Sugar Maple-Basswood-Ash*** (York County): a 20-acre stand on a mesic lower slope (Cameron 2001); **Borestone Mountain**: approximately 15 acres of 200-year-old Red Spruce within a 1600-acre preserve owned by the National Audubon Society (Merchant 1993, Dunstan 1993); **Rocky Brook Old-Growth Cedar Forest** (Aroostook County): a 9-acre stand of old-growth Northern White-cedar, uncut as of 1983 (MCAP 1983a); **Cobbosseecontee hardwood stand** (Kennebec County): ll acres of privately owned northern hardwoods--American Beech, Sugar Maple, Northern Red Oak up to around 200 years in age--over which White Pine about 215 years old tower (MCAP 1983a, Cogbill 1993a); **Ordway Pines** (Oxford County): mixed old-growth forest of hardwoods with Eastern Hemlock and White Pine, owned and protected by the Twin Town Nature Club(Cogbill 1993a, Kershner 2000); a 6-acre privately owned **Black Gum swamp** in New Gloucester (Cumberland County), with Black Gum 400 to 450 years old (Vogelmann 1990).

Big Reed Forest Preserve , north-central Maine (Piscataquis County)

Some 5000 acres acquired by The Nature Conservancy in two transactions. The Conservancy's Keil Stockwell says that "most" of the acreage is old growth. The 5000 acres, which surround Big Reed Pond, constitute a natural mixed mosaic of the forest types in Maine, including spruce-fir, northern hardwoods, cedar swamps, and rich woods. In having the whole range in one area, the site is unique, according to Lissa Widoff, who helped the Conservancy make its purchase. She feels that Big Reed Pond is "definitely the largest" mid to low-elevation old growth in the state, and that it is probably virgin (1990). Cogbill reports that the "area has a documented history showing only spotty removal of scattered pine and cedar 110 to 70 years ago."

"The nature of the original landscape" in the Northeast "can perhaps best be seen" at the Preserve, according to Cogbill. The forest is approximately 45% softwoods, 25% hardwoods, 25% mixed woods, and 5% cedar swamps. Red Spruce and Sugar Maple are dominants. The area has suffered major disturbances, including a widespread fire in 1816, insect infestation in 1805-10 and 1916-21, a hurricane in 1815, and more recent blowdowns. Thus the forest illustrates that "northern forests were always extensively disturbed" (Cogbill 1993b).

The land around the preserve "has been and is being intensively harvested" (Chokkalingam 2001). According to Cogbill in 1993, whether or not any old growth had been cut was unclear (1993a).

Upper Saint John River Watershed,* northwestern Maine (Aroostook and Somerset Counties)

Almost 5000 acres of old growth, divided among a number of tracts, on 180,000 acres of land on the Upper Saint John owned by The Nature Conservancy. The Conservancy's Josh Royte and Keil Stockwell note that "some large pine or spruce" were likely "removed between 1870 and 1910 by horse." However, The Conservancy has not found any indications of "mechanized clearing." Maps dating back to 1926 and survey records from 1870-1880 indicate that the areas experienced natural fires and included pockets of "black growth," the old, dense stands of Black Spruce that remain today. The trees in the old-growth areas are not large, because growing conditions are poor and because the areas burned frequently until the late 1950s when fire suppression began. The Conservancy protects the old growth in ecological reserve units.

The old growth is divided among townships as follows:

--T 11 R 17 Wels (Aroostook County): 47 acres of hardwoods and 154 acres of Black Spruce and Northern White-cedar (in separate but nearby tracts);

--T 11 R 16 Wels (Aroostook County): 195 acres of spruce;

--T 9 R 18 Wels (Somerset County): 346 acres of Northern White-cedar;

--T 9 R 17 Wels (Somerset County): 2200 acres of spruce-fir and Northern White-cedar;

--T 8 R 17 Wels (Somerset County): 441 acres of spruce-fir

--T 8 R 16 Wels 250 acres of Black Spruce (divided among three areas) and 901 acres of northern hardwoods (in some four separate but nearby areas) (Royte and Stockwell 2002).

Baxter State Park, north-central Maine (Piscataquis County)

Old growth within and without the Scientific Forest Management Area in the 205,000-acre State Park. The Scientific Forest Management Area is to be used to demonstrate forest management. Therefore much of it is open to logging.

--Boody Brook Natural Area*, in the Scientific Forest Management Area (SFMA)

About 451 acres of northern hardwood, mixed hardwood-conifer, and spruce forests in good condition, constituting the Natural Area or primary reserve, within the 29,537-acre SFMA. The Natural Area is traversed by the south branch of Boody Brook. Trees south of the brook include Sugar Maple, Red Maple, Yellow Birch, American Beech, Eastern Hemlock, Red Spruce, and an occasional Eastern White Pine. No signs of past logging are found here. North of the brook, the forest is primarily Red Spruce with mixtures of Yellow Birch, Red Maple, White Pine, and Balsam Fir. Here can be seen decaying stumps of White Pine from selective logging prior to 1900. Wind and spruce budworm appear to be the main disturbances.

Around the primary reserve is the secondary reserve, 1213 acres of forest that have been subject to logging and fire. A 1567-acre tertiary reserve encompasses the remainder of the Boody Brook watershed (all three drainages).

The old growth was discovered in 1993, before roads or even trails had been constructed in or near it. The Design and Management Plan for the Natural Area specifies that the primary reserve is to "be protected from management disturbance" and from construction of trails. In the secondary reserve a trail has been constructed to assist visitors; but logging and road construction are forbidden. In the tertiary reserve road building (to within 1500 feet of the secondary reserve) and logging are permitted, but activities that could impact the old growth, such as planting non-native species, are forbidden (Bissel 2001; Baxter nd).

--Outside the SFMA, three types of old-growth communities are found: subalpine fir forest, Red Spruce, and Black Spruce.

The *uncut subalpine forest*, totaling 23,094 acres, consists almost entirely of Balsam Fir. Trees in subalpine forest are generally no more than 100 years old. In Baxter State Park the forest is comprised of alternating stands of dead and living fir, "fir waves," found nowhere else in Maine and few places in the world, some biologists say, and resulting partly from wind. Subalpine forest exists in the park between 2500 feet elevation and treeline.

Documentation shows that in Baxter State Park, commercial logging did not take place above 2500 feet. Therefore, in the park the subalpine forest as a whole was spared. Balsam Fir subalpine forest is found in the following locations: **Mount Katahdin**, including North Peaks, Northwest Basin, Harvey Ridge, Hunt's Spur, Keep Ridge, and Great Basin (5470 acres); **Mullen Mountain**, **Fort Mountain**, **North Brother**, and **South Brother** (together 4263 acres); **North Turner** (2600 acres); **The Traveler** (2120 acres); **Russell Mountain** (985 acres); **South Turner** (665 acres); **North Pogy Mountain** (620 acres), **Wassataquoik Mountain** (385 acres); **Center Mountain** (90 acres); **South Traveler Mountain** (34 acres); and **Black Cat Mountain** (18 acres) (MCAP 1986).

Old-growth Red Spruce is represented by four sizeable areas:

North Turner Brook. Approximately 200 acres of Red Spruce. A tree cored at 400 years of age is the oldest known Red Spruce in the state. The median age of the canopy is greater than 200 years (Cogbill 1993a).

North Traveler Mountain. A couple of hundred acres of Red Spruce divided among stands of 20 to 30 or 100 acres each (Cogbill 1993a). The first stand identified was 25 acres in size, 230 to 300 years old, and at an elevation of 2000 to 2450 feet (MCAP 1983a).

Basin Ponds . Approximately 50 acres of old-growth Red Spruce (Cogbill 1993a). The first old-growth Red Spruce discovered at this site covered only 1.5 acres, were at an elevation of 2700 to 2800 feet, and were 300 to 360 years old.

Wassataquoik Mountain. Twenty plus acres of Red Spruce 200 to 250 years in age, at 1900 to 2400 feet.

Old-growth Black Spruce survives in two stands at the subalpine level, one of which is sizeable. **The Klondike Black Spruce** is comprised of 832 acres of "totally undisturbed" forest of Black Spruce 120 to 150 years old. The forest is in a bowl at an elevation of 2500 to 2800 feet (MCAP 1986).

Mahoosuc Mountains Ecological Reserve , on the border with New Hampshire (Oxford County)

A total of 2444 acres of uncut, subalpine Balsam Fir forest within the Maine Bureau of Public Lands' Mahoosuc Mountains Management Unit (MCAP 1986), now the 9974-acre Mahoosuc Mountains Ecological Reserve (MNAP 2001). Old Speck and Mahoosuc Arm together have 1089 acres. Fulling Mill and South Peck, Goose-Eye, and Mount Carlo account for 1355 acres. These figures for uncut fir forest include only spruce growing at an elevation of 3000 feet or more, because researchers have found "some evidence" of harvesting between 2700 and 3000 feet (MCAP 1986). Notch Two has 50 acres of Red Spruce forest, and Mahoosuc Arm a couple of hundred acres of montane spruce-fir (Cogbill 1993a). Mahoosuc Notch supports a beech-birch-maple forest, with no evidence of cutting (MNAP 2001).

Bradstreet Jack Pine, west-central Maine (Somerset County)

Approximately 2000 acres of uncut forest in which Jack Pine is prominent. A portion of the area is a Natural Area of the Society of American Foresters. The Jack Pine occupies from 10% to 90% of the canopy and is associated with Red and Black Spruce, Paper Birch, and poplar. The stand is thought to have originated after an extensive fire in 1888. Most of the trees cored around 1980 were 55 to 65 years old. The pine are taller and straighter than those in coastal areas. Apparently the tract is owned by Scott Paper Company (MCAP 1983b).

Big Spencer Mountain Ecological Reserve ,* northwestern Maine (Piscataquis County)

Extensive unlogged forest within the 4242-acre reserve. The summit of 3230-foot-high Big Spencer supports almost 200 acres of fir-birch subalpine forest plus krummholz of stunted Balsam Fir and Black Spruce. Although the existing vegetation is likely unlogged, it is interspersed with communication towers and their infrastructure and a snowmobile warming hut. From 3000 feet down to 2200 feet, fir-birch subalpine forest dominates. This subalpine forest, while showing signs of insect and ice damage, has not been logged. The eastern side of the mountain “falls off steeply with 150-foot-tall acidic cliffs.” The northwest and southeast sides below 2200 feet support mixed hardwood forests, for the most part unlogged down to 1900 feet. The Nature Conservancy, the North Woods Wilderness Trust, and the Forest Society of Maine contributed funds to the purchase of the 4242 acres, which were transferred to the state’s Bureau of Parks and Lands for management as an ecological reserve. The reserve is an addition to the original thirteen. (Sferra 2002).

Bigelow Mountain Ecological Reserve , west-central Maine (Somerset County)

Within the 10,540-acre reserve, 3100 acres of subalpine spruce-fir forest, only "some" of which have been logged. The forest shows the effects of spruce-budworm, wind, and ice (MNAP 2001). According to the Maine Critical Areas program, uncut subalpine Balsam Fir forest covers 1334 acres of Bigelow Mountain at over 3000 feet in elevation. Avery Peak-Horn is the location of 1322 of these acres. The fir average 70 years in age. The Preserve also has two small areas of old-growth lower-elevation forest: Little Bigelow Sugar Maple with 150-year-old trees (20+ acres) and East Nubble Red Spruce with 120- to 250-year-old trees (25 acres). The Maine Bureau of Public Lands manages this and other ecological reserves (MCAP 1986).

Sugarloaf Mountain-Burnt Hill, west-central Maine (Franklin County)

Uncut subalpine forests, predominantly Red Spruce and Balsam Fir, at an elevation of 3000 to 3300 feet, in the saddle between Sugarloaf Mountain and Burnt Hill. Reflecting natural forest dynamics, the area is a mosaic of stands of various ages, including pockets with very old trees. A cored Red Spruce was 260 years old; and a Balsam Fir 150 years. Adjacent to the saddle is alpine krummholz vegetation of stunted Red Spruce and Balsam Fir (MCAP 1983a). Charles Cogbill reports that the saddle contains a couple hundred acres of Red Spruce and a lot of high elevation fir. The land is in private ownership (Cogbill 1993a).

Deboullie Ecological Reserve (Township T 15 R 9 Wels), northern Maine (Aroostook County)

Uncut spruce-fir forest in the southeastern part of the Maine Public Lands Bureau's Deboullie Management Unit, now a 10,540-acre ecological reserve. The reserve is within the North Maine Woods, most of which is privately owned. MCAP describes five specific stands totaling 607 acres, but implies that the township may have additional uncut stands. Mountains in the area are no higher than 1981 feet, but some stands on isolated ridges and steep slopes escaped harvesting. Trees in the five documented stands are only 90 to 130 years old and small, due to severe growing conditions. The five stands are in the following locations: Gardner Mountain (212 acres), Crater-Denny-Galilee (140 acres), Black Mountain (130 acres), Deboullie Mountain (75 acres), Pushineer Pond (50 acres) (MCAP 1986). The Deboullie Ecological Reserve Fact sheet states that the "steep slopes of Deboullie and Black Mountains (and probably Whitman Mountain)" support several stands of unlogged spruce, which have been "heavily damaged by budworm and subsequent windthrow." It also notes the existence of two cold air talus woodlands on Deboullie and Gardner Ponds, respectively ranked "A" and "AB" (MNAP 2001).

Crocker Mountain, west-central Maine (Franklin County)

Forest on the east side of the mountain at 3300 to 4000 feet that has probably not been cut, because the terrain is very steep. The area includes stands of Paper Birch that have grown up after blow downs, and, according to MCAP, pockets of old growth, with Red Spruce, Paper Birch, and Balsam Fir, particularly on the north face of Crocker Cirque, on the ridge between Crocker and Devils Kitchen and on Devils Kitchen (1983a). Charles Cogbill says that any older component appears to be ill defined and not homogeneous (1993a). MCAP did not estimate old-growth acreage (1983a).

Waterboro Barrens, southern Maine (York County)

A 780-acre privately owned Pitch Pine site, with one segment of mature Pitch Pine and another of young Pitch Pine, scrub oak, and Pin Cherry. The younger stand grows on a terrace that may previously have supported blueberries. The older segment has Pitch Pine about 100 years old and up to 60 feet tall. The understory is scrub oak, Gray Birch, and scattered groves of Pitch Pine. Low Sweet Blueberry dominates the ground vegetation. The south end of the older segment has been selectively logged. The history of the younger segment is not known. However, Widoff gives the site overall full marks for "maintenance by fire of natural community structure and composition" and "adequacy of buffer zone/no man-made disturbance." Two rare moths have been collected at the site.

A roadside strip of Pitch Pine and scrub oak community connects the Waterboro Barrens to the Shapleigh Barrens three miles to the west. The 1170-acre Shapleigh Barrens have unfortunately undergone strip cutting and establishment of small Red Pine plantations within it (Widoff 1987).

Fryeburg Barrens, southern Maine (Oxford County)

Four pine barren segments: Clays Pond Area (610 acres), Oak Hill/Round Pond (60 acres), Jockey Cap (10 acres), and East Brownfield Barrens (82 acres). Widoff describes the four as "mostly intact and natural," but

unfortunately part of Clays Pond has been subjected to strip cutting to "improve" wildlife habitat. The East Brownfield barrens, which has a multilayered structure, appears to be the least disrupted of the three large segments. Pitch Pine and Gray Birch make up the overstory. Scrub Oak appears in the heath-sedge-lichen openings. A few Red Maple, White Pine, and Black Cherry are also present. The shrub layer is composed of Witherod and typical heath shrubs. Wintergreen and bracken fern are common in the herbaceous layer. The only apparent disruption is a snowmobile trail across the area. East Brownfield is at some distance from the other three sites, but is related to them geologically. The complex as a whole is 85% in public ownership (Maine Department of Inland Fisheries and Wildlife) and 15% in private (Widoff 1987).

Wassataquoik Stream Ecological Reserve,* central Maine (Penobscot County)

Old-growth hardwood forest within the floodplain along the East Branch of the Penobscot River, in a 775-acre reserve. The floodplain forest extends for more than a mile. Near the stream, Silver Maple, some over 120 cm dbh (diameter at breast height), dominate. Green Ash, Silver Maple, and elm are regenerating in canopy gaps (Smith 2002; MNAP 2001).

Great Wass Island, eastern Maine (Washington County)

A 550-acre stand of Jack Pine in a 1500-acre preserve occupying the major part of Great Wass Island. The pine occur on bedrock outcrops, in some areas of deeper soil, and in a peatland. On the bedrock the pine are dwarfed, with growth rates as low as one inch in diameter per 40 years. Diameters in general range from less than one inch to 10 inches and trees reach only 20 feet in height. On the deeper soils, diameters range from 4 to 14 inches and trees are up to 35 feet tall. In the peatland diameters are 1 to 5 inches and trees up to 15 feet tall. The pines are uneven-age, with trees on bedrock up to 110 years old and trees on deeper soil up to 126. The population includes many "dense stands of trees." Seedlings are fairly common in the peatland, scarcer elsewhere. The origin of the population is not known, but the area is "undisturbed." The Nature Conservancy owns the preserve (MCAP 1983b)

Schoodic Peninsula, Maine coast (Hancock County)

Several undisrupted populations of Jack Pine, the largest of which is some 300 acres on the east, south, and west flanks of Schoodic Head. This stand is 80% Jack Pine, with Red Spruce, Northern White-cedar, and Paper Birch. Tree heights range from only 4 to 6 feet on the summit to 40 feet at low elevations. Ages are up to 95 years. Growing conditions are difficult, since the glacial till soils are thin, and the sea brings storms and fog (MCAP 1983b)

Baldpate Mountain, western Maine (Oxford County)

Above 3000 feet, 332 acres of uncut Balsam Fir, averaging 60 years in age. Forest between 2700 feet and 3000 feet may also be undisrupted. Baldpate Mountain is within the Public Land Bureau's Mahoosuc Mountain Management Unit (MCAP 1986).

Yankeetuladi Hardwoods , northwestern Maine (Aroostook County)

Two hundred and forty acres of virgin Sugar Maple, American Beech, and Yellow Birch on a ridge 1200 feet in elevation. Scattered through the stand are big White Spruce and smaller Red Spruce, in addition to beech saplings and shrubs. The canopy covers 90% of the stand and averages 55 feet in height (MCAP 1983a, Selva 1993).

Acadia National Park , southern Maine coast (Hancock County)

A park of more than 46,000 acres on Mount Desert Island, Ile au Haut, and the Schoodic Peninsula, including the following old growth:

--Big Heath. A raised peatland of some 420 acres, of which more than 200 acres have "low and tall tree cover." Forest appears on the edges of the peatland, on most of the northern area, and on tree islands in the open southern portion. Scattered Common Juniper grow on the open peatland. The site is "in completely natural condition."

--Bernard Mountain Red Spruce. Twenty to thirty acres of old-growth Red Spruce, amid which grow Yellow Birch, Red Maple, Balsam Fir, and Paper Birch. The stand is on "exposed ridges and protected notches," on the southeast-facing, upper slope of the mountain. The elevation is between 700 and 1050 feet. Average age of the spruce is 150 years, but trees over 200 years old are present. The stand appears to have originated after a fire and never been cut. However, winds have toppled many trees (Cogbill 1993a, MCAP 1983a).

--Hunter's Brook Old Growth.* The brook is lined for more than a mile with a forest of mixed composition, including Eastern Hemlock, Red Spruce, White Ash, and Yellow Birch. The stand supports much Lungwort (Wessels 2001).

--**Dwarf Pitch Pine**.* The granite summits of Mount Desert Island support some dwarf Pitch Pine communities (Wessels 1999).

Nahmakanta Ecological Reserve* (Piscataquis County)

A "large," fire-origin "red pine woodland" within an 11,082-acre reserve (Publicover 2002, MNAP 2001). The woodland has never been logged, and pockets of trees survived the fire (Smith 2002). Despite its classification, the woodland is dominated by White Pine. It has less than 25% tree cover, with an understory of heath shrubs. David Publicover writes that the Nahmakanta area has other "exemplary post-burn stands," but that they are outside the ecological reserve (2002). The reserve consists of two areas that are separated by the Appalachian Trail corridor A mixed hardwood-conifer forest with the rank of "A" and a spruce slope forest with the rank of "AB" are partly within the reserve and partly within the Appalachian Trail corridor, where the National Park Service protects them (MNAP 2001). The reserve was purchased by the state under the Land for Maine's Future program (Smith 2002).

Kelley Point Peatland Complex, east-central Maine (Washington County)

Two hundred and fifty acres of "undisturbed" coastal plateau bog. A mosaic of peatland types: wooded, semi-wooded, thicket, and open, extends eastward from the plateau to tidewater. Waters descending from the plateau pass through one of several drainage ways, including Tamarack fens and other wooded fens (Worley 1980).

Musquacook Hardwoods , northwestern Maine (Aroostook County)

A 125-acre, uncut ridge, dominated by Sugar Maple and American Beech. Yellow Birch, apparently dying back, and fir are found throughout the stand; and Red Spruce and Red Maple are also present. The canopy is 60 feet high, and covers 90% of the area. The basal area of 27.3 square meters per hectare is the greatest for hardwood stands in the region. The stand illustrates the dynamics of hardwood forests, as it appears to have two even-aged components, about 115 years and about 200 years of age. Apparently one part of the stand suffered a natural blowdown about 115 years ago; the older section may have grown up after a fire (MCAP 1983a, Selva 1993).

Great Cranberry Isle Heath, in the Cranberry Isles (Hancock County)

A raised peatland on about half the southwest corner of Cranberry Isle, with Common Juniper in the central sphagnum communities and Black Spruce islands scattered through the varied plateau areas. Trees on the islands are usually yellow from scarcity of nutrients and usually less than three feet in height, although some islands have trees six to eight feet tall. The site covers approximately 215 acres, of which 150 or more are open. It is "in excellent natural condition" (Worley 1980).

Hafey Hardwoods , northwestern Maine (Aroostook County)

One hundred acres of apparently uncut, predominantly small American Beech and large Sugar Maples (16 to 21 inches dbh [diameter at breast height]) on a ridge 1300 feet in elevation. The trees are more than 275 years old (MCAP 1983a)

Turtle Island Preserve , east-central Maine (Hancock County)

Some 90 acres of possibly virgin spruce-fir forest within a 136-acre island preserve. The remaining one third of the island was clearcut in the early 1960s. A local environmentalist, shocked at the lumbering, interested The Nature Conservancy in purchasing the island while much of the forest remained intact. According to core samples, the spruce and fir are at least 150 years old. A colony of Great Blue Heron and, from time to time, Osprey, inhabit the forest (Lannon [n.d.]).

T13 R11 (Dry Town) Old-Growth Spruce Forest, northern Maine (Aroostook County)

Old-growth spruce-fir and northern hardwood stands. The spruce-fir stand, which is dominated by Red Spruce, is in a flat, shallow saddle, 1400+ feet in elevation, between two ridge tops. The hardwoods are on the western ridge. The spruce-fir forest and the hardwood forest are each approximately 50 acres in size (Cogbill 1993a). The area has not been disrupted except for the cutting of White Pine in the 1860s. Whether White Pine was cut from

the old-growth stands themselves is unclear. The spruce are of various ages up to 190 years and are reproducing. Hobble Bush, Stiff Clubmoss, and Snowberry form the ground cover in this stand (MCAP 1983a).

Gero Island Ecological Reserve , northern Maine (Piscataquis County)

Seventy acres of old-growth White Pine in the northeastern section of Gero Island, a 3175-acre reserve. The pines tower over Red Spruce and fir, which form the lower level of the two-story stand. The pines are 150 to 200 years old, 100 feet to 120 feet tall, and up to 38 inches dbh (MCAP 1983a, MNAP 2001). According to the Critical Areas Program, Gero Island was one of the few areas of the state where White Pine was "maintained in its natural presettlement condition" (MCAP 1983a).

Scraggly Lake Hemlock , northern Maine (Penobscot County)

A 65-acre mixed forest of conifers and hardwoods. Eastern Hemlock comprises 45% of the canopy. Red Spruce and Sugar Maple are next in importance. Red Spruce, American Beech, Eastern Hophornbeam, and Balsam Fir comprise the understory. The hemlock range in dbh from 16 to 36 inches. The oldest hemlock without heart rot on which researchers did a tree ring count in 1976 was 243 years old. Striped Maple is common in the shrub layer in certain areas. Needles replace herbaceous species as ground cover in sections dominated by hemlock. Herbaceous species elsewhere include Goldthread, several trillium species, Partridge-Berry, and Corn Lily. As of 1986 the stand showed no evidence of disturbance, but had few hemlock seedlings. The site is owned by the state, and the Bureau of Public Lands has named it an old-growth preserve (Pinette and Rowe 1987).

Hedgehog Mountain, northern Maine (Aroostook County)

About 50 acres of northern hardwoods. Steve Selva, who studied the area says that, according to the lichens at the site, it is old growth. He suspects that the site may have been a sugar bush at one time, but saw no evidence of cutting (Selva 1993).

Mooseleuk Mountain, in north-central Maine (Piscataquis County)

Thirty-three acres of uncut Red Spruce on the steep east slope of Mooseleuk Mountain above 2000 feet in elevation, plus 20 to 30 additional acres of uncut forest on the south and southwest sides of the mountain. Pinette and Rowe do not make clear whether they are writing of one or two stands and do not describe the old growth on the south and southwest. The Spruce Budworm has killed most of the Balsam Fir that was in the east-slope stand; Yellow Birch and Paper Birch are still scattered through it. Most of the Red Spruce are 100 to 150 years old; spruce and fir seedlings abound. Pinette and Rowe visited the site in 1986 (Pinette and Rowe, 1987).

In 1980 John Grena found an estimated 200 acres of uncut spruce-fir forest on Mooseleuk Mountain at what he described as an elevation of 1500 to 2000 feet. He recommended further study of the site (MCAP 1983a). Whether the two visits were to the same stand is not clear.

Charles Cogbill suggests that the Mooseleuk Mountain site is less interesting than a site like Sugarloaf Mountain-Burnt Hill, because the trees are relatively young, albeit through natural causes. Maine has "hundreds of other sites" like Mooseleuk, he says (1993a).

Eagle Lake Stand, on the east shore of Eagle Lake, northern Maine (Piscataquis County)

More than 50 acres of old-growth White Pine, up to 130 feet tall. Under the pine are mature spruce and fir. The stand probably grew up after a windthrow. As of 1978, part was in the Allagash Waterway; part was privately owned (Conkling 1978).

Elephant Mountain, west-central Maine (Franklin County)

Old-growth Red Spruce-Balsam Fir in the saddle between Old Blue Mountain and Elephant Mountain. Acreage estimates vary. Cogbill considers the old growth to be limited to 50 to 100 acres, although estimates go as high as several hundred acres (Cogbill 1993a). The old-growth spruce grow on both sides of the Appalachian Trail. As a result, the National Park Service owns part of the stand (Cogbill 1993a). The 30 acres of old-growth spruce-fir first identified at this location are an uneven-aged climax stand. Spruce and fir are both regenerating, but fir predominates among the seedlings. The oldest spruce is 310 years of age or older. Average dbh of the spruce is 19 inches; the largest, 28 inches (MCAP 1983a).

Southwest Branch--North--White Cedar, west-central Maine (Somerset County)

Forty-five acres of Northern White-cedar mixed with a few Black Spruce and Balsam Fir, at the edge of a bog. The trees are of various ages. Most trees cored by Pinette and Rowe were 100 to 150 years old, but the oldest was 223. The trees were as tall as 60 feet with dbhs of 25 inches. The south end of the stand, where the larger trees were located, was selectively logged about 1976.

In the same general area is a 35-acre stand, Southwest Branch--South--White Cedar, of Northern White-cedar (93%), Black Spruce (6%), and Balsam Fir (1%) with no signs of disturbance (Pinette and Rowe 1987).

Duck Lake Ecological Reserve* (Hancock County)

A thirty or forty acre stand of Red Pine and White Pine within the 3870-acre Duck Lake Reserve. Most of the stand escaped logging, because the area was remote in relation to roads and the pattern of ownership. A Native American portage trail linking two river systems crosses the stand. The Reserve is almost completely forested and, like Maine's other Ecological Reserves, is owned by the state (Smith 2002).

Mark Island Preserve, Penobscot Bay (Knox County)

An undisturbed hardwood forest and an outer ring of spruce and fir that together cover a 36-acre island. Dominant hardwoods are Sugar Maple, Yellow Birch, American Beech, and Northern Red Oak. In the understory are baneberry, Canada Yew, and Alternate-leaf Dogwood, among other species. Mark Island is the only island in Penobscot Bay with an extensive hardwood forest (Lannon [n.d.]).

East Plummer Island (Washington County)

A 10-acre oceanic island that appears never to have been "farmed or timbered." Red and White Spruce mingled with Yellow Birch and Mountain Ash cover the area. Near the middle of the island is a stand of ash. Because the weather is wet, ferns, mosses, and lichens abound (Lannon [n.d.]).

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MASSACHUSETTS

Our survey of Massachusetts concentrates on old-growth sites in the Berkshire-Taconic region. The state may, however, include other types of original forest. One type of community that should be considered is holly maritime forest, present on Martha's Vineyard and in Nantucket (Ebert 1993). Another possibility is pine barrens. As of 1987, Massachusetts had at least six pine barrens, representing both the coastal Pitch Pine-Scrub Oak and mid-latitude Pitch Pine-scrub oak types. The barrens ranged in size from 50,000 partially protected acres in Plymouth/Miles Standish State Forest to 200 completely protected acres in Wellfleet (Widoff 1987). Researchers have begun to study their history.

Motzkin, Patterson, and Foster have examined the pine plains of the Connecticut River Valley. At the time of European settlement, pine plains dominated by Pitch Pine and White Pine occurred on at least 9,000 hectares or about 22,500 acres of the approximately 32,000 ha of xeric outwash deposits in the valley. As of 1985, only 1094 ha of Pitch Pine stands and 74 ha of scrub oak stands occurred on never-plowed land in the outwash deposits. Most of the never-plowed sites are small and scattered. Only seven of them were over 40 acres in extent, and development threatened all of them. These Pitch Pine and scrub oak stands are not old growth or primary forest, as they have been logged, support no large trees, and differ in composition from the communities that existed there at the time of European settlement. However, the vegetation on the never-plowed land differs substantially from that on areas that have reverted to forest after having been farmed. The never-plowed land supports, for instance, Dwarf Chinquapin Oak, Bear Oak, and Wintergreen, which may once have been common in the area but which have not reestablished themselves on the formerly plowed land (Motzkin et al. 1999). A pine plain community on Martha's Vineyard studied by Foster and Motzkin, which seems to us to be closer to old-growth status, is described below.

Some Atlantic White-cedar stands are old growth, according to loose definitions of the term, but are not original forest. All the Atlantic White-cedar stands in Massachusetts have apparently been cut; but the state has several sites with stands of trees 150 to 200 years old. They include **Marconi Atlantic White Cedar Swamp** (Wellfleet and Barnstable Counties): 12 acres dominated by old cedar amidst which Red Maple grow; and **Acushnet Cedar Swamp** (New Bedford and Bristol Counties): an extensive wetlands complex, on 400 acres of which Atlantic White-cedar, some in old-growth stands, provide more than 25% of the cover (Motzkin 1991, 1993).

Robert Leverett contributed virtually all our information on old growth in the Berkshire-Taconic region. Unless otherwise stated, his personal communications to us and to the Eastern Native Tree Society's internet list are the source of the material in this chapter. He has been assisted by a variety of biologists, ecologists, other scientists, and citizen naturalists in his field expeditions in western Massachusetts and beyond. Therefore, his statistics are the product of teamwork.

For the first edition of this guide, Leverett divided the state's old growth into three categories: primary, secondary, and marginal. For this edition, he gives a single figure for the old growth at each site. He is basically defining old growth "as areas with trees in the 150-year-old range and older, no visible signs of human disturbance, and tree species that reflect long-term colonization" (Leverett 2001). The statistics are as of October 2002. They total 2742 acres.

Small documented old-growth sites are **Skinner State Park*** (Hampshire County): 35 acres of old-growth hemlock-hardwoods in the 390-acre park on Mount Holyoke (Leverett 2002); **Ice Glen** (Berkshire County): 25 acres of old-growth White Pine, Red Pine, Eastern Hemlock, and hardwoods, owned by the private Laurel Hill Association and located on the outskirts of Stockbridge (Leverett 2002); **Tower Brook** (Berkshire County): 25 acres of privately owned old-growth hemlock-hardwoods in Monroe (Leverett 2000, 2002); **Rowley Farm*** (Berkshire County) 25 acres of privately owned old-growth hemlock on an 800-acre site in Monterey (Leverett 2000; Leverett 2002); **Beartown State Forest*** (Berkshire County): 10 acres of old-growth hemlock, Northern Red Oak, White Pine, Sweet Birch, and Yellow Birch in Burgoyne Pass and 12 acres of old-growth hemlock and Yellow Birch in East Brook (Leverett 2002); **Mount Toby State Reservation*** (Franklin County): 20 acres of old-growth Eastern Hemlock and hardwoods, including Northern Red Oak, White Ash, and American Basswood on Mount Toby (Leverett 2002); **William Cullen Bryant Homestead** (Berkshire County): 15 acres of old-growth White Pine, Eastern Hemlock, White Ash, and Sugar Maple, owned by the Trustees of Reservations (Leverett 2000, 2002); **Chesterfield Gorge** (Berkshire County): 15 acres of old growth owned by the Trustees of Reservations in Chesterfield; **Holland Glen*** (Hampshire County): 15 acres of privately owned old growth with Eastern Hemlock, White Pine, and Sweet Birch in Belchertown; **Erving State**

Forest* (Franklin County): 15 acres of old growth with hemlock, Chestnut Oak, and Sweet Birch on Hermit Mountain (Leverett 2000, 2002); **Holyoke Range State Park*** (Hampshire County): 15 acres of old growth with hemlock, Sweet Birch, Northern Red Oak, White Oak, and White Ash on Mount Norwottuck (Leverett 2002); **Mount Tom State Reservation*** (Hampshire County) 15 acres of old-growth hemlock-hardwoods on Mount Tom within the 1800-acre reservation (Leverett 2002); **Williams College*** (Berkshire County): 15 acres of old growth on the campus of the college in Williamstown (Leverett 2002); **Lennox Mountain*** (Berkshire County): 10 acres of old growth owned by Massachusetts Audubon (Leverett 2002); **Reed Brook** (Berkshire County): 10 acres of old-growth White Pine, Eastern Hemlock, and White Ash within a preserve owned by The Nature Conservancy (Leverett 2002); **Windsor State Forest*** (Berkshire County): 10 acres of hemlock, Red Spruce, Sugar Maple, Sweet Birch, and Yellow Birch in the Gorge traversed by Windsor Jambs Brook (Leverett 2002); **Bartholomew Cobble*** (Franklin County): 5 acres of old growth in Ashfield owned by the Trustees of Reservations (Leverett 2002); **Bullard Woods*** (Berkshire County): 5 acres of large trees, including White Pine, Tulip Tree, and Eastern Hemlock more than 200 years old, owned by the town of Stockbridge (Leverett 2000, 2002); **Monument Mountain*** (Berkshire County): 5 acres of old growth with White Pine, Pitch Pine, and Sweet Birch, owned by the Trustees of Reservations (Leverett 2002); **Mount Toby—University of Massachusetts*** (Franklin County): 5 acres of old growth owned by the University of Massachusetts; and **Westfield Watershed*** (Hampden County): 5 acres of old growth owned by the town of Westfield (Leverett 2002).

Leverett estimates that 220 to 250 acres of old growth on public and private land have not yet been classified (Leverett 2002). He lists Ice Gulch in the 1902-acre **East Mountain State Forest** (Berkshire County) as including as yet undetermined acreage of old-growth hemlock-hardwoods (Leverett 02).

Manuel F. Correllus State Forest* on Martha's Vineyard (Dukes County)

Two to three thousand acres of sand-plain communities that have existed for more than two thousand years, within what is now a 5200-acre state forest. During the twentieth century more than 1200 acres of the state forest were turned into plantations of non-native conifers. The native woodland and scrubland that remain are "dominated by scrub oak, white, black, and post oaks, ericaceous shrubs, and pitch pine." The woodland and scrubland experienced frequent fires in the past, probably partly as a result of the activities of Native Americans, and were logged for fuel. As a result of a reduction in fires and logging, trees are now taller than they were earlier. However, the native scrubland and woodland were never clearcut, grazed, or plowed. Even in parts of the pine plantations, native species remain in the groundcover, because the conifers were generally planted in the scrub rather than in fields.

Today, the state forest is "56% hardwood forest, 23% plantations, 12% scrub oak, less than 7% pitch pine and oak, less than 4% fire breaks, roads, and grassland." Foster and Motzkin, who conducted a historical and ecological assessment of the state forest, believe that it "presents an unusual opportunity to protect and restore an extensive sand-plain ecosystem. . . Through proposed restoration efforts, this landscape could become a functioning example of a globally uncommon vegetation community harboring numerous uncommon species" (Foster and Motzkin 1999).

Mohawk Trail State Forest (Franklin and Berkshire Counties)

A total of 612 acres of old growth within the 6800-acre state forest. The old growth is divided among seven locations.

--Todd-Clark Mountain. A total of 311 acres of old growth with trees up to 350+ years in age on the north side of State Route 2 (Leverett 2002). Sites include:

Steep sides of Todd Mountain. Because of difficult growing conditions, the trees are not large; but many of the Sweet Birch, White Oak, Northern Red Oak, and Eastern Hemlock are 150-250 years old, and some trees are older (Kershner and Leverett 2002).

An east-facing bowl on Todd Mountain, with cliff-side old growth. Eastern Hemlock, White Pine, Sugar Maple, Red Maple, Northern Red Oak, White Oak, White Ash, Black Cherry, hickory, and basswood blend (Leverett 1993).

Todd-Clark Ridge Line. Almost three miles of old growth Eastern Hemlock and Northern Red Oak, on the northeast-facing ridge of Todd Mountain and its continuation, Clark Ridge. Some of the oak exceed 240 years in age. Hemlock ages exceed 300 years (Leverett 1993).

--**Cold River A.** 103 acres of old growth with Sugar Maple, Northern Red Oak, White Ash, American Beech, Red Maple, Sweet Birch, Yellow Birch, and Eastern Hemlock—the hemlock up to 400 years in age.

The various areas of old growth identified as "Cold River," under Mohawk Trail and Savoy Mountain State Forests, occur in the Cold River Gorge on the south side of State Route 2. The Cold River A site starts about a quarter of a mile before the confluence of Cold River and Black Brook. The Cold River old-growth region can be visualized as "swaths that are on one or the other or both sides of the gorge at varying widths, but are fairly continuous for 6.5 miles." After the 6.5 miles a break in the old growth occurs. Then the old growth "picks up again for about 0.5 miles. In some places the old-growth swaths are fairly high on the ridges and in others the swaths come down nearly to or all the way to the river" (Leverett, 2001, 21 November e-mail).

--Cold River B--Black Brook. 12 acres of old-growth Sugar Maple, American Beech, Red Maple, Yellow Birch, and hemlock up to 350+ years in age.

--Cold River C. 113 acres of old-growth Sugar Maple, White Ash, American Beech, Red Maple, Sweet Birch, Yellow Birch, Red Spruce, and hemlock up to 400 years in age.

--Trout Brook-Totem Trail. 43 acres of old growth including Sugar Maple, Northern Red Oak, Eastern Hemlock, White Ash, Red Maple, and White Pine, up to 350+ years in age.

--Trout Brook-Hawks Mountain. 25 acres of old-growth American Beech, Northern Red Oak, Sugar Maple, Eastern Hemlock, Sweet Birch, and Yellow Birch, up to 400 years in age (Leverett 2002).

--Thumper Mountain. Near the summit, 5 acres of old-growth trees that are small because of past fires and difficult growing conditions. Tree species present are hemlock, White Pine, Northern Red Oak, White Oak, Sweet Birch, and Red Maple. Ages are 130-200+ years (Leverett 2002, Kershner and Leverett 2002).

Mount Greylock State Reservation (Berkshire County)

A total of 555 acres of old growth divided among four sites. Mount Greylock, the highest mountain in Massachusetts, rises to 3491 feet above sea level.

--Paris-Bacon-Money Brooks. Four hundred acres of hemlock-hardwoods old growth with trees up to 350 years in age on the steep western side of Mount Greylock (Leverett 2002, Kershner and Leverett 2002). The area includes the celebrated Hopper, which is usually regarded as the remnant of a glacial cirque. Most of the Hopper shows substantial disturbance, but on its steep sides are several waterfalls surrounded by primary old growth. Red Spruce, Eastern Hemlock, Sugar Maple, Yellow Birch, and American Beech reach impressive dimensions here. One Red Spruce is 120 feet in height (Leverett 1993, 2002).

--DeerHill-Roaring Brook. Sixty-five acres of old-growth Sugar Maple, Northern Red Oak, American Beech, Red Maple, Sweet Birch, and Yellow Birch, up to 400 years in age (Leverett 2002).

--Mount Williams. Sixty acres of old-growth hemlock-hardwoods on the north side of a mountain near Mount Greylock. Trees are up to 300 years in age (Leverett 2002).

--Stony Ledge. Thirty acres of old growth comprised of Sugar Maple, Northern Red Oak, American Beech, Red Maple, Sweet Birch, and Yellow Birch, up to 250 years in age.

Mount Everett State Reservation, southwestern Massachusetts (Berkshire County)

An estimated 530 acres of old growth within the 1100-acre state reservation. Mount Everett is 2608 feet tall and gains 1950 feet in elevation from the base to the summit. The old growth is divided among three sites, two of which are described together here.

-- Mount Everett-East Side and Summit.* An estimated 500 acres of old-growth hemlock-hardwoods, plus a dwarf pine community of some 15 acres. Research is ongoing, and the 500-acre figure may eventually be surpassed.

Trees in the 500 acres, mostly stunted and gnarled because of harsh climactic conditions, are Eastern Hemlock, White Pine, Sugar Maple, Red Maple, Northern Red Oak, White Ash, American Beech, Sweet Birch, and Yellow Birch. Within the old growth are two healthy American Chestnuts, one of them 2.9 feet around and 66.3 feet in height. A particularly fine area of old-growth White Oak, the most extensive in Massachusetts, has been found in the zone of frequent winter icing. (Leverett 2002).

The summit of Mount Everett supports a community that is described as Pitch Pine or, more descriptively by Frelich, as a mosaic of Pitch Pine/blueberry and hardwood/huckleberry communities. The hardwoods are Bear Oak, with scattered Northern Red Oak and Red Maple. Since the trees grow in very thin soil on schist bedrock and are subject to high winds and extremes of temperature, the community is "shrub-scale." The pines in the 15 acres of old growth range in age from 12 to 170 years, with an average age of 78 years. They were apparently established without fire. Despite its small size, the site has high value for conservationists and biologists. It has, for example, 112 lichen species, including one globally rare rock-dwelling species and one tree-dwelling species "probably new to science"

(May 2001). The community "is naturally open and almost surely pre-dates settlement by Euro-Americans," Webb states (2002). The only logging has been for the construction of two fire towers and trails. Motzkin et al. note, "few sites in the northeastern United States have experienced such limited disturbance by human activity over the past few centuries with no documented history of cutting, grazing, or agriculture" (2002). Leverett does not include the 15 acres in his old-growth statistics for Massachusetts, because some researchers require the Pitch Pines to be older to qualify as old growth (Leverett 2002, personal communication Dec. 3).

--Guilder Pond.* 30 acres of old-growth Northern Red Oak, Eastern Hemlock, White Pine, Red Maple, and Sweet Birch around and near the pond. Mountain Laurel up to 125 years of age is also present. The pond is just to the north of Mount Everett (Kershner and Leverett 2002).

Mount Washington State Forest (southern Taconics; Berkshire County)

A total of 300 acres of old growth divided among five sites.

--Bashbish Falls. Up to 100 acres of old growth around and near the falls on the steep side of Bashbish Mountain. The falls are within Bashbish Falls State Park, a portion of Mount Washington State Forest. Tree species are varied: Sugar Maple, Northern Red Oak, White Pine, Eastern Hemlock, White Ash, American Beech, Red Maple, American Basswood, Sweet Birch, and Yellow Birch (Leverett 2002, Kershner and Leverett 2002). Densities of old hemlock may be greater here than at any other site, and many of the hemlock are more than 300 years old (Leverett 1993).

--**Sage's Ravine.** One hundred acres of Red Maple, Sweet Birch, and Yellow Birch within a steep ravine, which straddles the Massachusetts/Connecticut border (Leverett 2002).

--Mount Race.* Fifty acres of old growth with White Pine, Pitch Pine, and Northern Red Oak. Mature Mountain Laurel forms the understory of the dwarfed Pitch Pine community. Trees have been aged at 150-250 years. Mount Race is just south of Mount Everett(Kershner and Leverett 2002, Leverett 2002).

--Jug End State Reservation and Wildlife Management Area* (within the state forest)**.** Thirty-five acres of old growth (Leverett 2002).

--Mount Alander.* Fifteen acres of old growth (Leverett 2002).

Monroe State Forest

A total of 273 acres of old growth divided among five sites.

--Dunbar Brook-Bear Swamp. Two hundred acres of White Pine, Eastern Hemlock, and hardwoods with ages of 150-300 years (Leverett 2002).

--Parsonage Brook. Fifteen acres of old growth. Hemlock, Red Spruce, Yellow Birch, and American Beech are the most conspicuous trees. Hemlocks are up to 250 years in age; Red Spruce are between 150 and 200 years (Leverett 1993, 2002).

--**Fife Brook.** Forty-five acres of old growth on the south-facing slope of the watershed within Monroe State Forest. Trees are Eastern Hemlock, Red Maple, American Basswood, Sweet Birch, and other hardwoods. Their ages range from 150-350 years (Leverett 2002). Leverett wrote in 1993 that the stand is arguably the best mixed old-growth northern hardwood-hemlock stand in Massachusetts. The area was logged somewhat around the perimeter, and attempts were made to pasture livestock in the sun-exposed eastern end. A greater diversity of herbaceous species occur at Fife Brook than in most other Berkshire old-growth areas (Leverett 1993).

An additional 100 acres of privately owned old growth is located within the Fife Brook watershed (Leverett 2002).

--Upper Dunbar Brook. Five acres of old-growth hemlock, Sugar Maple, White Ash, and Yellow Birch 150-300 years in age (Leverett 2002).

--Spruce Mountain. Eight acres of old-growth Eastern Hemlock, Sugar Maple, American Beech, and Yellow Birch 150-250 years in age.

Mount Wachusett State Reservation,* central Massachusetts (Worcester County)

A band of 220 acres of old growth that encircles the upper 500 feet of the 2006-foot-high Mount Wachusett. The old growth is found along rock ledges. The south slopes support Northern Red Oak, American Beech, White Ash, and Shagbark Hickory; the northern slopes, Red Maple, Sugar Maple, Yellow Birch, Red Spruce, and Eastern Hemlock. Stunted Red Oaks appear on northern exposures near the summit. The trees have been aged at 150-370 years (Kershner and Leverett 2002; Leverett 2002). The private company Wachusett Mountain Associates rents 450

acres of the 3000-acre Reservation from the Massachusetts Department of Environmental Management for a commercial ski resort. The company's desire to expand the ski slopes threatens the old growth. In the spring of 1998, illegally cut trails were found in the old growth.

Little River,* in Springfield (Hampden County)

In Little River Gorge, 150 acres of uneven-aged old growth. The old growth is owned and protected by the city of Springfield (Leverett 2000 and 2001).

Savoy Mountain State Forest, adjacent to Mohawk Trail State Forest in northwestern Massachusetts (Berkshire County)

A total of 120 acres of old growth divided among five sites.

--Cold River D. 35 acres of old-growth northern hardwoods mixed with Red Spruce and Eastern Hemlock. Like all the other sites in Savoy Mountain State Forest, trees are 150-400 years in age. (On the Cold River sites, see Mohawk Trail State Forest.)

--Cold River E. 20 acres of old-growth hemlock-hardwoods.

--Cold River F. 25 acres of old-growth northern hardwoods with Red Spruce and hemlock.

--Cold River G. 20 acres of old-growth hemlock-hardwoods.

--Tannery Falls. 20 acres of old-growth hemlock, Red Spruce, Yellow Birch, and Sugar Maple.

Negus Mountain* (Franklin County)

One hundred acres of old growth on the south and southeast sides of the privately owned mountain. The slopes are rugged, "with elevation change coming at an average angle of over 40 degrees in a series of rock pitches that are separated by narrow to fairly broad shelf." Big Sugar Maples grow at the base of the rock ledges; and Northern Red Oaks are everywhere abundant. The many other species include Bitternut Hickory, Hophornbeam, and Sweet Birch. At the level of the ledges and boulders, there are no signs of human disturbance. Below the ledges, where the slope is gentle, parts of very old rock walls are evident (Leverett 1997 and 2002).

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NEW HAMPSHIRE

In the 1970s William Reiners and Gerald Lang studied the upper subalpine or fir zone in the White Mountains of New Hampshire. This zone extends from approximately 4000 feet to 4750 feet (from the upper limit of Red Spruce to treeline). They noted that "this vegetation affords an unusual opportunity for the study of natural stand dynamics because it is virtually untouched by logging" (1979). Due primarily to elevation and wind exposure and secondarily to such factors as hurricanes and avalanches, individual trees average only 50 years in age. Regeneration of a segment often begins before all the trees in the preceding generation have died. Tree species present are limited to Balsam Fir, Mountain Paper Birch, Red Spruce, Black Spruce, and Mountain Ash. Reiners and Lange state that "there is a high degree of similarity between the New Hampshire White Mountains, the White Mountains of Maine, the Green Mountains of Vermont, the Adirondack Mountains of New York, and upland areas of adjacent Canada" (1979). Unfortunately, the spruce-fir zone throughout the Appalachians and Adirondacks is being damaged by acid deposition and ozone pollution.

For a thesis at the University of New Hampshire, Lee Ellen Carbonneau identified and, in 1984, sampled 12 old-growth stands that showed no signs of cutting and were 10 or more acres in size. All had uneven-aged trees, and in each "the oldest cohort of trees was 150 years for hardwoods and spruce trees, and 200-250 for hemlocks" (1986). Her stands 40 or more acres in size and a 10-acre companion stand that she analyzed are included below. Carbonneau wrote that "undoubtedly there are other uncut stands remaining and many high altitude balsam fir stands will qualify as old-growth using [my] criteria" (1986). Dan Sperduto, Ecologist with the New Hampshire Natural Heritage Inventory, reported in 1993 that the Inventory was in the process of gathering information on potential old-growth sites. The Inventory would make the sites public, after it had determined whether they were indeed old growth.

The New Hampshire Inventory is financed only by funding designated for specific projects. Old growth has not been among the projects that have received financial support. Therefore, the staff has not been able to make as much headway on the inventory as Sperduto had hoped (Sperduto 2001). Also, because their time must be spent on the funded projects, they have been able to afford us only minimal assistance with revision of the survey.

The US Forest Service (USFS) is revising the management plan for White Mountain National Forest. In the spring of 2000 the agency received comments from the public as part of the scoping process. USFS has outlined for the public the conceptual basis of the alternatives that it is considering and, in late 2002, was developing the specifics of these alternatives. The agency hoped to release a draft management plan by the end of 2003 (Giles 2002). White Mountain National Forest is one of the few National Forests in which USFS is searching for and delineating old-growth stands.

The Lakes Region Conservation Trust has employed Rick Van de Poll of Antioch New England Graduate School to search for and delineate old growth on certain of its lands. The Trust hoped to continue to support old-growth research in 2003 (Curran 2002, LCRT 2003).

New Hampshire has three Pitch Pine/Bear Oak barrens: **Concord Pine Barren**, shrunk from 500 to 300 acres; **Nashua-Merrimack River Pine Barren**, 15 acres of a former 1000 acres; and **Ossipee Lake Pine Barren**, 2500 acres today but formerly 3500 acres. Ossipee is the only one of the three that is described as “intact.” Nevertheless, it is located in a landscape that would have been cut at least once in the mid- to late eighteenth century, was subject to at least three fires related to the arrival of the railroads in the early twentieth century, and has since been selectively logged (Anderson 1998). As of mid-2003, the Nature Conservancy owned 573 acres of the Ossipee Barren: 341 acres in its West Branch Pine Barrens Preserve, open to the public and 232 acres in its West Branch Pine Barrens (South) Preserve, closed to the public. In late 2002, The Conservancy purchased an additional 100 acres of barrens just north of Ossipee Lake (TNC Web 2002). The three barrens are subject to prescribed burns to the extent feasible in an attempt to prevent them from becoming White Pine-Northern Red Oak forest (Widoff 1987, Eckert 1993).

Swift Corwin, a consulting forester, told us that Black Gums up to 500 years old have been found in swampy areas (2002). Lionel Chute, coordinator of the Natural Heritage Inventory, to whom Corwin referred us, stated that he is familiar with small, old-growth tracts with Black Gum mostly on private land, but he did not follow up with any details (Chute 2002). An article in the *Concord Monitor*, in June 2000, describes a 700-year-old Black Gum in a swamp in Northwood in the southeastern part of the state

(Strafford County). An estimated 300 Black Gum trees live in the swamp, "at least a dozen . . . more than 500 years old." The author of the article describes the swamp as "undisturbed," but does not say whether it completely escaped logging. In New England, Black Gum has not normally been cut for lumber (Graham 2000).

Sites identified as supporting or likely supporting small areas of old growth include: **Coolidge Point* (Carroll County):** 37 acres (15 ha) of old-growth hemlock with Red Spruce within a tract owned by the Lakes Region Conservation Trust on the shore of Squam Lake (Van de Poll 2002); **Sheldrick Forest*** (Hillsborough County): about 20 acres of possible old growth within the 227-acre forest owned by The Nature Conservancy (Corwin 2002); **Red Hill*** (Carroll County): 9 acres (3.6 ha) of old growth northern hardwoods owned by the Lakes Region Conservation Trust on a mountain on which the Trust has protected a total of 2550 acres (Van de Poll 2002, Curran 2002); **Mount Cardigan*** (Grafton County): dwarf Pitch Pine on the north ridge of the 3121-foot-high mountain (Wessels 1999); **Hanover*** river shore (Grafton County); a strip of old growth on the banks of the Connecticut River that includes Eastern Hemlock, Sweet Birch, and "large and very old" White Pines and that is owned in part by Dartmouth College (Leverett 2001); **Stonedam and Five Mile Islands*** (Belknap County): pockets of possible old growth owned by the Lakes Region Conservation Trust on two small islands in Lake Winnepesaukee (Curran 2002).

WHITE MOUNTAIN NATIONAL FOREST

--Great Gulf Wilderness (Coos County). Extensive old growth including virgin forest within a 5552-acre Wilderness. The elevation varies from 1700 to 5800 feet. Approximately 1000 acres of the Wilderness are above tree line. The Wilderness supports some northern hardwoods; and the Maine Critical Areas Program, in a list of New England old-growth sites, reports that old-growth hardwoods may be found along Great Gulf Trail in New Hampshire (1983). However, softwoods occupy most of the Wilderness. At medium elevations in the more remote areas are scattered virgin stands of Red Spruce and Balsam Fir, including Red Spruce-dominated stands along Adams Brook and Cascades Brook (Foster and Reiners 1983, MCAP 1983, Foster 1982). At higher elevations is fir forest, described as completely or partly undisturbed. Relaying the general view, the Maine Critical Areas Program wrote that "much of the subalpine area is short undisturbed fir forest" (MCAP 1983). Lyon and Bormann stated, "On the steep slopes of the ridges, and floors and headwalls of the ravines, all the forest is virgin but of reduced size" (1962). Cogbill pointed to the Wilderness as the site of old-growth softwoods (1993), and Foster went so far as to write that the Wilderness in its entirety consists of "virgin forests," much battered by natural disturbances (1982).

--Presidential Range Dry River Wilderness (Coos County). Possibly unlogged forest. Fred Kacprzynski of the White Mountain National Forest reports that this 27,380-acre Wilderness is alpine and very rough so may not all have been cut. In contrast, the 45,000-acre Pemigewasset Wilderness was the site of one of the largest railroad logging operations (Kacprzynski 1993).

--Crawford Notch (Coos County). An old-growth forest of 1650 acres that encompasses in whole or in part four watersheds: Gibbs Brook, Elephant Head Brook, Flume Cascade, and Silver Cascade (Foster 1982). Three vegetation zones cut across the watersheds: northern hardwood-spruce, subalpine spruce, and subalpine Balsam Fir (Foster and Reiners 1983). The watersheds of Gibbs Brook and Elephant Brook have been much studied, and Gibbs Brook has given its name to a 1600-acre (737 ha) Scenic Area and candidate Research Natural Area (RNA) site. Carbonneau sampled stands in 890 acres of Red Spruce-Balsam Fir (2300 feet to 4300 feet) and an adjacent 10 acres of Eastern Hemlock (2200 feet to 2300 feet) (1986).

Foster and Reiners describe the Crawford Notch old-growth site as unlogged (1983). However, Lyon and Bormann report that though "probably much of the area contains virgin forest," the land between the Gibbs Brook and Elephant Head Brook ravines appears to have been selectively cut. The Forest Supervisor told them that this area "was logged around the edges about 1890" (1962). In 2000, a USFS team studying the Gibbs Brook Scenic Area for suitability as a Research Natural Area determined that the Area would meet the goal of the RNA program to "preserve pristine habitats" and "maintain genetic diversity." They found a total of 102 species of vascular plants, three of them on the New Hampshire Rare Plant List, and numerous large trees, including Yellow Birch to 26.4 inch dbh (diameter at breast height), Red Spruce to 23.6 inch dbh, and Balsam Fir to 19.0 inch dbh (Fay 2002). Earlier, Foster found in Crawford Notch a Red Spruce 323 years old, Yellow Birch 261 years old, Paper Birch 187 years old, and Balsam Fir 150 years old (1982).

A portion of Crawford Notch's old growth is in Crawford Notch State Park rather than in White Mountain National Forest. The Park, which was established before the National Forest, lies between the Forest and US 302.

--The Bowl [Old Growth], within Sandwich Range Wilderness and partially within the Research Natural Area called The Bowl (Grafton County). Old growth covering the western side of a mountain valley. This side is generally believed to have suffered no disruptions (MCAP 1983, Lyon and Bormann 1962). Carbonneau analyzed only hardwoods: 500 acres, at 1900 feet to 2500 feet in elevation (1986). The mountain, however, rises to around 4000 feet, and the vegetation clearly changes with elevation. As Carbonneau states, Sugar Maple, American Beech, and Yellow Birch dominate the gentle lower slopes. Between approximately 2500 and 3000 feet, Red Spruce is the dominant, sometimes occurring in pure stands. Above 3000 feet, Red Spruce and Balsam Fir share dominance (MCAP 1983, Lyon and Bormann, 1962).

The 510-acre Research Natural Area called The Bowl was established in 1937 to protect a portion of the old growth. The staff of White Mountain National Forest has since created a candidate RNA known as the Bowl Extension with about 925 additional acres of old growth (USDA 2001). The 925 acres are well protected, Stephen Fay of USFS reports (Fay 2002).

--Nancy Brook (Carroll and Grafton Counties). An unlogged forest dominated by Red Spruce and Balsam Fir within and adjacent to the 1385-acre Nancy Brook Research Natural Area . Carbonneau analyzed 1000 acres of old growth at an elevation of 2800 to 3900 feet (1986). The 2000 Monitoring Report for the White Mountain National Forest describes Nancy Brook as 2000 acres and states that the area "is believed to be the largest virgin mountain spruce-fir forest in New Hampshire and one of the few remaining large examples in the Northeast" (USDA 2001). According to Foster, Nancy Brook "boasts the finest example of virgin red spruce swamp flat forest in the White Mountains" (1982). Nancy Brook supports a documented total of 167 species of vascular plants and 29 species of mosses and liverworts (USDA 2001). Carbonneau found that Wood Sorrel was the most common species in the herbaceous layer of the New Hampshire spruce-fir stands that she studied. Additional elements were wood ferns, sphagnum moss and other mosses, lichens, and *Clintonia borealis* (1986).

--Lafayette Brook Scenic Area, in Franconia Notch (Grafton County). Small areas of old-growth hardwood and spruce-hardwood at the lower elevations and old-growth spruce-fir at the upper elevations, in a watershed that ranges from 1780 to 5249 feet in elevation (Pyles 1961). Carbonneau analyzed 62+ acres of hardwoods at 1900 to 2400 feet, and 15 acres of spruce-forest at 2000 to 2400 feet at Eagle Cliff (1986). Foster mentions a "fine virgin hemlock/spruce stand" in addition to an old-growth hardwood stand (1982). According to the Forest Service Order Establishing the Lafayette Brook Scenic Area, the entire upper half of the valley below tree line may be virgin, and Forest Service maps show approximately 75 acres of virgin spruce (Pyles 1961).

--Mountain Pond North (Carroll County). An old-growth northern hardwood stand that is a candidate for RNA status. Figures on the old growth vary. Leak characterized the area as containing 100 to 150 acres of old growth (1987); Fay, about 105 acres (Fay 2000). The 2000 Monitoring Report describes a site "of about 70 acres" (USDA 2001); but a USFS Region 9 list of actual and candidate RNAs says that the candidate is 300 acres in extent. Carbonneau analyzed 150 acres of old growth at 1600 to 1800 feet (1986). Sugar Maple and White Ash are up to 35" dbh (USDA 2001). By basal area, almost 80% of the stand is American Beech and Sugar Maple (Leak 1987). A smaller percentage of the area is in herbaceous cover than is the case for other stands Carbonneau studied, and Wood Sorrel and Canada Mayflower are absent. Carbonneau theorized that competition with large Sugar Maple seedlings may be the reason (1986). The January 1998 ice storm knocked over many of the trees. Candidate RNA status gives the stand informal protection. (Fay 2002).

--Shingle Pond, on the east slope of Kearsarge North Mountain (Carroll County). Old-growth mixed northern hardwoods and hemlock, at least 65 acres and probably considerably more. Forest types are Red Spruce-Balsam Fir, Sugar Maple-Yellow Birch-hemlock, Sugar Maple-beech, and hemlock. Red Spruce has been measured at 27" dbh, Yellow Birch at 29.2", White Ash at 31.8", hemlock at 37.5", and Sugar Maple at 38.4". An American Beech dates from 1773 and a Sugar Maple from 1775 (USDA 2001). Researchers have found 90 species of vascular plants; and, with one possible exception (*Hieracium* in the pit of a blowdown), no exotics. Shrubs and young trees, in particular Hobble Bush and Striped Maple, are growing vigorously in hardwood areas damaged in the 1998 ice storm (USDA 2000). Stephen Fay, a USFS ecologist and soil scientist, discovered the site (Fay 2000). The 2000 Monitoring Reports lists it as a "possible future RNA" (USDA 2001).

--Mount Moosilauke (Grafton County). Unlogged Balsam Fir forest between 3700 feet in elevation and tree line. Mount Jim and Mount Blue are two minor summits with old growth (Lambert et al. 1980, Lang et al. 1980).

--Mount Stanton Cliff and Talus Area (Carroll County). On talus, at an elevation of 700 to 1700 feet, a community that has probably never been logged. The talus has areas of large rocks and areas of gravel with soil. The drier portions of the latter support Northern Red Oak and Red Pine; the moister and richer portions, basswood and

hophornbeam. Round-leaved Dogwood is common on the talus; and Harebell on the talus and adjacent cliffs. Eastern Red-cedar is scattered on the cliffs, which Lyon and Bormann described as the tree's northernmost known site in New Hampshire (1962). Talus and cliffs cover 250 acres. The woods below the talus are second growth (Lyon and Bormann 1962). Red Pine blew down some years ago, but only a narrow area along the river, not the old-growth area, was salvage cut (Leak 1993, Marx 1993).

--Alpine Gardens Research Natural Area* (Carroll County). A 300-acre arctic-alpine tundra community on the eastern shoulder of Mount Washington, between Huntington and Tuckerman Ravines, elevation 4750-5500 feet. The natural community includes "scattered pockets of krummholz and matted black spruce." The community supports 33 plant species that are on the state endangered, threatened, or rare list, four animal species on the state rare list, plus one plant that is a candidate for federal listing as endangered (USDA 2001).

Franconia Notch State Park (Grafton County)

--Uncut Red Spruce-Balsam Fir forest with some Paper Birch in "less accessible areas" above 2000 feet (Perry and Perry 1990). As in Crawford Notch, the state park is located on both sides of the highway, next to White Mountain National Forest.

--Cannon Mountain. Dwarf forest in gullies on the talus and possibly also on the cliffs on a slope of Cannon Mountain at an elevation of 2000 to 2500 feet. The forest is presumably unharvested, because of its location and character. The talus supports dwarf Mountain Maple, Pin Cherry, and Paper Birch. Beneath these trees are Red Baneberry, Purple Trillium, and currant. Lyon and Bormann do not mention trees on the adjacent cliffs, and describe the talus and cliffs as covering 320 acres (1962). Miner characterizes 400 acres of cliff and talus as supporting old-growth Red Spruce, Balsam Fir, and Mountain Paper Birch (1993).

--Charcoal Hearth. Seventy-four acres of old-growth hardwoods at 1600 to 2000 feet. As in most of the other hardwood stands, the principal species in the herbaceous layer are Wood Sorrel, Mountain Aster, Shining Clubmoss, Wild Sarsparilla, wood ferns, and mosses (Carbonneau 1986).

Pisgah Forest, southwestern New Hampshire (Cheshire County)

Unlogged old-growth stands, scattered over a 5000-acre area, severely disturbed by the 1938 hurricane. Communities before the hurricane were pine-birch-hemlock, pine-hemlock-oak, pine-hemlock-hardwood, hemlock-hardwood, chestnut-birch (the chestnut trees were dead), and beech-Sugar Maple-Sweet Birch. Most of the old-growth patches are owned by the state and are in the 13,066-acre Pisgah State Park; but the Pisgah Tract of Harvard State Forest, a 25-acre tract within the park's boundaries, has been owned by Harvard University since 1927. The University obtained the site to protect it as a contiguous stand of high-quality old growth. Before the 1938 hurricane Harvard's Pisgah Tract was composed principally of Eastern Hemlock (50 to 60% of stems and basal area) and White Pine (40% of basal area) with some Sweet Birch, Red Maple, and Northern Red Oak. Now Eastern Hemlock have greatly decreased in number; White Pine have almost disappeared; and Sweet Birch, Paper Birch, and Pin Cherry have increased greatly in relative density (Foster 1988, O'Keefe 1993).

Norton Pool, in northeastern New Hampshire (Coos County)

A 427-acre virgin Red Spruce-Balsam Fir forest that belongs to The Nature Conservancy. The Spruce Budworm destroyed most of the fir trees in the mid- to late-1980s, but the forest is recovering (Hoose 1988, Benson 2002). The tract is believed to be the state's only "low-elevation, first-growth spruce-fir forest" (Hoose 1988).

Nash Stream Forest, northern New Hampshire (Coos County)

Old-growth hardwoods of uncertain extent within the 40,000-acre property. Tom Miner of the New Hampshire Bureau of Forestry reported in 1993 that upper Sugar Loaf Mountain had several hundred acres of old-growth northern hardwoods and that this was the only old-growth hardwood stand in the forest. On the other hand, Bob McGregor, the forester for Nash Stream Forest, told us ten years later that the only old-growth hardwoods with which he was acquainted were on Fitch Mountain (Number Three Mountain) in the northwestern corner of the property. McGregor thinks that the high-elevation spruce-fir forest was logged (2003). Nash Stream Forest was acquired through a joint effort in which the state of New Hampshire, the federal government, and the Trust for New Hampshire Lands participated. The state now owns Nash Stream Forest and the state's Bureau of Forestry manages

it; but the US government holds a conservation easement, which White Mountain National Forest officials administer (Miner 2003).

Vickie A. Bunnell Preserve ,* in Stratford, northern New Hampshire (Coos County)

Three hundred and fifty acres of old growth dominated by Red Spruce-Balsam Fir-Mountain Ash montane forest (formerly known as the Bean Tract), within a preserve of approximately 11,000 acres. Many of the canopy trees are more than 200 years old, and some Red Spruce are more than 250 years old. Red Spruce, Balsam Fir, White Birch, and Yellow Birch reach two feet in diameter and almost 80 feet in height. Mountain Ash, usually only a tall shrub in New Hampshire, grows up to the canopy and attains 14-inch diameters. Seeps interspersed in the old growth converge to form the headwaters of West Branch Brook. The Nature Conservancy acquired the 350 acres in 2001, with help from Sweet Water Trust. They lie between and link the Bunnell Tract (the portion of the Bunnell Preserve that TNC previously owned) and Nash Stream State Forest (Benson 2002).

Ossipee Mountain Preserve ,* in Tamworth, east-central New Hampshire (Carroll County)

Within and adjacent to the preserve, 160 acres (65 ha) of old-growth northern hardwoods-hemlock and hemlock-spruce-northern hardwooods, and, on what is known as the Sanger Lot, Red Pine. The understory is spruce-fir, northern hardwoods, Striped Maple, and hemlock, with, on the Sanger Lot, heath. The soils are Marlow stony and, on the Sanger Lot, Lyman rock outcrop; the slope is 0-45%. The only known direct human disruption has been light timbering on the upper elevations. Natural disturbances have included periodic floods, ice storms, and, on the Sanger Lot in 1874, fire. The oldest trees are 200-450 years old except on the Sanger Lot where they postdate the fire. The preserve is owned by the Lakes Region Conservation Trust, which is protecting it as "forever wild." A family owns the old growth on land adjacent to the preserve (Van de Poll 2002, Curran 2002).

Harris Center Woods ,* southwestern New Hampshire (Hillsborough County)

Some 100 acres of mature hemlock-northern hardwoods forest in pockets of soil among rocks and boulders within a 500-acre block of woods that belongs to the non-profit Harris Center for Conservation Education. The forest includes occasional large American Beech, Sugar Maple, and Eastern Hemlock; but the beech are suffering from beech bark disease. Neither the condition of the forest nor the historical record indicates logging; and the terrain suggests that logging did not take place. Nevertheless, a few small areas were cleared for pasture. The 1938 hurricane felled trees (Ferguson 1993, Cadot 1993).

Peirce Reservation* in Stoddard, southwestern New Hampshire (Cheshire County)

Seventy-seven acres (31 ha) of possible old growth within a 3576-acre reservation. The remains of a barbed wire fence on the site suggest that it may have been at least grazed, but no other signs of direct human disruption have been noted (Chute 2002). The cover type is northern hardwoods and northern hardwoods-Red Oak and the understory is northern hardwoods, Striped Maple, and Red Spruce. Soils are Berkshire and Monadnock with many boulders; the slope, 0-40%. Natural disturbances include a fire around 1818, a blow down of 15% of the area in the 1938 hurricane, and ice damage. The average age of the oldest trees is approximately 225-250 years (Van de Poll 2002). The Society of New Hampshire Forests, which owns the reservation, foresees making the 77 acres part of a much larger designated natural area (Alderman 2002).

Big Pines Natural Area, in Hemenway State Forest. east-central New Hampshire (Carroll County)

Old-growth White Pine intermingled with Eastern Hemlock and other species, within a 125-acre natural area. Leak characterizes the area as including trees over 200 years old; the Perrys write of 150-year-old trees, including White Pine 42 inches in diameter (1990). Carbonneau did not analyze the area, because she found that it had an "absence of wide ranges of tree sizes and ages" (1986).

Louis B. Thacher Memorial Forest, southwestern New Hampshire (Hillsborough County)

Five acres of virgin White Pine and 87 acres of selectively cut forest. The forest belongs to the New England Forestry Foundation (Kershner 1990). Carbonneau did not analyze it, because of an "absence of wide ranges of tree sizes and ages" (1986).

Heath Pond Bog, east-central New Hampshire (Carroll County)

A "thoroughly natural" open peat bog with a small pond near one edge. Ericaceous shrubs dominate the bog, chiefly Leatherleaf, Rhodora, and Sheep Laurel. Scattered through the bog are small Tamarack and Black Spruce, and an occasional small White Pine. Sphagnum moss and sedges form the ground layer. As of 1962, there were no signs of cutting. The state owns the bog, which Lyon and Bormann characterize as 70 acres in size (1962), and Miner as 240 acres (1993).

Thurston Williams Family Forest, southwestern New Hampshire (Cheshire County)

Two old-growth areas within a 379-acre forest, owned by the Society for the Protection of New Hampshire Forests. In the larger, 51-acre area, the trees are primarily Yellow Birch, Sugar Maple, and White Ash, with dbhs between 36 inches and 44 inches (Jones 1993). To the Society's knowledge, the 50 acres have not been cut; and, if they were cut, only softwoods were taken. The smaller area is five acres of old-growth hemlock, which Carbonneau sampled (1986). The Society, whose primary mission is to protect forest land, owns 132 tracts totaling 34,319 acres. They manage most of the tracts, but set aside 25% of what they own as natural areas (Jones 1993; Alderman 2002).

Mount Sunapee State Park,* southeastern New Hampshire, (Merrimack County)

Potential old growth composed of northern hardwood/Red Spruce forest with hemlock, Red Spruce or Sugar Maple/White Ash/basswood dominated inclusions on the upper slopes north and east of Mount Sunapee's ridge line. Ski trails now bisect portions of the forest, one notable exception being the 175-acre East Bowl composed of Yellow Birch/Sugar Maple with super-canopy Red Spruce. Red Spruce have been aged to 254 years; and Yellow Birch to 288 years. The ridge-line forest of Red Spruce/Balsam Fir has never been cut, according to Chris Kane, who rediscovered the site in 1997 and furnished the preceding description (Kane 2002). The New Hampshire Natural Heritage visited Mount Sunapee in the fall of 2002 to gather data in order to determine whether the forest is actually old growth. Dan Sperduto tells us that the staff found "older growth" there, and, in June 2003, was in the process of comparing it to other sites in the state in preparation for issuing a report (Sperduto 2003). Philip Ayres in his 1915 Manual of Mount Sunapee, published by the Sunapee branch of the Society for the Protection of New Hampshire Forests, relates that conservationists prevented the logging of the forest in the early 1900s. The Society acquired much of the land and deeded it to the state in the 1950s (Kane 2002). In 1999 the state of New Hampshire leased a ski area on the mountain, previously managed by the state, to a private company. Concerned citizens created a Mount Sunapee Preservation Committee to monitor the lease, including any impact on potential old growth near the ski area (Crabtree 1999).

Mount Misery Ledges and Deciduous Forest, southeastern New Hampshire (Strafford County)

Old-growth forest on ledges and on a talus slope at 300 to 500 feet on Mount Misery. Oaks of various species occur on the dry ledge rim. The talus slope supports more varied hardwoods: Shagbark Hickory, American Basswood, White Ash, Eastern Hophornbeam, Sugar Birch, Sweet Birch, and Yellow Birch. Lyon and Bormann speculated that the tract was never cleared and that the forest is "probably the closest approach to a virgin hardwood stand in southeastern New Hampshire" (1962).

Pitch Pine Natural Area, in White Lake State Park, east-central New Hampshire (Carroll County)

A stand of old-growth Pitch Pine, under which Bear Oak are growing up, due to lack of fire. Lyon and Bormann described the site as 31 acres (1962); but the Natural Area is 70 acres in size (Miner 1993).

Castle in the Clouds/Ossipee Park,* eastern New Hampshire (Carroll County)

Within the 5400-acre tract on the eastern slope of the Ossipees, two old-growth stands with a total of 74-86 acres (30-35 ha) of old growth, plus additional stands. Rick Van De Poll was in the process of mapping the old growth on the tract in 2002 when he last communicated with us (Van De Poll 2002). In mid-2003 the Lakes Region Conservation Trust, on whose behalf Van De Poll was studying the old growth, was raising the final payment on the tract, which it is purchasing from a private owner (LRCT 2003).

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NEW JERSEY

Tom Breden, Coordinator/Ecologist with the New Jersey Natural Heritage Program, reports that the program has not made a concerted effort to identify all the old growth in New Jersey. They have put more emphasis on endangered species and their habitat (2002). The state may, however, have a fair number of old and mature forest patches, including small tracts with trees over 100 years old, he pointed out in 1990. To date, only three sizable, largely uncut and ungrazed sites have been delineated, and they are not in the Pine Barrens, the area most familiar to people outside the state.

The Pine Barrens has "nothing that fits into the primeval category," Breden says, because of both natural and anthropogenic disturbances. Natural fire is common in the Pine Barrens; and people have exploited the area's resources (Breden 1990). As the New York-New Jersey Trails Conference puts it, "First to move in were the loggers, who cut clean. Pine and cedar lumber moved steadily to shipyards and nearby towns for years before, during, and after the Revolution" (NY-NJTC 1984). Charcoal production and iron ore mining were two local industries for which trees were cut. Southern New Jersey once had extensive Atlantic White-cedar swamps, but the trees were valuable as timber, and now only pockets remain (Breden 1990).

Independent researchers Bruce Kershner and Robert Leverett have recently identified a number of small old-growth sites in New Jersey. In several of them hemlock plays a major role (Kershner and Leverett 2002). Unfortunately the hemlock sites do not appear to be destined to remain intact for long. New Jersey is severely impacted by the Hemlock Wooly Adelgid, which reportedly has infected ninety percent of the state's hemlocks in only eleven years. Dan Palmer, a researcher with the New Jersey Department of Agriculture, has been quoted as saying, "The groves are considered to be doomed. If we find a control measure, at least we can reforest." His laboratory has sent the beetle *Pseudoscymnus tsugae*, which preys on the adelgid, to selected sites in New Jersey in a pilot eradication program (Associated Press 2002, Breden 2002). Both the Hemlock Wooly Adelgid and its intended beetle predator are exotic species, belonging in Japan.

Small areas of old growth include **Tillman Ravine Natural Area*** in Stokes State Forest (Sussex County): a 25-acre selectively cut hemlock-mixed hardwood forest in a ravine within a 500-acre Natural Area (Kershner and Leverett 2002, Stern 2002); **Bull's Island (Cook) Natural Area*** within Bull's Island Recreation Area, in turn within Delaware and Raritan Canal State Park (Hunterdon County): 24 acres of probable old-growth floodplain forest comprising the Natural Area (Kershner and Leverett 2002; Williams 2002); **Valhalla Hemlock Glen** (Essex County): a 30-acre preserve with unlogged hemlock along a stream and gorge and a mixed oak woods, owned by Montclair State College; **Greenbrook Sanctuary*** (Bergen County): 10 acres of possible old growth within a second-growth forest near the rim of the Palisades, owned by the Palisades Nature Association (Kershner and Leverett 2002); **Laurel Pond*** in Wawayanda Swamp Natural Area in Wawayanda State Park (Sussex County): an "essentially virgin" hemlock stand of perhaps 5 acres (Kershner and Leverett 2002, Foley 2002). We print descriptions of two other sites of less than 40 acres below, as well as of larger sites.

Delaware Water Gap National Recreation Area,* northwestern New Jersey (Warren County)

Undetermined acreage of Eastern Hemlock, pine, and Sweet Birch on cliffs that tower above the Delaware River. The trees are 150-300 years old (Kershner 2002). Hemlock in the area have been particularly hard hit by the Hemlock Wooly Adelgid, and *P. tsugae* beetles have been sent to the Water Gap in hopes of stemming the loss of hemlock.

Bear Swamp West, southwestern New Jersey (Cumberland County)

A hundred acres of old-growth broadleaf swamp forest within Bear Swamp West. Dominant trees are Black Gum, Sweetgum, Red Maple, and Sweetbay Magnolia. The Black Gum are up to four feet in diameter and, according to Kerschner, are 400 to 600 or more years old; the Sweetgum, up to four feet in diameter and 300 years old. Many of the Red Maple are more than four feet in diameter. Other trees include American Beech, Swamp White Oak, and American Holly, the last with trees 22 inches in diameter and 80 feet tall (Kershner 2002). A three-layered structure of woody plants--closed canopy (A), semi-closed canopy (B), and shrub and small trees (C)--is among the indications that the forest "has never been cut, or at most that it has been cut only minimally and selectively" (Heckscher 1994).

Approximately one-fifth of the old growth is owned and protected by the Natural Lands Trust, which owns

about 350 acres in Bear Swamp. The balance is owned by Better Materials, a subsidiary of Better Minerals and Aggregates Company. The company allows researchers to visit the area by permission only. Better Materials mines sand in the area. It has not mined in the old growth, but nearby mining for sand indirectly threatens the old growth, because the mining is lowering the water table and also may allow salt water to seep in from the nearby bay. The state of New Jersey is interested in acquiring the portion of the forest owned by Better Materials (Heckscher 1994, 2002).

Bear Swamp East, in Belle Plain State Forest, southwestern New Jersey (Cumberland County)

Within the 1438-acre Bear Swamp East, 115 acres of old-growth broadleaf swamp forest dominated by Black Gum, Sweetbay Magnolia, and Red Maple. Bear Swamp East, which is part of a 15,660-acre state forest, is separated from Bear Swamp West only by gravel mines and roads but it is wetter than Bear Swamp West (Breden 1990, 1993, Lawrence 2002). The vegetation is similar except that Bear Swamp East includes large Tulip Trees, scattered about the swamp on hummocks. The trees are up to five feet in diameter and 300 to 400 years of age. Only one Tulip Tree had been found at Bear Swamp West as of 1994. Before the advent of the Gypsy Moth, Bear Swamp East had larger Swamp Chestnut Oak than did Bear Swamp West. In both areas mortality among the species has been high (Heckscher 1994). Bald Eagles nest at Bear Swamp East. Like Bear Swamp West, Bear Swamp East is threatened indirectly by nearby sand mining (Kershner 2002, Heckscher 2002).

William L. Hutcheson Memorial Forest, formerly known as Mettler Woods, east-central New Jersey (Middlesex County)

A 65-acre tract of mixed oak forest, surrounded by 173 acres of abandoned fields, young woods, and research plots. The mixed oak forest and the surrounding land comprise the Hutcheson Memorial Forest Center. The oak forest "has been uncut since 1790" (Johnson 1990). The canopy is dominated by White Oak, Black Oak, and Northern Red Oak, with some trees almost 400 years of age. American Beech, White Ash, Shagbark Hickory, and Pignut Hickory are also present. A 1950 storm, by felling many large trees, accelerated the growth of the dogwood and oak understory, now more than 40 feet tall (Johnson 1990, Breden 1993). The forest is owned by Rutgers University, and is open for scheduled tours on Sundays. Contact Dr. Edmund Stiles, J. B. Smith Hall, Rutgers University, New Brunswick, NJ 08901 for information.

Kershner writes that the forest is suffering because alien invasive plants such as multiflora rose and honeysuckle are spreading in openings created by trees that have blown down after storms. Growth of tree seedlings is coming to a halt. The policy of Rutgers University is “to allow only natural process to occur.” “If nothing is done to control the invasives, the future of the forest is in doubt,” Kershner points out (2002). The director of the forest confirmed that the university has a hands off policy as regards the old growth (Stiles 2002)

Great Cedar Swamp, southern New Jersey (Cape May County)

Possibly isolated patches of old growth. Probably at one time the area was an Atlantic White-cedar swamp, the bulk of which was cut and converted to hardwood forest. Most of the cutting was clearcutting, but some small patches of cedar swamp remain. In addition, the swamp has hardwood areas that have not been cut for 200 or 300 years, in particular two patches of Red Maple-Sweetgum forest, 100 acres each in size (Windisch 1993). The US Fish and Wildlife Service has acquired approximately 5500 acres of Great Cedar Swamp for the Cape May National Wildlife Refuge, which currently totals some 11,000 acres. The agency is working to acquire land within the swamp that is still privately owned although within the proclamation boundary of the refuge. It has not done any logging on the land in the swamp that it has acquired (Schlegel 2002).

High Point State Park, northwestern New Jersey (Sussex County)

Pitch Pine-scrub oak communities on ridge tops within and without the 10,935-acre park in the Kittatinny Mountains. Windisch says that the ridge top forest was probably not logged, because it would have been without commercial value; but he does not consider it old growth, since severe growing conditions cause the trees to die young (1993). Whether or not the forest can be called undisrupted by Euro-Americans is, in any case, debatable, because it burned, and the fires were sometimes caused by logging operations elsewhere. The bigger Pitch Pine are about 70 years old and have dbhs of 8 to 10 inches. Pine comprises 76% of the open tree layer, with Red Maple, Gray Birch, Smooth and Downy Serviceberry, and Sweet Birch also present. The canopy is only about 18 to 20 feet high. Under it is Bear Oak and below that heaths and a sparse herbaceous layer (Niering 1953). According to Kershner, the **Dryden Kuser State Natural Area*** within the park probably has old-growth Atlantic White Cedar, which would be

one of the only old-growth occurrence of that species in the world (2002).

Frank G. Helyar Woods,* in East Brunswick (Middlesex County)

Likely mixed hardwood old growth within a 41-acre woods. Kershner and Leverett write of "a 30-acre ancient forest" (2002). Whether the entire 30 acres is unlogged is unclear. A brochure on the nature trail through Helyar Woods, printed by Rutgers University, owner of the woods, suggests that "an example of an uncut virgin forest" occupies less than half the acreage (Rutgers [nd]). The director of Hutcheson Memorial Forest, when asked about Helyar Woods, said that it has many old trees but that its history is unknown. Therefore the university does not know whether it is old growth (Stiles 2002). The woods supports twenty-three tree species with oaks—White, Black, Northern Red, Scarlet, and Swamp White—dominating (Kershner and Leverett 2002). It adjoins Rutgers Gardens, a series of botanical collections arranged in garden settings and spread over 50 acres (Rutgers 2002).

MacArthur Woods* (also known as Saddlers Woods), in Haddon Township, six miles from downtown Philadelphia and three from Camden (Camden County)

A thirty acre woods that includes old growth. State forester Dave Johnson measured seven of the larger trees in the old growth. The youngest of the seven was a 178-year-old Black Oak with a circumference of almost 12 feet; and the oldest, a 298-year-old American Beech with a circumference of 13 feet (Graham 2002). Additional tree species include Tulip Tree; Chestnut, White, and Northern Red Oak; and Red Maple (Kershner 2002). Spicebush and other native species are in the understory (Largess, 2002).

The thirty acres are divided into three tracts, each with a different owner. Haddonview Associates owns the northern 4.4 acres. The Associates would like the forest to be preserved. The Diocese of Camden owns the southern 10.5 acres. According to the Township, the Diocese has refused to sell a portion of its holding to the Township for purposes of preservation and has threatened to build athletic fields on the land. The Township of Haddon owns the central 15.3 acres. It is planning to clearcut six of them to make space for athletic fields (Dill, 2002). The portion that would be cut is young, but is needed as a buffer for the old growth (Kershner 2002, June 10). As of September 2002, the outlook for the old growth was uncertain, all the more so because the woods are surrounded by schools, shopping centers, a water tower, and high-rise apartments (Largess 2002).

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NEW YORK

New York state may have more undocumented old growth than any other state east of the Mississippi. Researchers, including Michael Kudish, Robert Leverett, and Barbara McMartin are working to close the gap in our knowledge. Furthermore, organizations are rising to the challenge. Since 1989 the Western New York Old Growth Survey Team, led by Bruce Kershner, has mapped numerous sites in western New York. An Eastern New York Old Growth Survey Team was formed in 2001 and a Central Team, in 2002. The members of these groups teach about and defend as well as discover old growth. For instance, the Western Team, worked with other organizations to stop logging in Zoar Valley and Allegany State Park, and Thomas Howard, now of the Central Team, has led the fight to preserve old growth in and around Syracuse. In 2002 a New York Old Growth Forest Association, which brings together the existing teams and plans to sponsor others, was founded.

This chapter presents a sampling rather than an exhaustive list of the sites in New York that have been described as old growth. One reason is that the sites below 40 acres in extent are too numerous for complete coverage. Another is that members of the New York Old Growth Forest Association use the terms "ancient forest" and "old growth" for some second-growth forests as well as for primary or first forests. Their site descriptions do not always make clear whether a stand is primary or secondary. In trying to avoid presenting second growth, which is outside our definition of old growth, we may have inadvertently excluded some old-growth sites.

Franz Seischab and John M. Bernard have studied the Pitch Pine communities in New York state. Seischab wrote to us that the "only true old growth pitch pine site" that they examined was a site that Abrams and Orwig analyzed--a 12-acre(5 ha) rock outcrop area along the southwest boundary of **Minnewaska State Park*** outside New Paltz, New York (Seischab 2001). Pitch Pine at the site were up to 320 years old, which "may represent one of the oldest intact examples of this forest type." The Pitch Pine, 88% of all sampled trees, exhibited continuous recruitment since the late 1600s. Recruitment of Black Gum and Chestnut Oak began after 1830 (Abrams and Orwig 1995).

Seischab also noted that additional sites have probably been continuously forested and never subjected to logging. He mentioned the existence of such Pitch Pine sites at **Flat Rock*** in Altona (Clinton County) and in **Mohonk Preserve*** and in Minnewaska State Park, "shallow to bedrock sites with trees of little commercial value" (Seischab 1998). E. Russell believes that between 1800 and today almost all forests in the Shawangunk Mountains were logged, but that some Pitch Pine and Chestnut Oak on ridges and Eastern Hemlock on talus slopes were spared. The problem when it comes to describing Pitch Pine in the Shawangunks as old growth, Seischab points out, is that the sites burned. The fires raise the question of what is old growth, since humans caused many of them. Furthermore, for researchers who believe that old growth should be composed of old trees, even natural-origin fires pose a problem. To judge whether a site is old growth you would need to know the age of root stocks rather than of above-ground stems, Seischab says, and he does not know of any study successfully determining the age of root stock (Seischab 1998).

Neil Pederson has discovered three sites in eastern New York that have old trees and are of interest from an ecological standpoint but that he does not characterize as old growth, because they show signs of having been logged or grazed by livestock or both. All are at least 40 acres in size. They are **Prospect Mountain**,* east of Lake George (Warren County): an oak-hickory stand with White Oak to 313 years in age and Shagbark Hickory to around 180 years; **RamsHorn-Livingston Sanctuary*** (Greene County): the largest tidal swamp forest on the Hudson with Swamp White Oak, Northern White-cedar, and Black Gum, each species with trees close to or more than 200 years old**; Shushan White Spruce Outlier*** (Washington County): a large boreal swamp forest with the southernmost known stand of White Spruce in New York State. The oldest spruce is 185 years in age, as is the oldest White Pine (Pederson 2000 and 2001).

Examples of small areas of old growth, grouped by region, follow.

WEST. Areas include **Knox Farm State Park*** (Erie County): 28 acres of old growth in three groves that were preserved on a wealthy estate (Kershner 2002); **Bentley Woods** (Monroe County): 23 acres of old growth, including a wetland and a glacial esker with Red, White, and Black Oak (Keister 1993, Kershner 1990, Kershner 2002); **Lilydale Grove*** (Chautauqua County): 20 acres of old growth with trees 200-250 years old, including large Northern Red Oak, Eastern White Pine, and Black Cherry, owned by the Lilydale Spiritualist Assembly (Kershner and Leverett 2002); **Mossy Point*** (Erie County): 20 acres of old growth along the 200-foot deep gorge of Hunters Creek, part privately owned and unprotected and part in a nature preserve owned by the town of Evans (Kershner 2002); **Pfeiffer**

Nature Center* (Cattaraugus County): approximately 20 acres of old growth surrounded by mature forest within a 188-acre non-profit environmental education center (Kershner and Leverett 2002); **Long Point State Park*** (Chautauqua County): up to 15-20 acres of diverse old growth along the north shore of Chatauqua Lake, discovered by Jim Battaglia and Bruce Kershner (Kershner 2003); **Panama Rocks*** (Chautauqua County): 15 acres of twisted trees growing amid boulders, privately owned (Kershner and Leverett 2002); **Reynolds Gully*** (Livingston County): 15 acres of old-growth Eastern Hemlock-Yellow Birch forest at the bottom of a rugged gorge, partly owned by the City of Rochester and partly privately owned (Kershner 2002); **Tryon Park*** (Monroe County): some 25 acres of old growth, including oaks, beech, Sweet Birch, and Tulip Tree, within a park owned by the City of Rochester (Kershner 2002); **Irondequoit Bluff**,* western New York (Monroe County): 15 acres of old growth in a ravine cutting down to the shore of Irondequoit Bay, Lake Ontario, apparently owned collectively by homeowners in a development above the bay (Kershner 2002); **Whispering Brook*** (Ontario County): 15 apparently unlogged acres of White Ash-Northern Red Oak forest within the Cutler Reservation Boy Scout Camp (Kershner 2002); **Washington Woods Park*** (Monroe County): apparently unlogged Black, Northern Red, and White Oaks with other species comprising a 12-acre park owned by the City of Rochester (Kershner 2002).

In addition to the Niagara Gorge (described below), areas with ancient trees on cliffs include **Genessee Gorge*** (Monroe County), undetermined but small acreage of Eastern Red-cedar in the gorge of the Genessee River where it cuts through the City of Rochester (Monroe County).

CENTRAL. Jonathan R. Mawdsley has compiled a list of old-growth sites in Tompkins County, along with a statement of the criteria used in compiling the list. "Tompkins County has thousands of acres of forest that have never been completely cleared for agriculture and that have a species composition close to that of the presettlement forests of central New York. The vast majority of these primary forest stands have been extensively and continuously logged since European settlement, and forests that exhibit all or most of the stand characteristics associated with old-growth conditions are quite rare. In compiling the following list, we have included all known sites that have a) live, standing trees in excess of 200 years in age and b) minimal signs of human disturbance, and c) that exhibit most or all of the stand characteristics typical of eastern old-growth forests." "European settlement began in Tompkins County in the 1790s."

Only one site on Mawdsley's list, Six Mile Creek Old Growth, is greater than 40 acres. We present that site below and include most of the smaller sites here, in the introduction. The sites include **Taughannock Gorge*** (Taughannock Falls State Park), approximately 30 acres of unlogged mesic forest, with small but apparently old trees, on a very steep talus slope (Kershner and Leverett [2003] describe twisted Eastern Red-cedar on 400-foot-high cliffs in the same park) ; **Stewart Park Woods/Fuertes Bird Sanctuary*** (Ithaca): a 22.5-acre remnant of a once-extensive floodplain forest at the south end of Cayuga Lake, probably had some logging in the past but shows no evidence today, owned by the City of Ithaca; **Smith Woods** (Village of Trumansburg): a 42-acre former farm woodlot, half of which has few signs of human impact and is characterized by enormous trees of the dominant species including basswood, beech, Cucumber Magnolia, Sugar Maple, and Tulip Tree, as of 1988 owned by the Village of Trumansburg (described by Kershner and Leverett [2002] as a combination of many second-growth trees and a few old-growth trees; by the New York Old Growth Forest Association's Web Site as "second growth," and by Marks et al.[1999] as " a well-developed, mesophytic, old growth stand"); **Middaugh Woods*** (Village of Brooktondale): as of 1988, 20 acres of old growth with White Pine over 100' and basswood to 110', within a privately owned 80-acre forested tract in a creek bottom; **Murphy Tract/ Fischer Old-Growth Forest*** (Town of Newfield): 18 acres of old growth on a steep slope, salvage logged for American Chestnut but otherwise unlogged, owned by Cornell University; **Palmer Woods*** (Village of Cayuga Heights): 25 acres of oak forest, of which 13 are old growth, unlogged except for chestnut salvage, owned by Cornell University; **Fall Creek Hemlock Grove/Behrends Woods Hemlock Grove*** (Cornell Plantations nature preserve): 10 acres, which, according to records were left alone, within a larger forested area that Cornell's now-defunct Forestry Department used for experimentation; **Lick Brook*** (Ithaca): approximately 10 acres of Eastern Hemlock and beech on north-facing slopes and White Oak, Chestnut Oak, Eastern Red-cedar on south-facing slopes within an extremely steep gorge that has probably had minimal logging, owned by the Finger Lakes Land Trust (northern half) and Cornell University (southern half); **Beebe Lake Woods*** (Cornell University's central campus): 10 acres of old growth, from which trees were undoubtedly removed in the early 1800s, dominated by Eastern Hemlock, White Pine, White Oak, and Northern Red Oak within a 40-acre woods owned by Cornell University (Kershner and Leverett [2002] describe two very small remnants of old growth, one on the south slope and one above the northeast slope at Beebe Lake); **Mount Pleasant*** (summit of Mount Pleasant): approximately 25 acres of old growth that was once a former farm woodlot, owned by Cornell University (Mawdsley

1998).

Other small sites in central New York include **Curtiss-Gale State Wildlife Management Area*** (Oswego County): 20 acres of beech-maple-basswood forest with trees at least 200-250 years in age, owned and protected by the New York State Department of Environmental Conservation (Howard 2002); **Liverpool School Maple Grove*** (Onondaga County): 15 acres of beech-maple-basswood forest owned by the Liverpool Central School District and potentially threatened (Howard 2002); **Nelson Swamp*** (Onondaga County): 12 acres of old growth within a 2000-acre cedar swamp, 574 acres of which, including the old growth, are owned by the State of New York (Reilly 1997); **Wizard of Oz Memorial Grove, ***North Syracuse (Onondaga County): 7 acres of oaks and Red Maple over 200 years in age, owned by the North Syracuse Central School District and in need of permanent protection (The grove probably inspired L. Frank Baum's Great Forest of Oz, as he grew up near it.) (Howard 2002); **Selkirk Shores State Park*** (Oswego County): 8 acres of beech-maple-basswood, owned by the State of New York (Howard 2002); and **North Syracuse Cemetery Oak Grove*** (Onondaga County): 1.5 acres of oaks and Red Maple over 200 years in age, owned by the North Syracuse Cemetery Association and in need of permanent protection (Howard 2002).

NORTHEAST. Areas include **Saratoga Spa State Park*** (Saratoga County): some 20 plus acres of old growth with White Oak, Red Maple, Sweet Birch, hemlock, and beech within the 2033-acre State Park (Yarrow 2002, Stewart 2003); and, in Adirondack State Park, **Three Ponds Mountain Old Growth** (Hamilton County): within Silver Lake Wilderness 20 acres of "huge" Sugar Maple, Yellow Birch, and Eastern Hemlock (Davis 1988); **The Elders Grove*** (Hamilton County): a 10- to 20-acre stand of old-growth White Pine, more than 150 feet tall, on state land adjacent to Paul Smith's College (NYOGFA 2002, Kudish 2003).

SOUTHEAST. Areas include **Shu Swamp** (Nassau County): 25-30 acres of old-growth Tulip Tree, Black Gum, American Beech, and other species within the 64-acre Charles T. Church Nature Sanctuary (Kershner and Leverett 2002); **Ironwood Hill Park*** (Manhattan): 25 acres of possible old-growth forest with Tulip Trees and oaks (Kershner and Leverett 2002); **Halle Ravine Preserve*** (Westchester County): 20 to 25 acres of old growth, dominated by hemlock dying because of the adelgid, within a steep ravine in the 38-acre preserve owned by The Nature Conservancy (Kershner and Leverett 2002, Levy 2003); **Greentree Foundation Property**,* Manhasset, Long Island (Queens): 20 acres of old growth, with oaks, beech, Sweet Birch, Sugar Maple, Tulip Tree, Cucumber Magnolia, and beech 200 to 300 years old, within the 430-acre property, formerly the estate of the Whitney family (Kershner 2002); **Tiffany Creek County Preserve*** (Nassau County): 20 acres of old growth in a preserve purchased in 1992 from three wealthy estates near Oyster Bay and owned by the county (Kershner 2002); **Pelham Bay Park (Bronx):*** 20 acres of old growth with 14 tree species, including Post Oak, within the 2764-acre park at the northern tip of Hunter's Island (Kershner and Leverett 2002); **Eugene and Agnes Meyer Nature Preserve*** (Westchester County): 20 acres of Chestnut, White, and Northern Red Oaks, Sweet Birch, and Eastern Hemlock dying because of the adelgid, on a terrace above and below cliffs in a 247-acre preserve (Kershner and Leverett 2002, Levy 2003); **Marshlands Conservancy*** (Westchester County): 20 acres of old growth with 9 species of trees including huge Black Oak, White Oak, and Tulip Tree within a 170-acre preserve owned by Westchester County (Kershner and Leverett 2002); **Old Maids' Woods*** (Schenectady County): approximately 10 acres of old growth, including Black Oak estimated to be 250 years old, at the upper edge of 21 acres of woods that belong to the City of Schenectady and are managed by The Nature Conservancy (Mawdsley 1998, NYOGFA 2001); **Wertheim National Wildlife Refuge** (Long Island): 10 to 15 acres of old-growth Black Gum swamp, discovered by Daniel Karpen and Bruce Kershner (Kershner 2003); **Wolfe's Pond Park*** (Staten Island): 10 acres of old growth within a steep ravine in the 317-acre park (Kershner and Leverett 2002); and **Little Nose and Big Nose*** (Montgomery County): ancient Northern White-cedar on limestone cliffs on either side of the New York Throughway, five miles east of Canajoharie (Kershner 2002).

ADIRONDACK STATE PARK, northeastern New York

In 1994 Barbara McMartin wrote that examination of the historical record shows that "unequivocally at least 200,000 acres [in Adirondack Park] have never been logged." She went on to say, "I feel confident now that the physical record will confirm the existence of at least a half million acres of old-growth forest in the Adirondacks" (1994). In 2000 she told us that her hypothesis of 500,000 acres is being confirmed. Graduate students who were conducting research on several sites had indicated that her estimates in the areas that they were studying were low (2000). Kershner, on the other hand, thinks that the actual acreage will be in the neighborhood of 150,000 acres (2002). The truth of the matter is not known. The lack of comprehensive knowledge of old growth stems in part from

the lack of agreement on the meaning of the term "old growth," part from a general lack of recognition of old-growth characteristics, and part from a lack of priority. The State of New York does not feel compelled to search for and classify its old-growth reserves. Furthermore, the ruggedness and vastness of the region make a complete inventory virtually impossible. Nevertheless, researchers, including McMartin, are making considerable headway in identification.

Adirondack Park encompasses approximately 6 million acres, of which some 2.7 million acres are owned by the state. This acreage belongs to the Forest Preserve and, according to Article VII, section 7 of the New York State Constitution, cannot be logged. The New York Department of Environmental Conservation (DEC) manages the state-owned land. The majority of the old growth in the Adirondacks is on the state land and thus is protected. The stands that readily fit accepted definitions of old growth are located in what DEC categorizes as Wild Forest or Wilderness areas, McMartin points out. The majority of the old growth in the southern Adirondacks is in "Silver Lake Wilderness, parts of the West Canada Lake and Siamese Ponds wilderness areas, Ferris Lake Wild Forest, and Wilcox Lake Wild Forest" (McMartin 1994).

Among Adirondack old growth are tens of thousands of acres of unlogged subalpine forest. E. H. Ketchledge reports that in the 1870s Verplanck Colvin cleared "all but a few" of the summits in the High Peaks region to establish triangulation stations for a survey of the Adirondacks (1979). Nevertheless, according to Peter O'Shea and Paul Jamieson, the mountains were not generally logged above 4000 feet. Subalpine forests burned at times, and the fires might be the result of human activities; but forests at upper elevations experienced considerably less fire than forests lower down (1992, 1993).

Red Spruce and Balsam Fir, accompanied by Mountain Ash and Mountain Paper Birch, dominate the forests between around 2800 feet and 4000 feet. From 4000 feet to treeline at 4900 or 5000 feet, the canopy is almost entirely Balsam Fir, although Black Spruce can also be found. The fir is only 30 or 40 feet tall in most of the subalpine region; and, as the forest approaches treeline, it becomes krummholz, dwarfed and twisted (O'Shea 1993, Ketchledge 1979).

Alpine vegetation lingers on a total of 85 acres of land divided among 11 peaks. Here, in fissures in the rock and in the shelter of ledges and boulders, Balsam Fir, Mountain Paper Birch, Mountain Alder, and Black Spruce are found (DiNunzio 1984).

Five Ponds Wilderness, west-central Adirondacks

--Southern Five Ponds Wilderness (Herkimer and Hamilton Counties). The largest known contiguous tract of unlogged forest in the Northeast. Acreage figures differ. George Davis describes as the southern half of the wilderness 47,326 acres in Herkimer County; O'Shea has used approximately the same figure without specifying the county (1993); J. Roman describes 20,000 hectares (49,421 acres) in Herkimer and Hamilton Counties, and quotes the Commissioners of Fisheries, Game, and Forest writing of a purchase of 50,125 acres (1980); Donald Leopold et al. cite Roman's 20,000 hectares (1998); Jamieson refers to 42,600 acres (1992).

Roman, who studied the area for a 1980 doctoral dissertation, described four forest communities: poor fen, rich fen, upland conifer, and upland mixed. In the poor fens are Black Spruce, Red Spruce, Tamarack, and Balsam Fir. Red Spruce and Balsam Fir are almost the only trees in the rich fens. Upland conifer stands are dominated by White Pine, "some of which are huge and form a super-canopy." (Pine Ridge, south of High Falls, and Five Ponds and Cranberry eskers are outstanding for their pines.) Among the upland mixed communities are beech-maple mesic, hemlock-northern hardwood, and spruce-northern hardwood forests. Fire and storms have disturbed the area, as have outbreaks of spruce budworm and beech scale.

The state bought the tract to settle a claim for damages brought by a land owner who charged that construction of a dam had prevented his shipping and therefore selling the timber on his land. Later the Adirondack Park Agency combined the tract with 12,000 acres in St. Lawrence County to form Five Ponds Wilderness Area (Leopold et al 1988, Roman 1980, Jamieson 1993). Ten thousand acres were severely impacted by a microburst storm in 1995. However, despite descriptions of wholesale destruction, many old-growth trees survived in scattered patches or as scattered individuals (Kershner 2002). Moreover, the Wilderness is large enough that the forest was expected to weather the storm well, not being invaded by exotic species as fragmented forests would likely be.

--Dead Creek Flow (St. Lawrence County). Old growth on either side of Dead Creek Flow, which empties into Cranberry Lake. Davis writes of 10 to 15 acres of old-growth hemlock-northern hardwoods, an old-growth northern hardwood forest, an almost pure pine stand that grew up after an 1880 fire, and an example of northern hardwood succession after a 1916 fire, all within a 400-acre tract (2000). On the other hand, Leopold et al. list 150 acres of old-growth hemlock-northern hardwood forest (1988); and Jamieson characterizes as old growth the land

described as tax sale 1881, totaling 1572 acres (1992).

--Otter Pond south to the St. Lawrence County/Herkimer County border (St. Lawrence County). A 3086-acre old-growth tract, tax sale item 1884 (Jamieson 1992). Northern hardwoods predominate (O'Shea 1993).

--West of Clear Pond (St. Lawrence County). Three hundred acres of old-growth on the St. Lawrence County/Herkimer County line. This tract was also part of tax sale item 1884, and is to the east of the larger tax sale area (Jamieson 1992).

Squaw Peak to Blue Ridge, central Adirondacks (Hamilton County)

A strip of intermittent old growth running along the ridge line from Squaw Peak, south across Snowy Mountain, Lewey Mountain, and Cellar Mountain to Blue Ridge. The length of the strip is approximately 15 miles (Kershner and Leverett 2002). In 1993 when Leverett had not yet explored beyond Cellar Mountain, he noted that the width between Squaw Mountain and Cellar Mountain varies from 1.5 miles to perhaps no more than 0.25 miles. An estimate of 0.75 miles in width and 6 miles in length equals 2900 acres--a very conservative figure (Leverett 1993). A fifteen-mile strip at an average width of 0.75 miles would contain almost 7000 acres of old growth.

The forest types represented from Squaw Peak to Cellar Mountain include high altitude spruce-fir-birch, northern hardwoods-hemlock-spruce, Sugar Maple-American Beech, and Sugar Maple-American Beech-Yellow Birch. Much additional work needs to be done to confirm the boundaries. The high altitude area of old growth extends part way down the west side of the ridge line that connects the peaks. Probably some of the Red Spruce in the lower reaches of the old growth were removed. Determining the exact extent of pre-settlement old growth will be difficult to impossible (Leverett 1993).

Panther Mountain to Fawn Lake,* central Adirondacks (Hamilton County)

A swath of forest totaling perhaps 6000 acres stretching northeast from Panther Mountain to Fawn Lake. Panther Mountain overlooks Piseco Lake. A dense tangle of old-growth Balsam Fir covers the top of Panther Mountain itself (Kershner and Leverett 2002).

Lower Jordan River watershed, northwestern Adirondacks (St. Lawrence County)

Eight lots totaling 4880 acres that the state acquired in 1881 and 1882. Researchers assume that little or no logging took place before state acquisition, except for the possible logging of the largest White Pine for use in ship masts during the Civil War. Lumberjacks could have floated the pines down the Jordan River. The land is predominantly low lying sphagnum swamp dominated by Red Spruce and Balsam Fir. Hummocks and ridges support scattered White Pine up to 150 years in age. Northern White-cedar and alder grow along the river banks. Camp Kildare is up river from these sites (Jamieson 1992, 1993).

Camp Kildare, northwestern Adirondacks (St. Lawrence County)

Four thousand six hundred acres of old-growth forest, including poor fen, hemlock-hardwood swamp, and spruce flats. Loggers apparently removed White Pine in the 1800s. The land is privately owned (Davis 1988). The old growth, known as the Hopkinton Tract, surrounds the lakes and the main buildings on the property. Also part of the property is a 5400-acre area, known as the Giddings Tract, which was selectively logged by the US Forest Service after World War II as part of a silviculture study (Adirondack Nature Conservancy nd).

Leopold et al. studied a 593-acre stand of spruce-northern hardwood forest at a site they name Kildare. Most of their stand was on private land; but the state owns small inholdings, and their sample plot was in the Jordan River Wild Forest. Apparently the privately owned portion of their 593 acres is Camp Kildare.

The sampled site contains many Sugar Maple of all sizes, many small Red Spruce, and Yellow Birch. The birch are represented by a few very large, living trees and a few large, standing, dead trees. A diverse shrub layer is characterized by Red Raspberry, Dwarf Blackberry, and Hobble Bush. Sugar Maple and Red Spruce are among the saplings (1988).

Saint Regis Mountain, north-central Adirondacks (Franklin County)

Thousands of acres of old-growth mixed woods in the vicinity of Saint Regis Mountain, Michael Kudish of Paul Smith's College reports. One large area extends southeastward from the eastern end of Fish Pond. Another, which can be seen from Saint Regis Pond, extends up the lower southeastern slope of the mountain. Smaller areas occur to the north: south of Keese Mill and south of Lower Saint Regis Lake. Scattered pockets of old growth can

also be found. Settlers did not enter the region until the time of the Civil War, and shortly thereafter the state forest service arrived. As a result, the state acquired much land before settlers had time to log it. Fires have occurred and, after a 1950 blowdown, the state put in roads to salvage cut. The estimate of "thousands of acres" reflects only unburned areas (Kudish 1993).

East Notch-West Notch Mountain, central Adirondacks (Hamilton County)

Red Spruce-hemlock-northern hardwoods old growth at least 2000 acres in size. In the 1993 edition of *Adirondack Life, Annual Guide to the Adirondacks* and in *The Great Forest of the Adirondacks* (1994), Barbara McMartin characterized the East Notch-West Notch area as "spectacular," without stating acreage. She described a Yellow Birch as 53 inches in diameter, and Red Spruce as over 30 inches in diameter. One Red Spruce stand that she investigated averaged 285 years in age. Bruce Kershner states that the large Yellow Birch are 400 to 480 years in age (2002). Bob Leverett has several times visited the site described by McMartin and corroborates her description. The old growth stretches for several miles on both sides of the Powley road, which passes between East Notch and West Notch Mountains. He estimates that the old growth encompasses at least 2000 acres, and may be substantially more extensive. Some areas exhibit patterns of disturbance that could either be natural or the result of selective logging. After 100 years, the imprint of highly selective logging as practiced around the turn of the century may be indistinguishable from the aftermath of natural disturbances (Leverett 1993). This site is intersected by a 1.2-mile trail to Gold Mine Creek, where some of the most impressive Yellow Birch and Red Spruce can be easily seen (Kershner 2002).

Philosopher's Landing Floodplain, north-central Adirondacks (Franklin County)

Two thousand acres of old-growth floodplain forest along the Raquette River near Tupper Lake. Trees include Silver Maple. David Hunt discovered the old growth, while he was conducting research for The Nature Conservancy. Part of the old growth is on state land; part, on private land (Dunham 1997, Kershner 2002).

Ampersand Mountain, central Adirondacks (Franklin County)

Old-growth hemlock-northern hardwood forest, described by Davis as 1400 acres in extent and by Leopold et. al. as approximately 494 acres. Kershner believes the site to be closer to 2000 acres (2002); and Woods and Cogbill characterize it as "extensive and diverse" (1994). Greenleaf Chase described the old growth as 2 miles deep and 8 miles long (1992). In the hemlock-northern hardwood forest here are many large Eastern Hemlock, a few large Sugar Maple, and many smaller beech. Kershner reports that the site contains the most impressive series of old-growth Yellow Birch in New York State, with ages to nearly 500 years (2002). The dominant subcanopy tree is Striped Maple. In the sparse shrub layer are Sugar Maple, beech, Striped Maple, Eastern Hemlock, and Red Spruce saplings. Hobble Bush is the most common shrub (Leopold et al. 1988). In some areas many beech have died as the result of beech-bark disease (Woods and Cogbill 1994).

Ausable Club/Adirondack Mountain Reserve , east-central Adirondacks (Essex County)

Eleven hundred and fifty acres of old-growth hemlock-northern hardwoods. Hemlock predominates, with numerous trees 3 feet in diameter and 90 to 100 feet tall. The stand also contains large Sugar Maple and Yellow Birch. The Ausable Club, which owns the tract, has given the state a conservation easement that guarantees "public access and restricts timber harvesting and development" (Davis 1988).

Gill Brook area,* east-central Adirondacks (Essex County)

Old-growth northern hardwood, spruce-northern hardwood, and mountain spruce-fir forest, continuing from Ausable Club land onto state land higher in the mountains. Leopold et al. did not sample this area, suggested to them by Ketchledge, because it did not meet all the criteria for their study (1988). However, Kershner has no doubt about its old-growth status (2002); and Woods and Cogbill describe the "forests bordering Gill Brook as it ascends from the Ausable River, on Ausable Club land, into state land" as "largely undisturbed" (1994). McMartin, citing James Goodwin, notes that "it is clear that the area around Gill Brook and up toward the valley between Nippletop and Colvin was never logged and is virgin forest" (1994).

Camp Kill-kare, central Adirondacks (Hamilton County)

One thousand acres of old-growth forest on the property of an old great camp (Schaefer 1991).

Huntington Wildlife Research Forest, central Adirondacks (Essex and Hamilton Counties)

Old growth of undetermined extent within a 14,820-acre area owned by Syracuse University, which holds it in trust for the State University of New York College of Environmental Science and Forestry. Leopold, Reschke, and Smith decided not to sample a 1000-acre designated natural area within the Research Forest, because a "small portion" of it through which they walked showed obvious signs of human disturbance. However, in 1941, F. E. Egler had described the natural area as old growth, though not virgin; and Leopold et al. acknowledge that "the majority of [the natural area] may indeed be undisturbed by man" (1988). Woods and Cogbill state that the natural area has not been logged (1994).

Davis describes the natural area as comprised of 418 acres of spruce flats about 125 years in age, 5 acres of spruce-fir swamp forest also 125 years in age, and 537 acres of northern hardwoods forest about 200 years old. He does not give the origin of the communities (2000). In 1985 Canham had sampled northern hardwoods at Arbutus Lake and Wolf Lake, stands which he said "had no record of logging" (Canham 1985). Timber is harvested in the forest outside the natural area, and Davis expresses the need for the state to obtain a conservation easement in order to make sure that harvesting does not occur within the natural area (2000). Beech bark disease has severely impacted the natural area (Woods and Cogbill 1994).

Siamese Ponds Wilderness, central Adirondacks (Hamilton County)

Undetermined acreage of virgin hardwoods, north of Wells and west of Route 8. The late conservation leader Paul Schaefer explored the area from a hunting camp he sets up in the wilderness each year. As of 1991, he had yet to find the boundary of the virgin forest (Schaefer 1991).

Meenahga Mountain Pine, north-central Adirondacks (Franklin County)

Along Meenahga Mountain, a ridge that runs east-west, 730 acres of old-growth White Pine and Red Spruce forest. Many White Pine are 4 feet in diameter and 130 feet tall; many Red Spruce, 2 feet in diameter and 75 feet tall (Davis 1988).

Wilcox Mountain,* east-central Adirondacks (Warren County)

At least several hundred acres of old growth dominated by Sugar Maple. Yellow Birch, hemlock, and a few White Ash and White Pine are also present. The old growth appears to extend at least a mile towards the north and towards the south (Kershner and Leverett 2002).

Whiteface Mountain, northeastern Adirondacks (Essex County)

Subalpine forest of undetermined acreage on the west side of the mountain, starting at about 2225 feet. This area was not logged and has not burned. Red Spruce and Balsam Fir compose the forest to around 4000 feet; Balsam Fir, accompanied by American Mountain Ash and Mountain Paper Birch, dominates above that altitude (Fitzgerald and Raynal 1991). As of 1994, few of the large Red Spruce were still living (Woods and Cogbill 1994), the high mortality likely attributable in part to acid deposition.

Mount Tamarac, in the McKenzie Mountain Wilderness, northeastern Adirondacks (Essex County)

A northern hardwoods stand with Sugar Maple, Yellow Birch, and Red Spruce, covering 300 acres on the eastern slope of Mount Tamarac (Davis 1988).

Eighth Lake Old Growth, central Adirondacks (Hamilton County)

Three hundred acres of mixed wood old growth, in which Red Maple, Red Spruce, Yellow Birch, and Eastern Hemlock predominate. Uncommon leafy liverworts and mosses are found in the rich, moist soil. *Neckera pennota*, an epiphyte, grows luxuriantly on tree trunks (Davis 1988).

Ausable Delta, northeastern Adirondacks (Clinton County)

Two hundred and seventy acres of old-growth floodplain forest in the delta of the Ausable River, which flows into Lake Champlain. Silver Maple and Eastern Cottonwood dominate. This undeveloped land is privately owned. The state of New York owns the balance of the delta, the Ausable Wildlife Management Area (Davis 1988).

Marcy Swamp, east-central Adirondacks (Essex County)

A 220-acre swamp of Northern White-cedar, associated with Red Spruce and Balsam Fir. The white-cedar are up to two feet in diameter and forty feet tall (Davis 1988).

Phelps Brook, in the High Peaks Wilderness Area, east-central Adirondacks (Essex County).

Spruce-fir forest of 180 (Davis 1988) or 198 acres (Leopold et al. 1988) at an elevation of approximately 3700 feet. Balsam Fir dominates; Mountain Paper Birch and Red Spruce are also present in the canopy. The shrub layer consists mainly of Balsam Fir and Red Spruce saplings (Leopold et al. 1988). Davis notes that this stand is one of the few in the High Peaks that escaped fires in 1903 and 1908; but that it is now in decline, probably because of acid precipitation (2000). The stand shows no evidence of commercial logging (Woods and Cogbill 1994).

Roaring Brook Falls, in the Giant Mountain Wilderness, east-central Adirondacks (Essex County)

One or two old-growth stands. Davis speaks of a 170-acre stand of pure Eastern Hemlock, with trees almost 400 years old (2000). Leopold et al. describe a 148-acre stand of large Eastern Hemlock, some Sugar Maple, and many smaller American Beech (1988). Kershner measured hemlocks up to 430 years in age (2002).

McKenzie Mountain, in McKenzie Mountain Wilderness Area, northeastern Adirondacks (Essex County)

One hundred fifty acres of old-growth spruce-northern hardwood forest at an elevation of approximately 2600 feet (Leopold et al. 1988). It is located along the Two Creeks Trail west of Lake Placid, near the transition from conifer forests to hardwoods (Woods and Cogbill 1994).

Round Mountain,* east-central Adirondacks (Essex County)

An extensive old-growth stand on a steep, north-facing slope above the route to Keene Valley. The stand is dominated by Eastern Hemlock "with a healthy Sugar Maple component." A trail that loops over Noonmark Mountain and then Round Mountain traverses the old growth (Wessels 2001).

Arnold Pond,* High Peaks Wilderness (Essex County)

"Old-growth montane spruce-fir forests with no evidence of logging" surrounding Arnold Pond. A large portion of the stand is on rocky, steep slopes. Numerous large spruce had died shortly before 1994 (Woods and Cogbill 1994).

Whaletail Mountain,* High Peaks Wilderness (Essex County)

"A mid-elevation stand of hardwood-dominated forest" next to the main trail between Adirondack Loj and Marcy Dam. The stand shows no signs of logging. Furthermore, the presence of scattered Red Spruce suggest that it was not commercially logged (Woods and Cogbill 1994).

Mays Pond and Queer Lake,* central Adirondacks (Hamilton County)

Old growth of undetermined extent with Eastern Hemlock, White Pine, Sugar Maple, Yellow Birch, and Red Spruce (Kershner and Leverett 2002).

Panther Gorge, in High Peaks Wilderness Area, east-central Adirondacks (Essex County)

Unlogged rainforest in a gorge descending 2000 feet from the shoulder of Mount Marcy. Portions of the gorge, which is on the southeast side of the mountain, have been logged (Schaefer 1991, Papero 1993).

Cold Brook Floodplain, Harrietstown, north-central Adirondacks (Franklin County)

Eighty acres of mixed woods, in which Red Spruce are conspicuous because of their size (Davis 1988).

Camp Massawepie, northwest Adirondacks (St. Lawrence County).

Old growth within the 3600-acre Massawepie Scout Reservation. Paul Jamieson told us in 1993 that there was possible old-growth forest along the edges of the lakes of the wetland complex owned by the Boy Scouts. In 1997 the State of New York agreed to buy a conservation easement to protect the Reservation, including "a 2.5-mile esker with a stand of old-growth timber" (TNC 1997).

Pine Orchard, in Wilcox Lake Wild Forest, central Adirondacks (Hamilton County)

Fifty acres of White Pine, dated back, by core samples, to the hurricane of 1815. However, Kershner has aged the hemlock and Yellow Birch at the site to at least 300 years old, which, he says, means this grove is original old growth, partly opened by the 1815 hurricane to allow the pines to fill in the gaps between the hemlocks (2002). The pine average 35 inches in diameter; the largest pine is 54 inches (Davis 1988). A few stumps are scattered through the forest. According to Kershner, they were left after salvage logging following a blowdown in 1950 (2002).

Between Pine Orchard and Route 8 is a Sugar Maple old-growth forest. Sugar Maple is regenerating in the understory (Champagne 2002).

Pack Forest Natural Area, east-central Adirondacks (Warren County)

A 48-acre area with 12 to 14 acres of unlogged White Pine-hemlock forest and additional old growth. The White Pine are up to 45-58 inches dbh. The balance of the 48 acres is diverse and includes a northern hardwood forest against drumlins, a wooded pond, and an open fen. The northern hardwood forest burned about a hundred years ago, and whether or not the fire was of human origin is not known. However, a botanical survey of the forest conducted in 1991 by scientists from the New York State Museum suggests that the entire area is of natural origin. It has 433 vascular plant species and three hybrid species of which 355 species are native, an unusually varied native flora for a small area in a severe climate. "Non-native species are almost totally restricted to the periphery along roadways and power lines outside the old-growth forest." Pack Forest is owned by the State University of New York College of Environmental Science and Forestry and encompasses six square miles. The University uses the forest for educational purposes. A nature trail was recently renovated to accommodate the handicapped. Biologist Richard Mitchell reports that the ramps were installed on previously cut paths without disrupting the area (Mitchell and Tucker 1994, Mitchell 1998).

Sacandaga River, in Silver Lakes Wilderness, central Adirondacks (Hamilton County).

A stand of hemlock-dominated old growth on the north-facing ridge along the west branch of the Sacandaga River. The readily accessible area is at least 100 acres in size, but the old growth is likely to be much more extensive. "Old-growth characteristics are excellent throughout the stand" (Leverett 1993).

Moss Lake, central Adirondacks (Herkimer County)

A strip of mixed northern hardwoods-hemlock-Red Spruce on a ridge above Moss Lake. The area is 3/4 to 1 mile long and perhaps 1/8 of a mile wide, making a total of 60 to 64 acres. Around the old growth are large areas that were partially or completely logged for the camps constructed around the lake. The clearings have produced an edge effect, which allows some light-loving species like White Ash to penetrate the old growth (Leverett 1993).

CATSKILL STATE PARK, southeastern New York (Ulster and Greene Counties)

The Catskill region extends beyond the boundaries of the Catskill State Park; and, like Adirondack State Park, Catskill Park encompasses both private and public land. However, "pretty much all" the known old growth in the Catskills is on the Park's public land (Rudge 1993). Except for occasional low elevation stands saved by their inaccessibility, the known old growth occurs on the summits and upper slopes of mountains, largely in what Michael Kudish characterizes as ridge forest (1971).

Ridge forests usually begin at around 3000 feet in elevation and account for perhaps l/8 or 1/10 of the total forest. Below them are slope forests dominated by Sugar Maple and American Beech. In the ridge forest of the eastern Catskills, Red Spruce, Balsam Fir, and Mountain Paper Birch are the most common species. Among them may grow Yellow Birch, Red Maple, Black Cherry, and American Beech. Wherever Red Spruce is present Balsam Fir is often found, but Balsam Fir appears on some sites without spruce. In the central and western Catskills, Yellow Birch, Red Maple, Black Cherry, and American Beech dominate the ridge forests; and spruce, fir, and Paper Birch "are rare or absent." Balsam Fir is common in the central Catskills, but absent in the western. In disturbed areas and on steep ledges, Mountain Ash, Pin Cherry, and Mountain Maple accompany "scrubby" hardwoods and/or softwoods.

The hardwood ridge forests are interspersed with fern glades or openings that are permanent rather than a result of disturbance. The Mountain Wood Fern and, in smaller numbers, the Hay-scented Fern dominate the glades. Throughout the ridge forest of the Catskills, Mountain Wood Fern dominates the herb layer. The Hay-scented Fern

is also very common in both the spruce fir and hardwood ridge forests (Kudish 1971).

As of June, 2002, Kudish had identified 42 distinct areas of old growth (which he calls "first growth" to distinguish it from second growth) in the Catskills. The acreage totaled 97.1 square miles (>60,000 acres) (Kudish 2002). He continues to conduct research in the Catskills , and anticipates that the total acreage will increase. The largest areas are listed below.

The old-growth areas do not correlate with the four state-established Wilderness areas: Slide Mountain-Panther, Big Indian-Beaver Kill, West Kill-North Dome, and Plateau-Indian Head. Each of the Wilderness Areas contains second- and third-growth forest around a core of old growth. In addition, some of the smaller old-growth tracts are outside the Wilderness Areas. At the time that the Wilderness Areas were established, the old growth had not been mapped (Kudish 2000).

--Mill Brook Ridge-Big Indian Range, combined with Cradle Rock Ridge. 26.8 square miles; average elevation of entry points, 2779 feet.

--Slide-Panther-Peekamoose Range. 24.8 square miles; average elevation of entry points, 2649 feet.

--Beaver Kill Range.* 7.8 square miles; average elevation of entry points, 2520 feet. Kershner recently discovered that Beaverkill Range is continuous with Mill Brook Ridge.

--West Kill Mountain.* 6.0 square miles; average elevation of entry points, 2672 feet.

--Plateau Mountain. 4.4 square miles; average elevation of entry points, 2856 feet.

--Sugarloaf-Twin-Indian Head Mountain Range. 3.7 square miles; average elevation of entry points, 2660 feet.

--Blackhead Range. 3.3 square miles; average elevation of entry points, 3105 feet.

--Wildcat Mountain.* 3.7 square miles; average elevation of entry points, 2725 feet.

--North Dome-Sherrill Mountain Range.* 2.6 sq miles; average elevation of entry points, 2944 feet.

--Dry Brook Ridge, main.* 2.7 square miles; average elevation of entry points 2947 feet.

--Evergreen-Rusk Mountains.* 1.8 square miles; average elevation of entry points, 3025 feet

--Kaaterskill High Peak. 1.6 square miles; average elevation of entry points, 2758 feet.

--Belleayre Mountain.* 1.5 square miles; average elevation of entry points, 2945 feet.

--Halcott Mountain, main.* 1.2 square miles; average elevation of entry points, 3120 feet.

--Windham High Peak.* 0.9 square miles; average elevation of entry points, 3013 feet

--Cradle Rock Ridge.* 0.8 square miles; average elevation of entry points 2881 feet.

--Halcott Mountain, northeast.* 0.6 square miles; average elevation of entry points 3043 feet.

--Hunter Mountain.* 0.6 square miles; average elevation of entry points 3533 feet.

--Red Kill Ridge.* 0.4 square miles; average elevation of entry points 2982 feet.

--Platte Cove.* 0.4 square miles; average elevation of entry points 1510 feet.

Green Lakes State Park (Onondaga County)

Old growth of undetermined extent, but possibly in excess of 800 acres, within the 1875-acre park. Approximately 200 of the old-growth acres are found in slopes and hollows west of Round Lake. The majority of the old growth in the park is dominated by Sugar Maple, American Beech, Eastern Hemlock, and basswood. However, a sheltered cove southwest of Round Lake supports five to six acres dominated by Eastern Hemlock and towering Tulip Trees. Growing with them are Sugar Maple, American Beech, Northern Red Oak, Yellow Birch, basswood, Bitternut Hickory, and Eastern Hophornbeam (NYOGFA 2002).

Allegany State Park, southwestern New York (Cattaraugus County)

Thirteen stands of old growth totaling at least 705 acres within a 65,000-acre park. Researchers expect to identify additional old growth. The 13 stands include:

--Big Basin. At least 400 acres of never-logged old growth, possibly a total of 500 to 600 acres, within an 1800-acre area. Trees are 3 to 5 feet in diameter, and most are 200 to 350 years old. Dominant tree species are hemlock, Black Cherry, Sugar Maple, and Yellow Birch. Basswood, White Ash, American Beech, White Pine, and Red Maple are present in lesser numbers. A stand of Black Cherry is particularly impressive (Kershner, 2002), as it includes numerous trees with trunks 32 to 48 inches in diameter (Kershner and Leverett 2002).

The only direct human disruption has been logging along the northern fringe where 5-foot diameter White Pine were cut just before the park was created, and development in the 1950s of a now-abandoned ski run on 5 acres along the southern border. However, beech blight (necrosis) is killing most of the old beech. Thus part of the area is

open canopy, with thickets of beech root sprouts. Also, overabundant deer (50 per square mile) are eating tree seedlings and allowing thick fern colonies, which further prevent growth of seedlings, to develop.

--Cricks Run.* 50 acres of hemlock and northern hardwoods around and along a large brook.

--Red House Creek Headwaters.* 40 acres of beech, Sugar Maple, hemlock, Black Cherry, surrounding a beaver flow and meadow.

--Camp Ten Site.* 40 acres of old-growth hemlock, Sugar Maple, Black Cherry, beech, Northern Red Oak, on upper slopes above a campground.

--Halle Ravines.* 40 acres of hemlock and northern hardwoods around and along three small brook ravines.

In 1982 the state's Office of Parks, Recreation and Historic Preservation, which manages the state-owned park, proposed logging Big Basin and additional areas within the park. A 14-year citizens' campaign convinced Governor Pataki to protect the park's old growth in 1995, but a change of governor could end that protection (Kershner 2002).

Zoar Valley,* western New York (Erie and Cattaraugus Counties)

A complex of 630 acres of old growth in four canyons of Cattaraugus Creek (Main and South Branches). Four hundred of the 630 acres are within the 3000-acre Zoar Valley State Multiple Use Area. The remaining 230 acres belong to a variety of owners. Of the 400 state-owned acres, 215 have experienced no logging or fire.

For 9 miles along the Cattaraugus, all of the forested slopes, including those of numerous side ravines, are old growth. Much of the top rim of the gorge is edged by a 10-foot to 500-foot wide swath of selectively logged old growth. Valentine Point, a 750-foot-long knife-edge ridge supports craggy "ancient" Chestnut Oak, Red Oak, and Eastern Hemlock. Chestnut Oak grows in a dwarfed form on barren knife-edge ridges.

The Gallery of Giants, a six-mile-long mostly continuous belt of towering trees, covers the river terraces along the bottom of a 415-foot-high canyon and extends up the canyon's steep slopes to its top rims. Nineteen tree species grow in the Gallery, including Tulip Tree, American Sycamore, Northern Red Oak, Bitternut Hickory, Black Walnut, Sugar Maple, White Ash, Cucumber Magnolia, and Green Ash. On one of the terraces flourish two American Elms, apparently untouched by blight because of their isolation in the canyon. The Gallery is on state-owned land.

Five to ten acres of old growth are protected in the new Scobey Dam town park; 80 acres in the 450-acre Deer Lick Nature Conservancy Preserve, abutting the State Multiple Use Area; and 35 acres in the Alexander Preserve, owned by the Nature Sanctuary Society of Western New York. Private owners hold a total of 105 acres of old growth (and about 40% of the canyon as a whole, or 2700 acres). These acres are not protected. In the last five years, 120 acres of old growth on private land were clearcut. Unfortunately, the 400 acres of public land enjoy no permanent protection either. In 1996 the New York Department of Environmental Conservation (DEC) unveiled plans to log the Multiple Use Area, including a part of the old growth. Citizens waged a campaign to protect the old growth and succeeded in halting the logging for the indefinite future. The Citizens Campaign for the Environment (716-831-3206) and Niagara Frontier Botanical Society have published a Guide to the Ancient Forests of Zoar Valley by Bruce Kershner (2000) (Kershner 2002).

Palmaghatt Kill Ravine,* Minnewaska State Park Preserve (Ulster County)

Old growth of undetermined extent, but apparently at least 500 acres, in a ravine. Hemlock and Yellow Birch dominate. Red Maple, Black Cherry, and Sweet Birch are also present. The woolly adelgid has attacked the hemlock and as of mid-2002 the damage was "moderate to severe" (NYOGFA 2002, Yarrow 2002).

Hemlock Lake, west-central New York (Livingston County)

According to a preliminary estimate, 415 acres of old growth along the southwest shore of Hemlock Lake, one of the two westernmost Finger Lakes. The old growth is part of 7000 acres of land owned by the City of Rochester to protect water quality in Canadice and Hemlock Lakes, on which the city draws for drinking water. Most of the identified old growth is in a 2.5-mile swath on mild to very steep slopes. The vertical elevation change is 1000 feet. Twenty deep ravines and forested gullies punctuate the swath. The less steep slopes were selectively logged in the early 1900s; the steeper slopes show no signs of logging and are largely untouched. Red Oak, White Oak, and Sugar Maple are up to 250 years old. Hemlock is up to 400 years in age. A Bald Eagle nest is located just outside the old growth.

Other parts of the 7000 acres have potential for old growth and should be surveyed.

In 2001, the city secretly built a logging road to the edge of the forest. The logging would have included the old growth and steep ravines and would have caused erosion and siltation of the lake. A local resident discovered the road and informed the Sierra Club, which asked Bruce Kershner to show the extent and significance of the old growth. A major citizens' campaign then resulted in the city's agreeing to a two-year moratorium on logging (Kershner 2002).

Gardiners Island, between the two prongs of Long Island

Old-growth White Oak on a 3300-acre island owned by the Gardiner family since 1639. The island has trees 300 or 400 years old (Karpen 1993, Schmitt 1989). Old-growth acreage is reported to be 400 to 700 acres, but no team of old-growth experts has visited the site. Reportedly dense thickets of catbrier make exploration difficult. Different views of family members about the future of the site make the long-term survival of the old growth problematic (Kershner 2002).

Swamp Woods Natural Area, Montezuma National Wildlife Refuge, western New York (Seneca County)

One hundred acres of swamp woods believed to be uncut, within Montezuma Marshes, a 2100-acre section of the Wildlife Refuge. Red Maple and Swamp White Oak are the dominant trees (Vogelmann 1972).

Hale "Big Woods" Tract,* western New York (Monroe County)

One hundred acres of privately-owned old growth along the shore of Lake Ontario. The site supports Eastern Hemlock, Sugar Maple, Northern Red Oak, Yellow Birch, Tulip Tree, American Beech, and White Ash. Trees average 200 to 300 years in age; one 17-inch fallen hemlock was found to be 515 years old. The site was part of the property of the town's first European settler, Mr. Hale. His descendants still own it, and live in homes along the shore. Except for the removal of dead and hazardous trees they think that the site has not been logged since the mid-1800s. A road parallel to the lake, passes through the property (Kershner 2002).

Montauk Point Black Gum Forest (Long Island)

Up to 100 acres of old growth dominated by towering Black Gum up to 420 years in age. Amid the Black Gum are White Oak 3 feet in diameter and up to 250 years in age, Black Oak, Scarlet Oak, American Holly up to 200 years in age, and American Beech also up to 200 years old. Mosses are lush. The old growth is on a bluff above the Atlantic Ocean and only about a mile from the eastern tip of Long Island. The area is the former Camp Hero Military Installation, now a state park adjoining Montauk State Park. The old growth was discovered and confirmed by David Hunt, Bruce Kershner, and Daniel Karpen (Kershner 2003).

Neversink River Preserve , southeastern New York (Orange County)

A 520-acre preserve containing 50 or 60 acres of old growth. The preserve is on the lower Neversink River. The old growth extends from the floodplain, where sycamore and Red Maple dominate, to slightly higher ground where Sugar Maple and then, on more acidic soil, huge White Pine grow (Curatola 1993, Schuler 2003).

Reinstein Woods State Preserve/Stiglmeier Town Park (Erie County)

Eighty acres of old growth within a 600-acre natural area: 65 acres of old growth in the 290-acre Reinstein Woods State Preserve and 15 acres of old growth in an adjacent 310-acre park owned by the town of Cheektowaga. The old growth is dominated by Sugar Maple, American Beech, and Black Cherry. Beech and Black Cherry are up to 4 feet in diameter. Dr. Victor Reinstein, who willed the land for the preserve and donated much of the land for the town park, purchased the land from the descendants of the Native Americans who once owned it. The 1798 Holland Land Survey contains an account of the tract; and two stone pillars from the survey remain on the site (Kershner 2002).

The abundant Black Cherry and open-grown tree forms indicate that past disturbances opened up parts of the woodland; but, according to Mrs. Reinstein, who researched the site's history, it was not logged (Leverett 2001).

The state preserve is protected by a "forever wild" state law passed specifically to protect it. However, the natural area is surrounded by residential and industrial development. Beech blight is gradually killing the beech. Furthermore, a dense deer population (100 deer per square mile) has killed the woods's wildflower colonies and 90% of the tree seedlings (Kershner 2002). A detailed account of the woods can be found in Bruce Kershner's book *Buffalo's Backyard Wilderness* (Western New York Heritage Institute, Canisius, NY, 1993).

Mianus Gorge Preserve ,* southeastern New York (Westchester County)

Fifty-three acres of never-logged forest with trees 350 or more years old. The forest includes Eastern Hemlock, White Oak, Chestnut Oak, American Beech, Tulip Tree, Sweet Birch, Yellow Birch, Flowering Dogwood, and Highbush Blueberry. Deer are destroying the understory. The preserve is managed by Mianus Gorge Preserve Inc. Mianus Gorge Preserve Inc. and The Nature Conservancy each own part of 730 acres, which includes the old growth. Additional acreage is protected by conservation easements (Kershner and Leverett 2002, Christie 2003).

Sunken Forest, in Fire Island National Seashore, on a barrier island between Great South Bay and the Atlantic Ocean

A 70-acre site with 20 to 30 acres of maritime holly forest that has never been logged, according to Park Superintendent Jack Hauptman. American Holly, Sassafras, and Shadbush dominate the forest. Black Gum is found in damp depressions. Also within the site is a pristine dune and swale community and a salt marsh community. Growing on the portion of the dunes and swales nearest the maritime forest are Eastern Red-cedar, Pitch Pine, Black Cherry, Dwarf Sumac, Highbush Blueberry, and American Holly. The forest developed over a period of 200 to 300 years on what was originally bare sand. Currently a sand road and trails through the site are sources of erosion. Deer browsing also presents a problem. The ground in the forest today is almost bare, whereas 20 years ago it bore herbaceous plants (Ebert 1993, Art 1976, Hauptman 1992, Lawrence 2003).

The New York Botanical Garden, The Bronx

A 40-acre old-growth forest, dominated today by oaks, hickories, and Tulip Tree. The woolly adelgid has killed the hemlock (Kershner and Leverett 2002). The dogwood are in decline due to dogwood anthracnose (another exotic pathogen), particularly in the interior of the forest (Morrison 2000). The city purchased the land occupied by the Botanical Gardens from the Lorillard estate in 1884 and created the Gardens in 1895 (Kershner and Leverett 2002).

Letchworth State Park , western New York (Livingston and Wyoming Counties)

Within a 14,000-acre park, some 12 stands of old growth. The Western New York Old Growth Forest Survey team has visited and confirmed five sites totaling approximately 75 acres. Park naturalist Doug Bassett has told them that the park has an additional seven stands totaling 100 to 150 acres. Sites confirmed by the Survey are:

--**Eastern Red-cedar** growing in clusters on the canyon face and rim over a distance of seven miles. The red-cedar are 200 to 500 years in age. The cliff face totals approximately 30 acres.

--**Lower Falls Terrace Woods** .* Seven acres of old-growth hemlock and Sugar Maple on a terrace between the canyon top and the Genesee River. Trees are very tall and include a 140-foot White Ash.

--**Dehgayasoh Woods.*** Twelves acres of hemlock, beech, Sugar Maple, and White Pine, over 200 years in age, in a deep side ravine.

--**Great Bend Gorge Bottom.** * Twenty-five acres of old growth on an upland terrace at the bottom of the Great Bend portion of Letchworth Gorge (Kershner 2002; Bassett 1993).

Six Mile Creek Old Growth,* central New York (Tompkins County)

Fifty acres of old-growth ravine forest with large, tall trees —Eastern Hemlock, beech, Tulip Tree, Sugar Maple, basswood in the eastern end of Mulholland Wildflower Preserve and adjacent woodlands along the south bank of Six Mile Creek. Old water pipelines go through part of the site, which probably had salvage logging in the past. The site was featured on an 1886 botanical map of Tompkins County. The site, which is owned by the City of Ithaca, is also known as Beechwoods or Van Natta's Dam Area (Mawdsley 1988). Kershner and Leverett write that Mulholland Wildflower Preserve contains 15 to 20 or more acres of old growth. The old trees are widely and patchily distributed, which indicates past selective logging (2002).

Niagara Gorge,* western New York (Niagara County) and Ontario, Canada

About 40 acres of ancient Northern White-cedar along the seven-mile long Niagara Gorge. The white-cedar start within 75 feet of the American Falls and continue in irregular but lengthy patches on both sides of the 325-foot, limestone (dolostone) gorge. Sampling has confirmed that white-cedars on the talus slopes are more than 400 years old. The White-cedars on the cliff face have not been sampled, but research by Doug Larson of the University of Guelph, Ontario, has found trees up to 1700 years old on habitat in Canada that is identical to that of the Niagara Gorge.

The white-cedars on the cliffs include upside-down trees and "daredevils," trees that project straight out over the canyon. In the dense groves on the 45-degree boulder slopes are giant clones. Branches and trunks are physically connected to other branches, trunks, and roots as far away as thirty feet. The trunks, Bruce Kershner writes, are at least 150 to 500 years old, and the root bases may be thousands of years old. Kershner was the first to recognize the age of the gorge's White-cedar and began conducting research on them in 1999.

Massive Northern Red Oaks and White Oaks 180 to 260 years in age line the rim of the red shale banks over the lower Niagara River, downstream from the actual gorge (Kershner 2002).

Bergen Swamp Preserve ,* western New York (Genesee County)

Five acres of old-growth eastern Eastern Hemlock and White Pine and possible lowland old-growth within a 3000-acre preserve. The hemlock and pine, 200 to 260 years old, grow on an island mound surrounded by swamp. Probably this island is the only upland old-growth site. The balance of the preserve consists of open-canopy swamp with hemlock, Northern White-cedar, and White Pine growing on hummocks that project above the water line. Coring two fallen 17-inch cedars showed that their ages exceeded 250 years. The swamp has much larger cedars. "If the site is ever searched for old growth, a large acreage could be discovered," Kershner writes. The preserve is owned by the Bergen Swamp Preservation Society. Visits are permission only. See <http://www.bergenswamp.org> (Kershner 2002).

Fredonia State College Lodge,* southwestern New York (Chautauqua County)

Approximately 40 acres of old-growth on the crest of the Allegany Escarpment. Trees include American Beech, Black Cherry, and Sugar Maple. Individual fallen trees may have been cut up for firewood, but the 40 acres have apparently not been logged. The property totals 193 acres, the northern part of which has recently been selectively logged (Kershner and Leverett 2002, Western 1995).

Goose Egg Ridge,* east-central New York (Washington County)

Old growth of uncertain extent but more than 40 acres. Many portions of the upper slopes at the southern end of the ridge look undisturbed. The area is owned by the state (Pederson 2002).

Lincoln Mountain State Forest/Saratoga Restoration Area,* east-central New York (Saratoga County)

An old-growth swamp forest of uncertain extent but greater than 40 acres.
The oldest trees are Black Gum. Neil Pederson, who discovered the site, was able to process cores from 28 Black Gum. Eight of the trees are more than 500 years old. Red Spruce are also present, with the oldest having an inner ring date of 1857. The only evidence of logging that Pederson found was a single hemlock stump (Pederson 2002).

Tonawanda Indian Reservation* (Erie, Niagara, and Genesee Counties)

Three old-growth groves totaling 40 acres within a 7000-acre Indian Reservation: 20 acres with Tulip Trees, Sugar Maple, and Red Oak (Genesee County); a 15-acre stand of very old Sugar Maple, Red Oak, and other species in a lowland (Erie County); 5 acres on an upland knoll in the floodplain of Tonawanda Creek (Niagara County). The reservation belongs to the Tonawanda Band of the Seneca Tribe. Tribal members are free to log in the reservation without obtaining any permission unless they intend to cut trees near someone else's buildings. The old growth is not protected and has "survived only by luck" (Kershner 2002).

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PENNSYLVANIA

Thomas L. Smith of the Pennsylvania Natural Diversity Inventory, who surveyed the state's old-growth in *Natural Areas Journal* in 1989, wrote that in "attempting this initial review . . ., it has become alarmingly clear how little information is available on this critical natural resource. A thorough inventory and mapping of quantity, quality, and composition . . . is needed." The one complete study had been conducted by the Pennsylvania Bureau of Forestry on its own lands. The Bureau identified 13 old-growth areas, which it protected by designating them state forest natural areas (Smith 1989b).

We wrote in the 1993 edition of the survey at hand that our research underlined the need for the thorough inventory for which Smith calls. Site descriptions that we had been able to obtain often conflicted with one another as to species, acreage, and amount of past disruption. Furthermore, given the number of sites that researchers have discovered without a thorough inventory, it seemed safe to assume that numerous other sites remain to be identified.

Since, various scientific studies of known sites have been conducted. Furthermore, individuals knowledgeable about old growth have visited sites and reported on them to us. Among them are Bruce Kershner, co-founder of the Western New York Old Growth Survey, Ernest Ostuno, and Bill Sweeney. As a result, we have made subtractions and additions to the list of sites in the earlier edition of the survey. However, questions still remain about the acreage of old growth (primary forest) at given sites, presumably in large part due to different definitions of old growth.

A County Natural Heritage Inventory (CNHI) Program "designed to identify important ecological areas" may resolve some of the questions, although researchers are not centering their search on old growth (Wagner 2002). The Western Pennsylvania Conservancy is conducting the study in western Pennsylvania; The Nature Conservancy, in eastern Pennsylvania (Wagner 2003).

Small tracts of known old growth or near old growth include **Jenkins Woods** (Monroe County): 30 acres of privately owned Eastern Hemlock with a rhododendron understory (Smith 1989a, Davis 1992); **Chalfont site (**Bucks County): 10 or 15 acres of bottomland old growth with White Oak (Thatford 1993); **Schall's Gap*** (Centre County): about 25 acres of old-growth hemlocks, about 3 acres of which may never have been logged, owned by the Pennsylvania Department of Conservation and Natural Resources (PCNR) (Ostuno 2001; Black 2001); **Tiadaghton State Park** (Lycoming County): 20 or so acres of Red Pine about 200 years old, mixed with mature oak and younger birch. The pine are believed to have originated after a fire and to be virgin (Tiadaghton 1993); **Ferncliff*** (Fayette County): 15 acres of Eastern Hemlock, Tulip Tree, Sweet Birch, and oaks beside the Youghiogheny River in Ohiopyle State Park (Kershner and Leverett 2002); **Salt Springs State Park*** (Susquehanna County): 10 to 20 acres of old-growth hemlock around the gorge of Fall Brook (Kershner and Leverett 2002); **Martins Creek Environmental Preserve*** (Northampton County): possible old growth of uncertain extent, but perhaps 15 acres, with oaks, hickories, Tulip Tree, and other species, within the 750-acre preserve owned by PPL (formerly Pennsylvania Power and Light) (Sweeney 2002, Drabic 2002); **Tyler State Park*** (Bucks County): some 15 acres of old growth divided between two sites, the larger running along Porter Creek (Sweeney 2003); **Northern hardwood-conifer forest** (Wayne County): 10-15 privately owned acres with hemlock of all age classes, large Northern Red Oak, American Beech, and Black Cherry, and Yellow and Sweet Birch on an island surrounded by open water and swamp (Davis 1992); **Lower Jerry Run*** in Elk State Forest (Cameron County): two areas: an acre or two of old trees and 10 acres of old growth half a mile to their east (Ostuno 2000); **Tryon-Weber Woods*** (Crawford County): 10-20 acres of beech-maple old growth in a preserve owned by the Western Pennsylvania Conservancy (Carson 2002); **Mount Riansares*** (Clinton County): an estimated 10 or more acres of undisturbed old-growth hemlock on steep upper slopes, owned by the Pennsylvania Bureau of Forestry (Wagner 2002); **Erie National Wildlife Refuge** (Crawford County): 10 acres of old but selectively cut northern hardwoods, with oaks, American Beech, Sugar Maple, and large Black Cherry, among other species (Mountain 1993, Shaffer 1993); **Hopewell Furnace National Historic Site** (Berks County): a 360-year old Chestnut Oak stand of 8 to 10 acres on a steep talus slope owned by the National Park Service (Abrams 1993); **Sophia's Woods** at Friendship Hill National Historic Site (Fayette County): an 8- to 10-acre presettlement remnant of White Oak owned by the National Park Service (Abrams and Downs 1990, Abrams 1993); **Hickory Run State Park** (Carbon County) : "virgin" Red Spruce surrounding a boulder field (Erdman and Weigman 1974), but they are young (Whitney 1993) and park authorities do not know the stand's origin (Troutman 1993); **Hemlock Trail Natural Area*** (Somerset County): within the 5.8-acre natural area at Laurel Hill State Park, an old-growth stand of hemlocks and

hardwoods with Black Cherry up to 47 inches in diameter (Ostuno 1999, 2002).

The Pennypack Wilderness, owned and managed by a non-profit citizens' organization, contains two small areas of old growth or near old growth, which are of particular interest to designers of wildland reserves. The Pennypack Ecological Restoration Trust has succeeded in assembling a 720-acre corridor from more than 50 separate tracts with varying histories. Today half the acreage owned by the Trust is covered with forest; half is meadow or old-field. **Brandywine Forest** and **Peak Forest**, each approximately 7 acres in size, are the old sections of the forest. Both are "fairly even-aged stands" with "mature trees" 150 or more years old. Brandywine is a Black Oak-American Beech stand, bounded on three sides by a younger Tulip Tree-White Ash community and on the west by a swamp forest. Periwinkle "has largely overwhelmed the herbaceous layer." Tulip Tree and American Beech dominate Peak Forest, which seems more disrupted than Brandywine, since some oak trees appear to have been removed prior to 1984 when the Trust obtained it. Japanese Honeysuckle and other exotics are spreading into this forest from adjacent hayfields. The Trust owns all of Peak Forest and half of Brandywine Forest, the other half of which is under a conservation easement (Robertson 1991, Nyholm 2002).

The staff of Allegheny National Forest began to revise the Forest's management plan in 1997. The process shortly thereafter came to a halt when Congress withdrew funding for the revision. Work began again in late 2002, and the first public meeting is expected to be held in early 2003. The plan is not expected to be complete until 2006 (Barone 2002).

Because of the large number of sites in Pennsylvania, we have divided the bigger sites into 3 geographic areas: east, center, and west.

EASTERN PENNSYLVANIA

Arbutus Peak Oak Barren Macrosite, in east-central Pennsylvania (Luzerne County)

A 5313-acre, old-growth Pitch Pine-scrub oak barren, with Bear Oak *Quercus*, owned by the Pennsylvania Game Commission and others. Probably the pine barren has not been logged, but it has burned in the last twenty years. It is not clear to what extent fires in this and most other Pennsylvania pine barrens have been natural, and to what extent they have been caused by people (Smith 1989a, Davis 1992, 1993, 2002). The macrosite includes shallow peatlands, most of which have been manipulated. Biologist Gordon Whitney writes that most accounts he has seen of the Pitch Pine-scrub oak barrens of northeastern Pennsylvania make it appear that barrens there are "an artifact" of heavy logging for lumber to use in mines and elsewhere and of burning to further crop production; and that, in his view, the best of eastern Pennsylvania's Pitch Pine-scrub oak barrens have been "relatively undisrupted" for only about seventy years (1993).

Long Pond Macrosite, in east-central Pennsylvania (Monroe County)

An old-growth Pitch Pine-scrub oak (Bear Oak) barren, interspersed with bogs, vernal pools, and wetland forests of Balsam Fir, Tamarack, and Red Spruce, the whole totaling 5740 acres. The wetlands, which comprise some 10% to 20% of the site, have probably been logged; but the barrens probably not. The area has a history of natural fire. The Nature Conservancy has purchased 720 acres of barrens and surrounding wetlands and secured, by easements and other means, 1500 additional acres. The city of Bethlehem and various private parties also own land within the macrosite (Smith 1989a, Davis 1992, 1993, 2002, Myer 1993).

Ricketts Glen State Park, in northeastern Pennsylvania (Luzerne, Sullivan and Wyoming Counties)

Virgin forest within the 13,134-acre state park. The old growth has never been delineated (Adamic 2002) and estimates vary. Erdman and Weigman describe Kitchen Creek Gorge with some 2000 acres of "largely virgin hemlock-northern hardwood forest," and, near the Gorge, a "superb" Eastern Hemlock-White Pine stand (Erdman and Wiegman 1974, Wiegman 1993). Kershner writes that the park has "unquestionably at least 2000 acres of old growth, possibly more." Here as elsewhere, the large trees near streams are more frequently recognized as old growth than are the smaller trees on dry ridges, he points out (2002). The Bureau of Forestry lists only 30 acres of virgin forest (Croop 1990). Ostuno describes old growth on either side of Route 118. The northern site is comprised of at least 30 acres of old-growth hemlock, hardwoods, and scattered White Pine. The site to the south of the road includes an approximately 10-acre stand of virgin White Pine/hemlock," surrounded by similarly old White Pine/hemlock with some evidence of cutting, along Boston Run (Ostuno 2001, Feb. 14). A hemlock log in the park was reportedly found to have 900 growth rings (Ostuno 2000).

Glen Onoko Cove , east-central Pennsylvania (Carbon County)

Undetermined acreage of virgin hemlock-hardwoods on steep slopes. The Glen Onoko area is part of the 17,000-acre Pennsylvania State Game Land 141 owned by the State Game Commission (Kershner and Leverett 2002). Jeans Run Gorge, described below, is "around the corner of the mountain" from Glen Onoko (Erdman and Wiegman 1974, Costa 1993).

Bald Mountain, in northeastern Pennsylvania (Lackawanna County)

A 742-acre, old-growth Pitch Pine-scrub oak barren, with Bear Oak. It is in private ownership (Smith 1989a, Davis 1992, 2002).

Nescopeck Mountain Oak Barren, in eastern Pennsylvania (Luzerne County)

A 712-acre, old-growth Pitch Pine-scrub oak barren, of Bear Oak, on very narrow sandstone ridge tops with little soil. The Pennsylvania Game Commission and others own the land (Smith 1989a, Davis 1992, 1993, 2002).

Stafford Bald, in northeastern Pennsylvania (Lackawanna County)

A 610-acre, old-growth Pitch Pine-scrub oak barren, with Bear Oak. The land is privately owned. The trees have probably not been cut, but the area has experienced fires. Now houses are being built next to the area and perhaps on the barrens itself (Smith 1989a, Davis 1992, 1993, 2002).

Wyoming Mountain Oak Barren, in eastern Pennsylvania (Luzerne County)

A 290-acre old-growth Pitch Pine-scrub oak barren, with Bear Oak and Gray Birch. The barren is probably uncut, and has burned quite frequently (Smith 1989a, Davis 1992, 1993, 2002).

Woodbourne Forest and Wildlife Sanctuary, in northeastern Pennsylvania (Susquehanna County)

A 120-acre virgin hemlock-northern hardwood forest on a 654-acre preserve owned by The Nature Conservancy. Hardwoods include Sweet Birch, Sugar Maple, Northern Red Oak, White Ash, and beech. The beeches are fewer in number than they once were due to beach bark disease. The Hemlock Woolly Adelgid is near the preserve, but as of 2002 did not appear to have entered it. Nine species of salamander live in the forest. The birds, which are reminiscent of more northern woods, include the Blackburnian Warbler, Oven Bird and Black-Throated Green and Blue Warblers. For more than 150 years the majority of the forest was owned by the Cope family, which donated it to The Conservancy (Skinner 2002).

Camelback Mountain, in east-central Pennsylvania (Monroe County)

A 180-acre, dwarf Pitch Pine-scrub oak barren on the top of a ridge. Owners include the Pennsylvania Bureau of Parks and Game Commission (Smith 1989a, Davis 1992, 1993).

Jeans Run Gorge, in east-central Pennsylvania (Carbon County)

An old-growth northern conifer forest covering 140 acres. The Pennsylvania Game Commission owns the forest (Smith 1989a, Davis 1992, Fazzini 2002).

Otter Creek Natural Area, Holtwood Environmental Preserve, southeastern Pennsylvania (York County)

Within a 260-acre natural area, a rugged gorge much of which is lined with mixed mesophytic forest. Stands of Chestnut Oak grow on the upper slopes. Umbrella Magnolia, a rare species in Pennsylvania, flourishes here. Erdman and Weigman have described the gorge as including 200 uncut acres (1974), a description that Weigman said in 1993 was still valid (1993). Smith spoke of 100 acres of old-growth mixed mesophytic forest (1989b). Davis writes that the site has been at least selectively logged (1992). PPL (formerly Pennsylvania Power and Light) Co., which owns it, believes that portions, if not the whole, are unlogged, because they are very steep. In recent years the Hemlock Wooly Adelgid has killed many hemlock and, in the process, made the site more open.

The utility has formally set aside and does not cut Otter Creek and its other Natural Areas. Otter Creek and Kelly's Run, described below, have trails and are open to visitors (Arbogast 1993, 2001).

Chrome Serpentine Barrens Preserve , in southeastern Pennsylvania (Chester County)

One hundred and sixty acres of eastern serpentine barrens, a community that occurs only in Maryland and Pennsylvania. On an outcropping of green serpentine rock are savanna-like Pitch Pine barrens, wildflower meadows, and cliff outcroppings. Serpentine barrens are fire dependent; and the Chrome Barrens, owned by the township of Elk, is maintained by prescribed burning. The larger Goat Hill Serpentine Barrens, owned mostly by the Department of Environmental Resources' Bureau of Forestry, is similar, but is not in as good condition, because it has not burned for some time (Myer 1993).

Rupert Bluffs, in east-central Pennsylvania (Columbia County)

A 65-acre mesic calcareous shale talus forest, in private ownership (Smith 1989a, Davis 1992, 2002).

Delaware Water Gap National Recreation Area, northeastern Pennsylvania (Pike County)

Old growth of undetermined extent on cliffs within the 70,000-acre area (Kershner and Leverett 2002). Specific places in which old growth has been identified on the Pennsylvania side of the Delaware River are noted below.

--Dingmans Falls. Inaccessible virgin stands of hemlock-hardwoods on the gorge walls of the 100-foot Falls (Erdman and Wiegman 1974, Wiegman 1993, Kershner and Leverett 2002);

--Fulmer Falls,* Deer Leap Falls, and Factory Falls within George Childs Recreation Site. Tall White Pines and Eastern Hemlock on ledges from top to bottom of the cliffs (Kerschner and Leverett 2002);

--Walpack Bend.* Perhaps as much as 30 acres of old growth on a steep north-facing slope. Eastern Hemlock and Chestnut Oak dominate (Sweeney 2002).

Kelly's Run Natural Area, Holtwood Environmental Preserve,in southeastern Pennsylvania (Lancaster County)

Up to 65 acres of probably unlogged old growth on the south side of the steep mouth of a ravine. Kershner writes that there are at least 25 acres and "possibly" as much as 65 acres (Kershner and Leverett 2002). In the past, 65 acres has been the accepted figure. The old growth is mixed mesophytic with much hemlock and a thick rhododendron understory. The upper slopes of the ravine have second-growth mixed oak and some Table Mountain Pine. PPL (formerly Pennsylvania Power and Light) Co. is the owner. See Otter Creek Natural Area above. The Hemlock Wooly Adelgid has killed some of the hemlock at the site, according to Mark Arbogast. Anthony Davis describes the damage done by the adelgid as so severe that the site is no longer worthy of inclusion in our report. (Erdman and Wiegman 1974, Wiegman 1993, Arbogast 1993 and 2001, Davis 2001).

Ferncliff Wildflower and Wildlife Preserve , in southeastern Pennsylvania (Lancaster County)

A National Natural Landmark composed of a mile-long ravine with 65 acres of "near virgin mixed mesophytic forest." The forest includes Eastern Hemlock, Tulip Tree, American Beech, Red and Sugar Maples, and American Basswood. The herbaceous layer is rich. Henry Hough Bagel donated it to the Lancaster County Conservancy in 1996 (Erdman and Wiegman 1974, Wiegman 1993, Devine 2002).

Jakey Hollow Natural Area,* in Wyoming State Forest, east-central Pennsylvania (Columbia County)

A hollow with 58 acres of old-growth White Pine, Eastern Hemlock, and northern hardwoods along a stream (Ostuno 2002, Kershner and Leverett 2002). The area may have been selectively logged in the past, as "faint evidence of large stumps can be found." A field borders the natural area on the south (Ostuno 1999).

Henry's Woods* in Jacobsburg Environmental Education Center, east-central Pennsylvania (Northampton County)

Forty acres of old-growth woodland, within the 1168-acre Environmental Center. The old growth was preserved by the family of William Henry, a manufacturer of fire arms during the Revolutionary War. Part of the site is flat land next to Bushkill Creek, part is steep slopes. Tree species include Eastern Hemlock; Northern Red, White, and Chestnut Oaks; Yellow and Sweet Birch; White Pine; and Sugar Maple. The Bureau of State Parks administers the Center (Kershner and Leverett 2002, Sweeney 2002).

Counselman Run Natural Area, southeastern Pennsylvania (York County)

A tract of either virgin forest or very old second growth, with Tulip Tree and Sugar Maple, on the steep west wall of the Susquehanna River. The area is owned and protected by Pennsylvania Power and Light (Erdman and Weigman 1974, Arbogast 1993).

CENTRAL PENNSYLVANIA

Raystown Shale Barrens, south-central Pennsylvania (Huntingdon and Bedford Counties)

A complex comprised of some 2000 acres of shale barrens and contiguous natural areas, on both sides of Raystown Lake, an artificial "lake" formed when the US Corps of Engineers dammed the Raystown Branch of the Juniata River. The complex is the largest and probably the least disrupted group of shale barrens in Pennsylvania. The impoundment destroyed the bottoms of some shale barren slopes, but left intact the mid and upper slopes. The tree cover, often sparse, is generally Eastern Red-cedar, Virginia Pine, and stunted oak, frequently Chestnut Oak. Shale outcrops are common (Bier 1993, Kimball 1976).

Tussey Mount Barrens, south-central Pennsylvania (Huntingdon County)

Bear Oak-Pitch Pine barrens in several sites with sandy, infertile soil, on the ride of Tussey Mountain above 2000 feet elevation. Erdman and Wiegman give a figure of 800 acres for the site, but it is not clear whether they refer only to the barrens. As of 1974 they were privately owned (Erdman and Wiegman 1974).

Rothrock State Forest, south-central Pennsylvania

--Bear Meadows Natural Area (Centre County). Within an 890-acre Natural Area, a nearly enclosed basin of approximately 350 acres with a "high mountain" old-growth bog forest. Communities on the edges of the bog include Black Spruce-Balsam Fir and Eastern Hemlock-Yellow Birch, both ranked A in the Western Pennsylvania Conservancy database. (Erdman and Wiegman 1974, Bier 1993, Kelly 1993). Through a dendroecological investigation, Abrams et al. learned that the 50 acres of bog forest that they studied were selectively logged in the 1890s and subject to fires around 1900 and 1914. Balsam Fir, which has been present at the site for 10,000 years, is dying out, as most of the Balsam Fir have attained their pathological age of 50 to 85 years and are suffering from root rot and insects. There is no local seed source to make reestablishment possible. The Black Spruce are healthier (Abrams et al. 2001).

--Thickhead Mountain Wild Area* (Centre and Huntingdon Counties). A 3844-acre Wild Area of ridge and valley, mountain forestland, in which are a more than 50-acre (21.5 ha) Chestnut Oak community on a south-facing talus slope (within the Detweiler Run Watershed) (Ruffner and Abrams 1998) plus scattered ridgetop old-growth communities (Ruffner 1998). The talus slope forest includes Sweet Birch, Red Maple, and Black Gum in addition to the dominant Chestnut Oak, and is uneven-aged. Chestnut Oak was recruited almost continuously between 1670 and 1950 (Ruffner and Abrams 1998). Most of the Wild Area was owned by a charcoal iron company until the early 1900s when it was sold to the state. Thus, a great deal of the forest, particularly on the valley floors and side slopes, was cut for charcoal, but ridgetop timber that was poor in form was likely to be left intact. Chestnut oaks have been found to be as much as 300 to 350 years old (Ruffner 1998).

--Detweiler Run Natural Area (Huntingdon County). Eastern Hemlock-White Pine old growth with a rhododendron understory in the lower ravine through which Detweiler Run flows. Calculations of the unlogged acreage differ: The Bureau of Forestry states 185 acres (Croop 1990); Micakalitis, 20 acres (1956). Kershner, who found hemlock up to 4.5 feet in diameter, believes that Croop's figure is the more accurate (Kershner 2002).

--Alan Seeger Natural Area (Huntingdon County). Possible unlogged forest within a 370-acre Natural Area that supports stream bottom, stream terrace, upland cove, and upland slope forest communities. Hemlock are 112 feet in height and 4.5 feet in diameter (Kershner and Leverett 2002). However, in 1990 Nowacki and Abrams analyzed ten stands with the help of tree coring, and concluded that every stand showed "evidence of large-scale logging during the mid-1840s." Even 25 acres of stream bottom forest characterized by Mickalitis in 1956 as "virgin hemlock, white pine, and hardwoods" had been impacted, though modifications to the 25 acres may have been the result of logging of the stand's buffer rather than of direct logging. Nowacki and Abrams conclude that for researchers who accept "limited human disturbance" some "stands having a substantial number of old-aged trees" may be seen as old growth, though the small size and isolated character of the Natural Area limit the functional role of any old growth present (Nowacki and Abrams 1994).

--**Shingletown Gap*** (Centre County). Two areas of old growth separated by second-growth mixed oak and surrounded by second-growth hemlock, pine, and hardwoods: 1) about 10 acres of mature and old-growth hemlock, White Pine and hardwoods in a stream valley and 2) 20 acres of primarily hemlock old growth on a ridge top. The

area on the ridge top is partially in Rothrock State Forest and partially on land owned by the State College Borough Water Authority. Only a small portion of the area in the valley is in the State Forest (Ostuno 2001, 2002).

Big Flat Barren, south-central Pennsylvania (Adams and Cumberland Counties)

A 600-acre old-growth Pitch Pine-scrub oak barren, with Bear Oak-Black Tupelo-Pitch Pine. People burn this barren to improve the blueberry crop, but it has probably not been cut. The Pennsylvania Bureau of Forestry and others are owners (Smith 1989a, Davis 1992 and 1993).

Bald Eagle State Forest, central Pennsylvania

--Snyder-Middleswarth Natural Area (Snyder County). "Virgin" forest in a 500-acre Natural Area in the valley of Swift Run: 250 acres according to Mickalitis (1956); 500 acres according to Croop (1990) and Johnson (1993). Croop and Johnson refer to communities of Eastern Hemlock-White Pine and Pitch Pine (1990, 1993); Mickalitis to "chiefly" hemlock and White Pine (1956). Wiegman and Erdman write of approximately 330 acres of virgin Eastern Hemlock-White Pine on the north slope and bottom and poor quality mixed oak on the south slope (1974), but the Natural Area may have been enlarged to include adjacent acreage with Pitch Pine since they wrote this description. Kershner and Leverett write that the old growth in Snyder-Middleswarth and Tall Timbers (below) equals 600 acres (Kershner and Leverett 2002). There is only scattered recruitment of White Pine and hemlock (Ostuno, 1999, Dec. 7).

--Tall Timbers Natural Area. Approximately 100 acres of old-growth hardwoods with some Pitch Pine and an occasional Shortleaf Pine within a 660-acre natural area. The old-growth trees, which are concentrated in the stream corridor, were selectively cut, principally around 1900 and 1902. Tall Timbers State Natural Area extends westward from the western boundary of Snyder-Middleswarth (Johnson 1993).

--Joyce Kilmer Natural Area (Union County). On a ridge top, a 77-acre stand that is usually described as "virgin White Pine-Eastern Hemlock." However, a Ernest Ostuno in 1999 found only two large White Pine among the hemlock. Some hemlock recruitment was taking place, with seedlings growing near fallen logs (Ostuno, 1999). Sweet Birch are also present. Many of the trees are probably 300 to 400 years old, although due to difficult growing conditions, the larger trees are only around three feet in diameter (Ostuno 1999, Kershner 2002).

--Mount Logan Natural Area (Clinton County). A 512-acre Natural Area, which includes old-growth Eastern Hemlock on a Tuscarora sandstone outcrop. Estimates of the extent of the old growth range from 3-4 acres (Johnson 1993) through 32 acres (Croop 1990) to 50 acres (Erdman and Weigman 1974). The hemlock, at least 200 years old, are growing on almost pure rock, under xerophytic conditions. Some have branches longer than the height of the boles (Johnson 1993).

--**Bear Run Natural Area** (Centre County). Ostuno describes the old growth as "a very small area of about only two or three dozen large hemlocks along a three-acre section of Bear Run." The older trees are 300-400 years in age, according to Pennsylvania State Forestry staff who took cores. Hemlock recruitment is good. A separate stand of large hemlock, to the north on a dirt road, seem to be old growth. It may be on private land (Ostuno 1999). The Center for Rural Pennsylvania describes the Bear Run stand as 15 acres of hemlock (Center 1995).

Tuscarora State Forest, south-central Pennsylvania

--Hemlocks Natural Area (Perry County). Unlogged hemlock hardwoods. Micklatis refers to 20 acres of virgin hemlock (1956); Croop to 131 acres of virgin hemlock and cove hardwoods (1990). Kershner believes that Croop is more nearly correct (Kershner and Leverett 2002). Some old growth may be located to the west of the boundary of the Natural Area. Otherwise the area is surrounded by second-growth hemlock hardwoods (Ostuno 1999). The Hemlock Wooly Adelgid is severely impacting the hemlock at this and other sites in the State Forest (Davis 2002).

--Laurel Run Natural Area (Perry County). Stands of old-growth hemlock near the river and of virgin hemlock on steep talus. The forest was apparently "burned or otherwise severely disturbed in the late 1700s," but was only lightly cut in the late 1880s when many forests were heavily logged (Erdman and Wiegman 1974, Kelly 1993).

Pine Creek Gorge Natural Area, in Tioga State Forest, north-central Pennsylvania (Tioga County)

A twelve-mile long, 7216-acre Natural Area including "excessively steep" gorge walls on which the trees were never cut and virgin stands remain. Lower and more accessible parts of the gorge were cut or burned and are now second growth northern hardwoods or mixed oak. The Natural Area protects the gorge from "rim to rim." Colton

Point State Park and Leonard Harrison State Park are within Tioga State Forest and within the Natural Area (Erdman and Wiegman 1974, Kelly 1993).

Forrest H. Dutlinger Natural Area, in Susquehannock State Forest, north-central Pennsylvania (Clinton County)

158 acres of old-growth hemlock (Croop 1990, Kershner 2000). Erdman and Wiegman describe a 30-acre virgin stand of hemlock-hardwoods in a proposed Beach Bottom Natural Area (1974), which is now the Forrest H. Dutlinger Area (Kelly 1993). Ostuno notes that the unlogged area apparently resulted from a surveying error between the boundaries of the Goodyear and Lackawanna Lumber companies. The old growth consists primarily of hemlocks in the upper end of the valley of Beech Bottom Run; and a mixture of beech, hemlock, Black Cherry, Sugar Maple, and oak on the flat top of a mountain. Hemlock recruitment is sparse. The Natural Area includes two large White Pine, but it appears that other White Pine were removed before the boundary dispute arose (Ostuno 2001).

Gettysburg National Military Park,* south-central Pennsylvania (Adams County)

One hundred acres of possible old growth within the nearly 6000-acre Park.

--Big Round Top. Perhaps 70 acres of old growth dominated by White Oak, Northern Red Oak, White Ash, and Tulip Tree surround Big Round Top. Grazing and cutting of fuel wood probably took place, but boulders in the woods forestalled logging for agriculture.

--Philzer Woods. Some 10 acres of selectively cut old growth are located in the woods. White Oak dominates.

--Culps Hill. Some 5-10 acres of possible old growth are found, especially on the north side of the hill. The stand is dominated by White and Northern Red Oak. Boulders surround the hill.

--Possibly an additional 10 acres of old growth scattered through the Park (Sweeney 2002).

Caledonia State Park, south-central Pennsylvania (Franklin County)

Possibly remnants of primary forest in a state park that is mainly second growth. Erdman and Wiegman describe remnants that are part of a hemlock-hardwood swamp forest with a thick rhododendron understory. Oak forests in the park are not as old and have been more disturbed (1974, Wiegman 1993).

Crawford Hollow, in east-central Pennsylvania (Cumberland County)

90 acres of old-growth Eastern Hemlock-White Pine, in private ownership (Smith 1989a, Davis 1992).

Johnson Run Natural Area, in Elk State Forest, north-central Pennsylvania (Cameron County)

Possibly 50 or more acres of old growth within a 216-acre Natural Area. Ostuno describes the area as "virgin or near virgin" and notes that it supports White Pines that in a few cases are close to four feet in diameter (Ostuno 2000). Croop cited 26 acres of old-growth hemlock-hardwood (Croop 1990).

WESTERN PENNSYLVANIA

Allegheny National Forest, in northwestern Pennsylvania (McKean and Warren Counties)

--Tionesta Scenic and Research Natural Areas (McKean and Warren Counties). A single tract of 4131 (Colaninno 1990) or 3500 (Mickalitis 1956, Croop 1990) acres of "virgin," old-growth climax hemlock-beech forest, within a 2018-acre Scenic Natural Area and a 2113-acre Research Natural Area (RNA), both administered by the US Forest Service (USFS). This tract and the Hearts Content Scenic Area were purchased by the federal government, because they were the only known uncut remnants of a 6 million acre hemlock-beech forest that once covered the Allegheny Plateau (Bjorkbom 1977). USFS describes the RNA as Eastern Hemlock; Sugar Maple-American Beech-Yellow Birch; American Beech-Sugar Maple; and Black Cherry-Maple (USFS 1987). Mohlenbrock writes that in the SNA beeches and hemlocks more than 100 feet tall tower over Sugar Maple, Red Maple, Sweet Birch, Yellow Birch, basswood, Black Cherry, Tulip Tree, and even Cucumber Tree (1984). In 1985, after Mohlenbrock had published his guide, 800 acres of the Scenic Area were flattened by a tornado. Salvage work was done on pipelines and existing roads (Smith 1989b).

Current threats to the continued existence of the old growth are severe. In the absence of large predators (extirpated decades ago), the browsing of deer prevents the regeneration of species other than the unpalatable beech, and has all but removed Hobblebush from the understory (Dunshie 1993, Bjorkbom 1977). Tionesta has no fencing to

keep out deer (Nelson 2002) nor have plans been made to reintroduce the missing predators, including Eastern Cougar and Timber Wolf. The killing front of beech bark disease entered Tionesta in 2000 (Warren Times 2002). An estimated 156 oil and gas wells are scattered through the old growth. USFS owns the mineral rights below the RNA, but not below the Scenic Area (Johnson 2001). The boundaries of Tionesta are not clearly marked or are marked incorrectly, particularly on the north side. As a result, logging has encroached on old growth in recent years (Nowak and Nelson 1997).

Friends of the Allegheny Wilderness, led by Newkirk Johnson, has proposed the establishment of a Tionesta Wilderness Area of 20,000-32,000 acres (8000-13,000 ha), centering in the Tionesta Scenic and Research Natural Areas (Johnson 2001, Hopey 2001).

--Hearts Content Scenic Area (Warren County). Virgin old growth, 122 (Colaninno 1990) or 150 acres in extent (Croop 1990). The overstory includes White Pine, Eastern Hemlock, and American Beech. A predominantly White Pine segment of perhaps 20 acres has impressive trees 300-400 years old and 150-200 feet tall. Unfortunately the many trees that are now dead or dying, including beech suffering from beech bark disease, are not being replaced, because of heavy deer browsing. Only a few test plots in the forest have been fenced to exclude deer (Dunshie 1993, Whitney 1993, Colaninno 1990, Franklin 1989 and 1990, Johnson 2002).

--Crull's and Thompson's Islands. Old-growth riverine communities on islands in the Allegheny River. Erdman and Wiegman describe these communities as "virgin," and dominated by Silver Maple and American Sycamore (1974). The Western Pennsylvania Conservancy data sheets speak of "maturing and mature forest," with Sugar Maple, American Sycamore, and Slippery Elm as the chief woody species (Bier 1993). Both sources report that the islands include open areas. Crull's Island is 96 acres, and Thompson's Island is 67 acres.

Cook Forest State Park, in western Pennsylvania (Clarion, Jefferson, and Forest Counties)

A 7822 acre park with old growth that is spectacular but of uncertain acreage. Erdman and Wiegman describe three uncut or slightly cut coves: the Cathedral Area, 100 acres of virgin White Pine; the Seneca Tract, approximately 70 acres of virgin hemlock on a steep slope; and the Hemlock Swamp, 125 acres of near virgin Eastern Hemlock-White Pine swamp. Much of the remainder of the forest is mature second growth with old-growth characteristics, they write (Erdman and Wiegman 1974, Wiegman 1993). Mickalitis wrote of "171 acres of remnants of original hemlock and white pine forests and several hundred acres of mature timber which had been selectively cut-over about a century ago" (1956). Leverett notes that accounts suggest between 171 and 500 acres. He himself will go with a middle figure of around 300 acres until the acreage can be accurately assessed through global positioning technology (Leverett 2002). The forest has experienced considerable storm damage (Wary 1993), including a tornado in 1976. Nevertheless, the Cathedral has more White Pine over 150 feet tall than any other site in the Northeast. The Longfellow Pine, 180.1 feet in height and 42 inches in diameter and the Seneca Pine, 172 feet in height and 48 inches in diameter, are particularly impressive. A hemlock in the Cathedral is 138 feet tall. Other large species include Red Maple, American Beech, Black Cherry, and White Ash. The old-growth forest in the park apparently renewed itself after a drought and fire in 1644 (Kershner and Leverett 2002).

Bucktail State Park* (Clinton and Cameron Counties)

Old-growth of undetermined extent on steep, north-facing slopes along the west branch of the Susquehanna River. The old growth is composed of hemock and associates, including Sweet Birch. Clusters of 10 or so acres, scattered along the river, may amount to 100 acres in total (Wagner 2002). The park is a 75-mile ribbon through a narrow valley.

Pymatuning Swamp, in northwestern Pennsylvania (Crawford County)

More than 50 acres of little disturbed, mature Sugar Maple-American Beech-Yellow Birch forest, ranked "B"; and a 100-acre strip of White Pine-Tamarack forest, ranked "A," in portions of what remains of the once huge Pymatuning Swamp. The present swamp is a mixture of open marshland, shrub swamp, and swamp forest. According to the Western Pennsylvania Conservancy database, the Swamp needs further study (Bier 1993, Erdman and Weigman 1974).

Anders Run State Natural Area, in Cornplanter State Forest, northwestern Pennsylvania (Warren County)

Approximately 50 acres of old growth in the southern end of the 97-acre Natural Area. White Pine and Eastern Hemlock are the most conspicuous trees with diameters for the pine as high as 54 inches. According to ring

counts of fallen trees, hemlock are as old as 400 years (Kershner 2002) and White Pine up to 220 years. Species in addition to White Pine and hemlock include Cucumber Tree, American Beech, Ironwood, Black Cherry, and oaks (Ostuno 2000). Gordon Whitney has described the Natural Area as "mature, but hardly old-growth" (1993), and Donald Wary has spoken of possible logging in the early 1800s (1993). Kershner believes, however, that most of the southern end of the Natural Area, in and along a ravine, is unlogged, whereas the northern end has second growth. A road separates the two sections (Kershner 2002).

Buchanan State Forest, southwestern Pennsylvania (Bedford County)

--Sweet Root Natural Area. Within a 1403-acre Natural Area, 63 acres of forest that has never been logged. Trees are Eastern Hemlock, Sweet Birch, White Pine, basswood, and oaks (Croop 1990, Kershner and Leverett 2002). As of June 2003, approximately 90% of the hemlock were dead because of the woolly adelgid. The remaining hemlock were dying (Ostuno 2003).

--**Thirty to fifty acres of old growth*** within a steep ravine. Hemlock is the most common tree; Sweet Birch, second most common. Also present are Northern Red Oak, maple, and a little basswood (Hotopp 1998).

Bear Creek , in southwestern Pennsylvania (Westmoreland County)

A "near virgin woods" with Eastern Hemlock, Yellow Birch, and Sugar Maple, through which Bear Creek flows for half a mile. Bear Creek is a fork of Rolling Rock Creek. The land is in private hands (Erdman and Wiegman 1974, Wiegman 1993).

Silvermine Run, in southwestern Pennsylvania (Westmoreland County)

Stands of virgin forest in a deep valley. Hemlock predominates along the stream; Sugar Maple, on the upper slopes. Between them is a particularly fine stand of American Beech. Silvermine Run is a small tributary of Rolling Rock Creek. The site is privately owned (Erdman and Wiegman 1974, Wiegman 1993).

Bear Run Nature Reserve , southwestern Pennsylvania (Fayette County)

In Bear Run gorge, stands of old growth forest, some unlogged. Erdman and Wiegman speak of the steeper portion of Bear Run gorge as having "virgin stands of mixed oak with some mesic species" (1974). Wiegman estimates 35 acres of never cut or lightly cut old growth (1993). The Western Pennsylvania Conservancy database speaks of approximately 50 acres of mixed mesophytic "mature old growth forest" just below Fallingwater (a house designed by Frank Lloyd Wright), and points to the need for further investigation. Bier says that the reserve has a total of around 100 acres of various old-growth communities (1993). The reserve is mostly second-growth mixed oak (Erdman and Wiegman 1974) and is owned by the Western Pennsylvania Conservancy.

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RHODE ISLAND

Although Rhode Island has little old growth remaining, several good sites of known old growth have been documented.

Great Swamp Management Area, within a few miles of the Atlantic Ocean (Washington County)

Approximately 3000 acres of old growth owned by Rhode Island's Division of Fish and Wildlife. The Management Area has had some cutting as people would enter during the winter when the swamp was frozen; but "probably" portions were left intact, according to the Area's James Myers (1993). Rick Enser of the Natural Heritage Program says that in Rhode Island cedar was heavily cut, but it is likely that the Management Area has areas that were never logged, because skidders could not reach them (1933, 2001). Most of the area is covered by swamp forest over "shallow muck soils." Red Maple, Atlantic White-cedar, Black Gum, Black Alder, rhododendron, Sweet Pepperbush, and blueberry are common. The area has "excellent stands of American holly" (Goodwin and Niering 1975, Goodwin 1993).

Crandall Swamp (Washington County)

A wetland complex of up to 1500 acres, with a 700 to 1000-acre stand of mature Atlantic White-cedar. (The entire complex has acquired the name that first belonged only to the Atlantic White-cedar stand.) Probably portions of this swamp were not cut due to their inaccessibility. Also present are a couple of sizeable shrub bog mats: quaking bog habitat with shrubs and 30 acres of open bog mat. Leatherleaf is common; Red Maple occasional. The family that owned Crandall Swamp proper recently donated it to the Narraganset Indians on condition that the land remain as it is. The state and private parties own other areas of the wetland (Goodwin and Niering 1975, Enser 1993).

Pawcatuck River Floodplain Forest* (Washington County)

An old-growth Red Maple floodplain forest of about 250 acres. Most of this forest is more inaccessible than the nearby Great Swamp Management Area; and, if it was logged, the logging was done previous to any logging at Great Swamp. The attention of the Rhode Island Natural Heritage Program was drawn to the Pawcatuck Forest, because the first confirmed nesting of the Prothonetary Warbler, a bird associated with old growth, occurred there. The land is mostly in private hands (Enser 2001).

Oakland Farms ,* in the town of Portsmouth (Newport County)

A recently discovered twenty-acre mixed old-growth forest. American Beech, White Oak, Red Maple, and Scarlet Oak show old-growth forms, indicative of ages between 150 and 300 years. The beech have been measured to slightly more than 10 feet in circumference. Many have circumferences of 6.5 to 8.5 feet. They are up to 85 feet tall and are of varying ages. White Oaks mixed with the beech are in the 6 to 9 foot circumference range and between 70 and 80 feet tall, high for coastal forests. Regeneration is taking place. Portions of the site show no visible sign of post-settlement human disturbance; the balance shows only limited signs of such disturbance. In 1999, after Matthew Largess had discovered the likely significance of the forest, Dr. Charles Canham of the Institute of Ecosystem Studies, and old-growth sleuth Robert Leverett examined the site and concluded that, despite its location in the midst of a subdivision, it is functionally an old-growth forest, not just a collection of old trees. Oakland Forest was originally part of the Cornelius Vanderbilt estate, most of which was sold to a developer piece by piece. Matthew Largess and Eleanor Kinney spearheaded a campaign to save the forest, which led to the purchase and preservation of the site by the Aquidneck Island Land Trust (Leverett 1999, Leverett 2002, Largess Forestry 2002).

Ell Pond (Washington County)

Rhode Island's only National Natural Landmark, with a ten to fifteen-acre rocky ravine sheltering large Eastern Hemlock and a bog pond, around which is a floating mat with pitcher plants and other bog species. The hemlock stand is locally known as the Cathedral. However, The oolly adelgid has killed a large number of the hemlock, which are now standing dead trees. Atlantic White-cedar around the pond are less mature than those at Crandall. The site is protected, since it is owned by the state, Rhode Island Audubon, and The Nature Conservancy (Goodwin and Niering 1975, Enser 1993, 2001).

Factory Pond (Washington County)

A bog pond with some ten acres of stunted Atlantic White-cedar on a bog mat. The area may never have been cut. The town of South Kingston owns the pond and most of the adjacent wetland, which it has agreed to preserve (Enser 1993).

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VERMONT

The extent of uncut upper-elevation spruce-fir forest in Vermont has apparently not been thoroughly investigated; and opinions vary. H. W. Vogelmann, retired from the University of Vermont, thinks that the spruce-fir forest, which begins at an elevation of around 2800 feet, has been little cut, especially in the north (1993). On the other hand, according to Diane Burbank of Green Mountain National Forest, one would, as a general rule, be hard pressed to find unlogged upper-elevation sites other than krummholz. For example, a hotel was located just below the summit of Mount Abraham, to which people traveled in carriages; and the forest in the vicinity of the hotel and road was cut (1993). Diane Strohm in the Forest's Manchester District told us that in this district loggers worked as high as 4000 feet, and livestock grazed the sides of the mountain. She thinks that probably the district has unlogged areas at higher elevations, but has not identified specific sites (1993). Timothy Perkins of the University of Vermont, who has studied spruce decline at upper elevations of the state, has become familiar with unlogged areas only on Camel's Hump (1993).

From the Rochester District of Green Mountain National Forest, Bruce Reid reports that it is extremely difficult to distinguish areas that were logged in past centuries from never-cut areas, because recent events have masked past disturbances. Whether a particular area was cut depended on such factors as who was living there and what trails led off the mountain. Generalization on upper elevation forest is therefore not possible, he thinks. In the autumn when visibility is good, he finds traces of horse trails that indicate cutting; and he has found in aerial photographs taken in 1935 evidence of logging at "very high" elevations. Some high-elevation areas were even clear cut.

Nevertheless, Reid believes it is possible to identify upper-elevation spruce-fir areas that have probably experienced minimal human disturbance, although within these areas people may have cut small pockets of trees. The locations include the upper elevations of Mount Ellen, Cutts Peak, Nancy Hanks Peak, Lincoln Peak, and Mount Abraham; the upper elevation forest stretching from just south of Lincoln Gap through Mount Grant, Mount Cleveland, Gillepsie Peak, and Cape Lookoff Mountain, to Mount Horrid; the area around the peak of Goshen Mountain; ridge forest from just south of the Rutland County border through Farr Peak to Bloodroot Mountain; Bear Loaf Mountain, Battell Mountain, Boyce Mountain, Kirby Peak, and Burnt Hill; the area adjacent to and north of the peak of Hat Crown; and high-elevation forest on Worth Mountain. These areas are on or near the Long Trail which runs from north to south through Vermont. Ski runs have been constructed on Mount Ellen, but away from the actual runs the forest has not been disrupted (Reid 1993).

According to the report Significant Features of the Appalachian Trail Corridor in Vermont, the state has at least 10 documented examples of krummholz, twisted and dwarfed trees found near the treeline (Nongame 1991). The database of the Nongame and Natural Heritage Program contains information on only four sites, as the Program has never systematically inventoried this type of community. Most of the krummholz sites in Vermont are dominated by Balsam Fir under six feet in height, accompanied by smaller amounts of birch and Red or Black Spruce. Most of the sites are largely intact, but roads, trails, ski areas, and radio towers have damaged some (Marshall 1993). Areas with krummholz include Mount Mansfield, Jay Peak in Jay Peak State Forest, Killington and Little Killington Peaks, Pico Peak in Coolidge State Park, Camel's Hump in Camel's Hump State Park, and Mount Ellen (Marshall 1993, Nongame 1991).

The Vermont Nongame and Natural Heritage Program did a significant features inventory of Green Mountain National Forest for the US Forest Service (USFS) between 1990 and 1997. Researchers visited all stands that, according to USFS records, were 150 years or older. In the spring of 2002, USFS released a Notice of Intent to revise the management plan for the Green Mountain Forest (Burbank 2000 and 2002).

In 2002 the Nongame and Natural Heritage Program studied limestone bluff cedar-pine forests along Lake Champlain. In early 2003 they are in the process of writing up their findings. At this point, we can state that a few small patches of remnant forest were found on the tops of inaccessible cliffs near the lake (Sorenson 2003).

The sites described in our text below include a few areas with spruce-fir forest and krummholz. Lower elevation sites of actual and potential old growth, in addition to the sites below, include: **Lords Hill State Natural Area** (Washington County): 13 acres of old-growth beech-birch-maple forest, at least part of which may have been used as a sugar bush, within a 25-acre Natural Area, owned by the Vermont Department of Forests, Parks, and Recreation (VFPR) (Marshall 1993); **Black Island** (Orleans County): approximately 10 acres of Eastern Hemlock,

White Pine, and northern hardwoods that comprise a potential (Marshall 1993) or actual (Vogelmann 1993) old-growth site, owned by The Nature Conservancy; **Pitch Pine*** (Windham County), almost 10 acres on the eastern peak of Black Mountain, with the oldest trees dating from between 1790 and 1815 (Holt 1996); **Vernon Black Gum Swamp** (Windham County): an 8-acre old-growth Black Gum-Red Maple swamp, owned by the town of Vernon (Marshall 1993); **McCullough Woods** (Bennington County): 7 acres of potential old-growth rich northern hardwoods, dominated by Sugar Maple, American Beech, and Red Oak, owned by the Vermont Land Trust and The Nature Conservancy (Marshall 1993)**; Granville Gulf State Natural Area** (Addison County): within the Natural Area, a 6-acre potential old-growth hemlock-Red Spruce forest, owned by the Vermont Department of Forests, Parks and Recreation (Marshall 1993); **Willard Mountain** (Essex County): roughly 4 acres of Red Pine community, approximately 180 years old, on steep slopes, ledges, and small cliffs overlooking the Connecticut River (Marshall 1993); **Quechee Gorge** (Windsor County): a few acres of old-growth Eastern Hemlock, White Pine, and northern hardwoods (Leverett 1992).

We have not listed as old growth the Fisher-Scott Memorial Pines (Bennington County), although they are often described as old growth. They were found to have grown up in an abandoned field (Leverett 1993, Marshall 1993). Charles Cogbill, who questioned the old growth status of these pines, also has questioned that of the White Pine-hemlock forest in the 22-acre **Cambridge Pines State Natural Area** (Lamoille County) (Marshall 1993).

GREEN MOUNTAIN NATIONAL FOREST

--**The Cape,** also known as Lookoff Mountain, southwestern Vermont (Rutland County). A 295-acre Research Natural Area with approximately 100 acres of old-growth rich northern hardwoods forest (Burbank 2000). The location is a ridge top and a steep slope that faces west. On the ridge top the dominant species are American Beech, Sugar Maple, and Yellow Birch. Red Spruce and Yellow Birch dominate the upper slopes; Sugar Maple, the middle and lower slopes, which have deep soils and abundant wildflowers.

--White Rocks National Recreation Area, southwestern Vermont (Rutland County). Approximately 270 acres of Red Spruce on steep talus slopes within the National Recreation Area. Trees are up to 25 inches in diameter, though most are 6 to 11 inches in diameter. Ages of older trees range from 145 to 155 years. Significant Ecological Features of the Appalachian Trail Corridor describes the site as old-growth (Nongame 1991), but the Vermont Natural Heritage Program says that more research is needed to determine the site's status (Marshall 1993).

--Downer Glen, in Lye Brook Wilderness Area (Bennington County). One hundred acres of possible old-growth rich northern hardwoods forest in the deep gorge of Bourn Brook. Mature, large hardwoods and hemlock grow on the lower slopes of the gorge. Further research is needed to determine whether the site is old growth.

--West of Mount Tabor,* in Big Branch Wilderness, south-central Vermont (Bennington County). Fifty to eighty acres of old-growth mesic northern hardwoods on a steep and "extremely rocky" site. Dominant trees are Sugar Maple and Yellow Birch. Red Spruce, American Beech, and Paper Birch are scattered through the area. In the understory, beech saplings, spruce, Hobble Bush, and Striped Maple are among the dominants. Jennifer Ramstetter of the Vermont Natural Heritage Program conducted a field survey of the site for USFS in 1995 (Burbank 2000).

--**Monastery Mountain**, west-central Vermont (Addison County). Beech-birch-maple forest of unknown acreage on slopes varying from moderate to steep and ledgy. Preliminary research by Charles Cogbill, Chris Fichtel, and Charles Johnson indicates that the site is old-growth forest. Sugar Maple and Yellow Birch, accompanied by lesser amounts of American Beech and White Ash, dominate the site as a whole, but Red Spruce and Eastern Hemlock grow on ledges and the steepest slopes. Tree saplings and Hobble Bush compose the shrub layer (Marshall 1993).

--French Hollow,* town of Winhall (Bennington County). Three areas of old growth on a knoll of less than twenty acres. On the north, are large and presumably old Eastern Hemlock, Red Spruce, and Yellow Birch. Saplings of spruce, Balsam Fir, American Beech, and Sugar Maple are present. At the top of the knoll the hemlock are mixed with Sugar Maple, and fir is occasionally present. The understory here shows little regeneration of tree species and is composed mostly of Hobble Bush and Striped Maple. On the south slope, Sugar Maple is the dominant species; hemlock and Yellow Birch are also common. Red Spruce, American Beech, and Sugar Maple are regenerating in the understory, which they share with Hobble Bush. All three areas have large living trees, abundant dead trees, tip ups, hummocks, and snags. The site contains no evidence of logging but logging has occurred recently to the north (Burbank 2000).

Camel's Hump State Forest, west-central Vermont (Chittenden County)

A 10- to 15-acre patch of virgin forest plus extensive old-growth acreage, all on the west side of the mountain. H. W. Vogelmann reports that a doctoral student at the University of Vermont discovered the uncut and unburned area in the spruce-fir zone, after conducting a meticulous study of the cutting history of the mountain. In the spruce-fir zone as a whole (2800 feet to 4000 feet), the cutting occurred in the mid-19th century and was selective, with only a few trees picked. More cutting was done in the hardwoods, but the last cut was in 1954 and 1955 and was selective. The mountain at both the lower and higher elevations has the characteristics and the feel of old growth, Vogelmann says (1990).

Charles Vile, State Lands Forester, writes that during a period of almost 20 years, he has "cruised much of the park below" 2800 feet and walked over much of the rest, but has encountered no "stands," "not cut or disturbed by non-aboriginal people," only some individual trees more than 125 years old. There may, he says, be "isolated clumps of old trees high on the mountains" (Vile 1990).

The Audubon Society Field Guide to Natural Places of the Northeast: Inland, and the Maine State Planning Office both express a point of view similar to that of Vogelmann: "Up to 2600 feet the mountain is covered with a northern hardwood forest in a near-virgin condition. Sugar maple is widespread along with beech and yellow birch. Hobblebush, mountain maple, and striped maple are common shrubs of the understory" (Kulik et al. 1984). "The upper western slopes (2800-3900 feet) . . . support a relatively undisturbed montane boreal forest. The dominant trees vary from red spruce with balsam fir and paper birch at the lower elevation to pure balsam fir at the higher elevation" (Maine Critical Areas 1983).

Battell Biological Preserve , west-central Vermont (Addison County)

Two hundred acres of old-growth hemlock forest on the steep slope of South Mountain. Pockets of hemlock are more than 300 years old; most of the forest is about 180 years old. Sugar Maple, American Beech, and Yellow Birch occur in coves with deeper soil and in forest gaps. The forest has a long history of fire. Middlebury College owns the Preserve (Vogelmann 1964, Marshall 1993).

East Mountain, northeastern Vermont (Essex County)

A 150-acre, old-growth spruce-fir forest on a southwestern slope. At the upper elevation the trees are stunted. Lower down, the stand includes Balsam Fir to 12 inches in diameter, scattered Red Spruce from 16 to 24 inches in diameter, and some old Mountain Paper Birch. Most of the uneven-aged spruce are between 170 and 260 years in age. The only sign of disruption is a telephone right of way. The site is privately owned, and access is by permission from the owners only (Marshall 1993).

Shrewsbury Peak , southwestern Vermont (Rutland County)

Stunted spruce-fir forest. At least a 100-acre protected zone on the summit may be uncut (Nongame 1991).

Mount Mansfield, north-central Vermont (Lamoille County)

More than 100 acres of krummholz, the largest example of krummholz in the state (Marshall 1993). Charles Cogbill has remarked that Mount Mansfield has old growth, especially on the east side (1992). The summit of the mountain is owned by the University of Vermont; the spruce-fir slopes below are in Mount Mansfield State Forest (Vogelmann 1964). Mount Mansfield has been severely fragmented by a ski area.

Killington and Little Killington Peaks, southwestern Vermont (Rutland County).

Krummholz and montane forest. A ski area has been constructed on the mountain, but there are no trails on the west side. The upper western slopes have good stands of montane forest and krummholz (Vogelmann 1993). Marshall (1993) and the report on Significant Ecological Features (Nongame 1991) mention the krummholz.

Hunter Mountain, central Vermont (Washington County)

Old growth on the upper slopes. The mountain is owned by the state (Vogelmann 1993).

Mayo Mountain, northwestern Vermont (Chittenden County)

Sixty acres of possible old growth on the top and steep sides of the mountain. Northern Red Oak and Eastern Hemlock, estimated to be 180 to 240 years old, dominate the site. The oak are up to 43 inches in diameter, and many measure more than 30 inches. The hemlock are 25 inches to 30 inches in diameter. Sugar Maple and American Beech appear with the oak and hemlock in the overstory, which is 60 feet tall on flat and concave areas and 40 feet tall on steep slopes. Eastern Hophornbeam dominates a well-developed understory. On exposed bedrock outcrops, White Pine and very stunted Northern Red Oak appear. Apparently the site underwent grazing in the past. More research is needed to determine its status. The site is privately owned, and access is only by permission of the owner (Marshall 1993).

Daniel's Notch,* north-central Vermont (Lamoille County)

Approximately 50 acres of montane Yellow Birch-Red Spruce forest with old growth characteristics. This forest is at an elevation of 2300 to 2400 feet and includes Sugar Maple, Yellow Birch, Red Spruce, and American Beech. Red spruce is the most abundant species by stem density; individuals were aged at 108 to 232 years. The site is owned by VFPR (Baldwin et al. 1994, Vermont Nongame 2002).

Norton Pond Northwest Arm Swamp,* northeastern Vermont (Essex County)

A 40 acre Northern White-cedar swamp, with scattered White Pine and White Spruce emerging from the canopy. This mature cedar swamp has been selectively logged in the past for White Pine and White Spruce, but has a canopy of cedar trees 140 to 180 years old. The swamp is owned by Vermont Fish and Wildlife Department (Vermont Nongame 2002).

Merck Forest and Farmland Center,* southwestern Vermont (Bennington County)

Two stands of old growth within a 3130-acre center of forests and farmland, owned by a non-profit organization.

Approximately 13 acres of never-logged hemlock on a steep north-facing slope. A wind storm in 1999 blew down part of the stand.

Some 20 or 30 acres of old growth within a larger stand of mixed northern hardwoods dominated by Northern Red Oak. The old growth is mostly red oak and includes 180-year-old trees. Apparently the old-growth portion of the stand was never cleared.

The organization was founded by George Merck, former CEO of Merck and Company, but is not itself associated with the pharmaceutical firm. Although its mission is to teach sustainable forestry and farmland management, it preserves its old growth and other rare habitats (Smith 2002).

Roy Mountain Wildlife Management Area, northern Vermont (Caledonia County)

Two old-growth sites within the 1590-acre Wildlife Management Area, owned by the Vermont Fish and Wildlife Department.

--A 20-acre Northern White-cedar swamp,* with small amounts of Black Ash and Balsam Fir. This mature white-cedar swamp has cedars 191 years old and mature forest structure, although there is evidence of selective logging in approximately 1880 (Vermont Nongame 2002, Alexander 2003).

-- A 37-acre tract, described by the Fish and Wildlife Department as a natural area, with an 8-acre stand of old-growth Red Pine on the upper part of a southwest-facing slope. On the moister soils, the Red Pine is accompanied by Eastern Hemlock; on the rocky ledges, by White Pine. Most of the Red Pine are 6 to 12 inches in diameter; one is 23 inches. Some of the Red Pine are likely to be about 200 years in age. Lower on the slope, northern hardwoods with hemlock replace the pine (Marshall 1993, Vogelmann 1969, Alexander 2003).

Lamphere Woods , southwestern Vermont (Rutland County)

Twenty acres of privately owned potential old-growth hemlock-northern hardwoods forest. The dominant tree is hemlock. Thus the shrub and ground layer are sparse. Much of the history of the forest is unknown, and additional research is necessary to determine if it is actually old growth. However, it appears not to have been disrupted for at least 100 years (Marshall 1993).

Tinker Brook State Natural Area, southeastern Vermont (Windsor County)

Fifteen acres of spruce-fir/northern hardwoods forest on the walls of a steep ravine. Red Spruce, up to 20 inches in diameter, dominates. Hemlock, to 3 feet in diameter, is common in the overstory; Yellow Birch and American Beech in the understory. Trees are up to 240 years old. VFPR owns the site (Marshall 1993).

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Southeast

ALABAMA

The US Forest Service (USFS) is in the process of revising the management plan for the National Forests in Alabama. The agency expects to adopt a revision by 2004. In connection with the revision USFS is identifying old growth in certain portions of the forests. Furthermore, an effort to identify old growth independent of USFS is underway. In the summer of 2003, Wild Alabama and Wild South are sponsoring inventories of the Bankhead and Talladega National Forests, which will be conducted by interns from Duke University. The Bankhead has about 400 miles of canyons. The canyons have never been investigated systematically for old growth although a variety of sites have been identified (Marshall 2003).

Small old-growth sites include **Tuskegee National Forest*** (Macon County): three riparian old-growth pockets of ten acres or less each dominated by Cherrybark Oak, Southern Magnolia, and Swamp White Oak (Stewart 2003); **DeSoto Woods Preserve*** (DeKalb County): old-growth Tulip Tree-White Oak forest on terrace flats and old-growth oak-hickory on adjoining slopes within a 54-acre preserve owned by The Nature Conservancy (Wills 1999); **Rock Bridge Canyon*** (Franklin County): a privately owned box canyon with up to 30 acres of old-growth hemlock and hardwoods (Schotz 2003); **Salt Mountain*** (Clarke County): 6 or 7 privately owned acres of old-growth oaks, basswood, beech, and spruce-pine on mesic soils on a steep limestone slope (Schotz 2003); **Oak Mountain State Park** (Shelby County): the 5-acre Peavine Area of old-growth oak and pine on top of Double Oak Mountain (Ogletree 1993).

Grand Bay National Wildlife Refuge, southeastern Mississippi (Jackson County) and southwestern Alabama (Mobile County)

Probably old-growth Slash Pine savanna within the 1400–acre Refuge (Schotz 2003). For further information, see under Mississippi. The refuge straddles the line between the states.

CONECUH NATIONAL FOREST, on the border with the Florida Panhandle (Escambia and Covington Counties)

--Bear Bay Thicket.* A 750-acre swamp community dominated by cypress and tupelo. The 750 acres have not been logged, because they are inaccessible. Around the swamp is a bay thicket similar in composition to the Big Thicket in Texas. Fingers of the thicket reach into the swamp.

--Yellow River.* Along the Yellow River are 10-20-acre strips of old-growth riparian communities. Tree species include Sweetgum, tupelo, sycamore, Titi, and Swamp Chestnut Oak. Palmetto hummocks are found under the trees (Stewart 2003).

BANKHEAD NATIONAL FOREST, northwestern Alabama (Winston and Lawrence Counties)

Many scattered areas of old growth. The Bankhead is a dissected plateau that includes deep ravines that have not been logged heavily, Jim Huntley told us in 1993. Mary Burks noted that loggers would not always go all the way up the streams in the little canyons that end in waterfalls (1990). More recently Ken Wills wrote that "Many steep narrow canyons and heads of many large canyons throughout the [Sipsey] wilderness and forest contain small patches of old growth with tulip poplar, hemlock, and beech. . . . A few dry coves and ridge tops scattered across the forest support old-growth oak-hickory forest" (Wills 1999). Rhonda Stewart of USFS speaks of three types of old growth: hemlock-dominated forest, hardwoods-dominated slope forest, and a few calcareous riparian drains (Stewart 2003). Specific areas identified by researchers include:

--Bee Branch Gorge, in the 25,000-acre Sipsey Wilderness (Lawrence County). Stands of unlogged or very lightly logged forest on 150 acres along the upper portion of the 2-kilometer creek. A Research Natural Area embraces 128 acres of the old growth. The dominant trees are Eastern Hemlock and American Beech. The population of Eastern Hemlock is disjunct, as is a population of Sweet Birch. Tulip Tree is also important. The dominant shrub species are catbriers, Muscadine Grape, and Mountain Laurel. The rare Diana Fritillary Butterfly is present (Bailey 1990, Graham 1990, Hardin and Lewis 1980, US Forest Service [n.d.], Devall and Ramp 1992, Federal 1977).

--Buck Rough Canyon,* adjacent to Bee Branch Canyon. Easily 120 acres of old growth. The exact acreage is difficult to calculate, because it is not continuous (Stewart 2003). Ken Wills reports that Buck Rough contains as "impressive virgin or near virgin old growth forest" as Bee Branch. Trees in Buck Rough include Tulip Tree, White Oak, and Eastern Hemlock (Wills 1999). Jim Manasco believes that Bee Branch Gorge and Buck Rough Canyon have the only "virgin old growth of any size" (2003).

--Flint Creek.* Probably at least 100 acres of old-growth calcareous, riparian forest along the creek. The old growth is dominated by beech and butternut. Trilium carpet the area (Stewart 2003).

--Indian Tomb Hollow.* Some 50 or 60 acres of old growth, occupying roughly one-quarter of the canyon. The other three-fourths of the canyon have been farmed (Stewart 2003). The old growth is mainly oak-hickory, but the canyon also supports a small area of mixed mesophytic cove hardwood forest on rich soils derived from sandstone (Wills 1999). Manasco notes that the old growth would have been selectively logged, because the area has been settled a long time (2003).

--Brushy Creek Canyon.* Pockets of old growth, each 20 or fewer acres in extent. Hemlock dominates. Tulip Tree and Bigleaf Magnolia are also present. Conditions are very mesic (Stewart 2003).

--Rush Creek Canyon.* Patches of old growth similar to those in Brushy Creek Canyon (Stewart 2003).

--Turkey Creek Canyon,* in the Sipsey wilderness. Likely old growth. Ken Wills reports "an impressive old-growth hemlock-beech forest" (Wills 1999). Two other researchers to whom we talked have not visited the Canyon.

TALLADEGA NATIONAL FOREST

--**Shoal Creek District**, eastern Alabama (Clay and Cleburne Counties). Pockets of old growth scattered through the district east and north of Cheaha State Park. Old-growth montane Longleaf Pine grows in stands averaging 10 to 40 acres in size. Pockets of dry hardwoods, with Chestnut Oak and Scarlet Oak, generally less than 20 acres in size, are found. The district also supports pockets of American Beech, Bigleaf Magnolia, and Loblolly Pine on mesic north- and east-facing slopes, and never-logged pockets of huge native Loblolly Pine. On Rattlesnake Mountain are relict montane Longleaf Pine and relict Shortleaf Pine up to 300 years old. The areas of pine, one of which is well over 40 acres in extent, have a shrubby underlayer of Mountain Laurel. (Stewart 2003).

--Talladega District, east-central Alabama (Clay and Talladega Counties). Pockets of old-growth hardwoods. The pine was much more heavily logged on the Talladega District than on the Shoal Creek District. The 9000-acre Dugger Mountain Wilderness has, along with old-growth hardwoods, only two or three pockets of old-growth pines; those are a mixture of Longleaf and Shortleaf Pine. The land in the Wilderness was largely cut over in 1932 and 1936 just before USFS acquired it (Stewart 2003). Wills describes the north side of Dugger Mountain as supporting "fine examples" of old-growth Shortleaf Pine forest and stands of stunted old-growth White Oak forest (1999).

--Oakmulgee District,* central Alabama (Bibb, Chilton, Hale, Perry and Tuscaloosa Counties). Old growth of several types: cane, mesic hardwoods, longleaf, and possibly cypress-tupelo. Wills reported that the forest contains thousands of acres of Longleaf Pine with significant patches of old growth Longleaf (1999). Stewart, basically in agreement, indicates that Longleaf Pines of the coastal plain type are scattered throughout the district. Most Longleaf has been logged, but a few patches escaped logging. The mid-story has been cut out to manage for the Red-cockaded Woodpecker (2003). Wills also notes that the only tract bordering the Cahaba River contains an oxbow lake with old-growth cypress-tupelo swamp (1999).

------Reed Brake Research Natural Area.* Within the 598-acre Natural Area, pockets of old-growth cane 40-50 acres in extent (Stewart 2003). Some ravines support classic mesic hardwoods, including American Beech, Bigleaf Magnolia, and water oaks, with occasional Longleaf and Shortleaf Pine (Stewart 2003).

Gulf State Park, on the Gulf of Mexico (Baldwin County)

Apparently unlogged coastal vegetation. Park Naturalist Annette Salvatore describes 300 acres of Sand Pine, Slash Pine, and oaks on a sand dune ridge 1 to 2.5 miles inland. Shrubs include Seaside Balm and Sandhill Rosemary. She does not believe that the area was logged, because the trees are "short and scrubby and stubby" from lack of nutrients (1993). Scott Gunn describes the more-than-6000-acre park, with its woody coastal scrub, as "mostly still intact," although it contains some evidence of past human use (1993). Al Schotz of Alabama Natural Heritage characterizes the park as having some old-growth dune systems (2003).

Coon Gulf TVA Small Wild Area,* northeastern Alabama (Jackson County)

Old growth on the steeper slopes of the 2366-acre area. Wills writes of 30+ acres of old-growth Chestnut Oak forest just below the cliff line of the mountain (1999). Fraley gives what she terms a “conservative estimate” of 200 acres for the steeper slopes as a whole (2003).

Redstone Arsenal,* northern Alabama (Madison County)

Possible old-growth floodplain forest a couple of hundred acres in extent within the 38,000-acre arsenal owned by the US Army. The forest shows no signs of cutting but its history is not known. Trees include huge Red Maples and Eastern Cottonwoods. The Army protects all hardwood areas on the base. Also, it does no logging in floodplains (Schotz 2003, Weber 2003).

Solon Dixon Forestry Center,* southern Alabama (Escambia and Covington Counties)

Possible old-growth bottomland hardwoods within the 5300-acre Center owned by Auburn University. The Center, which is located within the purchase boundaries of the Conecuh National Forest, includes a variety of forest types (Wills 1999). Along the Conecuh River are 350-400 acres of bottomland hardwoods. They have been logged sporadically over the past 100 years but may include scattered, undisturbed areas, perhaps 100 acres in total (Johnson 2003). Among the many species of trees are “champion-size” oaks, Spruce Pine, and Planertree (Wills 1999). The likely old growth is not formally protected, but Red Johnson, Director of the Center, says that the Center intends to protect it (2003).

Fort McClellan, northeastern Alabama (Calhoun County)

Twelve stands of old-growth montane Longleaf Pine totaling 101 acres, delineated by researchers from Auburn University (Kush 2001), and examples of old-growth Chestnut Oak forest (Wills 1999). Fort McClellan is an inactive 18,000-acre US Department of Defense Army base. The Longleaf stands vary in size from one acre to more than 40 acres. (Old-growth Longleaf is here defined as Longleaf containing age clases that predate settlement of the area, ie about 1840) (Kush 2001). The montane Longleaf Pine is the same species as the Longleaf Pine that grows in the Atlantic and Gulf Coastal Plain. However, because of different growing conditions, the montane Longleaf acts differently, seeding each year.

A montane Longleaf Pine ecosystem is a mosaic of forest types. The Longleaf itself grows for the most part on south and southwest facing slopes and low ridge tops. Other components include Virginia Pine, Shortleaf Pine, Blackjack Oak, and Chestnut Oak. Most of the old-growth Longleaf stands are on ridges in the mountains where logging did not take place because of their physical inaccessibility or because they were in the line of military fire. Varner et al. estimate that the 40,000-acre fort currently supports 2000 acres of pure Longleaf Pine. Burning is infrequent and erratic. Thus, much previous Longleaf has succeeded to hardwoods. The Fort could perhaps support as much as 12,000 acres of pure Longleaf, given “aggressive fire management, harvesting, and planting” (2000).

Fort McClellan has been demilitarized. The military is conveying to the US Fish and Wildlife Service 7646 acres to create the Mountain Longleaf National Wildlife Refuge, which will be established no later than June 2003. As of January 2003, USFWS was seeking partners to acquire an additional 5000 acres of the military base (Viker 2003). The initial 7646 acres include 79 acres of the delineated old growth. Another 19 acres of the old growth are just outside the current Refuge boundary, and USFWS hopes to be able to acquire them in the future. Nevertheless, significant natural stands of high-quality old growth will be lost, as a four-lane highway will cut through the southwest portion of the Fort. The highway will obliterate some stands and maroon others between the highway and the city of Aniston (Garland 2001, 2003).

Bon Secour National Wildlife Refuge, Fort Morgan Peninsula in southern Alabama (Baldwin County)

Possibly old-growth barrier island vegetation of uncertain extent within the 6700-acre Refuge's Perdue and Little Point Clear Units. A long-timer in the area told the Refuge's director that pines in all units of the Refuge were logged more than 60-90 years ago. The Live Oaks and magnolias, on the other hand, are very old and have never been cut. A hurricane in 1906 sent salt water over the entire island and caused almost every pine living at the time to die. Many other trees, including cypress, were uprooted (Askins 2003). Swamps with Swamp Bay, Black Titi, and other wetland species, are scattered through the island's upland (Carroll 1993). We have not been able to learn their history.

Alabama River between Selma and Montgomery* (Autauga County)

Potential old growth on mesic, very steep slopes, along the Alabama River, in particular between Jones Bluff and House Bluff. Vegetation includes oaks, beech, and three-foot-in diameter Tulip Trees. Very big Loblolly Pines grow at the bottom of the slopes (Schotz 2003).

Big Woods,* northeastern Alabama (Etowah County)

Sixty or seventy acres of privately owned old-growth Appalachian hardwoods, divided into two parcels. The only logging in the 40-acre parcel was removal of Tulip Trees, which were cut a hundred years ago. The Nature Conservancy holds a conservation easement (Schotz 2003).

Cheaha State Park, east-central Alabama (Cleburne County)

Pockets of old growth, usually dominated by hardwoods, in inaccessible areas. Of particular interest are old-growth hardwood-dominated boulder fields. Trees in the boulder fields include White Oak, Northern Red Oak, Chestnut Oak, and relict montane Longleaf Pine. Virginia Pine may dominate at the edges. The boulder fields may be as much as 50-60 acres in size and are moving slowly, if at all (Stewart 2003). The state park is in the middle of Talladega National Forest and adjoins the National Forest's Cheaha Wilderness.

Tensaw Delta, southwestern Alabama (Baldwin County)

Possibly small areas of old growth (Robert Burks 1993, Mary Burks 1993, Bailey 1990, Lyons 1993, Gunn 1993). However, Al Schotz points out that the trees grow back quickly here so it is not always easy to tell where logging occurred. Baldcypress trees were high graded (Schotz 2003).

Flomaton Natural Area, central-southern Alabama (Escambia County)

Fifty-eight acres of never-logged Longleaf Pine, with trees more than 300 years old (Kush 2001). US Highway 31 bisects the stand, formerly known as the Hauss Natural Area. The site was not burned between the 1950s, when Champion International acquired it, and the mid-1990s. As a result, other species of pine grew into the overstory and a "substantial hardwood understory and midstory developed" (Kush 1998). In 1993 a fire killed 91% of the Longleaf greater than 15 inches dbh,(diameter at breast height) due to the deep pine needle litter at the bases of the trees (Varner et al. 2000). Champion has entered into an agreement with Auburn University, The Nature Conservancy, USFS's Southern Research Station, and other entities to cooperate in regard to restoration management, education, and research on the forest. A restoration program including controlled burns and hardwood harvesting began in 1994 (Kush 1998, 2000, and 2001).

Perry Lakes Park and Wildlife Sanctuary,* central Alabama (Perry County)

In a 600-acre park and sanctuary, approximately 50 acres of old growth with very big oaks and Loblolly Pine. The stand surrounds three oxbow lakes formed when the Cahaba River changed its channel. Perry County owns the site. The Nature Conservancy owns the adjoining 125-acre Barton's Beach Preserve (Schotz 2003).

Dismal Wonder Gardens,* northwestern Alabama (Franklin County)

Old-growth hemlock and hardwoods within a private park of approximately 300 acres. The old growth, which includes Bigleaf Magnolia, is in a 100-200 foot deep canyon bounded by high sandstone bluffs or cliffs. The park is open to the public (Schotz 2003, Wills 1999, Dalrymple 2001).

Monte Sano Mountain,* near Huntsville in northern Alabama (Madison County)

Small areas of old growth within the 2140-acre Monte Sano State Park and 540 adjacent acres owned by the city of Huntsville but managed by the Huntsville Land Trust. Limestone slopes with rich soils support scattered patches of old-growth mixed mesophytic cove hardwoods (Wills 1999). The best example of old growth, however, is the city's 20-acre Cold Springs Natural Area, where old-growth Northern Red Oak-Black Oak forest and mixed mesophytic cove hardwoods grow. Here are found the national champion White Basswood and the state champion Cucumber Tree, Yellow Buckeye, and Spicebush (Wills 1999, Gardner 1999, Weber 2003).

Tennessee Valley Authority (TVA) Land on the Tennessee River,* northeastern Alabama (Jackson County)

Possible old growth on the opposite side of the Tennessee River from TVA's Bellefonte Power Plant. Wills reports that on the lower slopes of the limestone mountain is a patch of old growth containing cedar barrens with examples of the rare Smoke Tree. The narrow floodplain/terrace between the cliffs and the river, and the toe of the slope, support old-growth mixed mesophytic cove hardwoods and big examples of bottomland trees, including the sycamore and Green Ash (Wills 1999). TVA's Nancy Fraley does not know of old growth in this location (2003).

Pisgah Gorge,* northeastern Alabama (Jackson County)

Old growth in the bottom of a gorge on TVA land, southwest of the Bellefonte Power Plant. The bottom of the gorge was not accessible to loggers. TVA's Nancy Fraley cannot confirm the old growth but believes that it may be present (2003).

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DELAWARE

The Delaware Natural Heritage Inventory has in the past conducted a limited amount of field work to identify "old-growth" forests within the state's three counties, New Castle, Kent, and Sussex (McAvoy 1993, 2001). Now the Natural Areas Program of the Division of Parks and Recreation is carrying out an identification project with photographs. It has mapped the state with aerial photographs and will compare them with aerial photographs made in 1937. The greatest clearing in Delaware occurred about 1880. Forest that had a mature canopy in 1937 and that shows up in all subsequent aerial photographs must be at least mature second growth. The comparisons will thus tell field researchers where to look for old growth. The Natural Areas Program expected to complete its study of the photographs in late 2002 or early 2003 (Line 2002).

Researchers believe that most mature to old-growth forests in Delaware are located in northern New Castle County in the piedmont physiographic region. Known sites here have not been disturbed for 100 to 200 years and are in the form of fragmented woodland in six stream valleys. Usually Tulip Tree or American Beech dominates the stands. Black Oak, Northern Red Oak, White Oak, and hickories are often mature canopy associates (McAvoy 1993, 2001).

Most mature to old-growth sites identified in the piedmont are in private hands. An exception is **Tulip Tree Woods**, with trees up to 220 or more years in age, which is a 24-acre, state-dedicated natural area in Brandywine Creek State Park (McAvoy 1993, 2001). The density of the Tulip Trees suggests that the site may have been cleared long ago, however (Line 2002). Furthermore, because of a “horrendous” deer population, the trees are not reproducing (Kaden 2001).

In Kent County to an even greater extent than in the remainder of the state, forestry, development, and agriculture have fragmented and eliminated woodlands. Nevertheless, three mature to old-growth sites have been identified. Two of the sites are described below. The third site, in the **Bombay Hook National Wildlife Refuge**, consists of approximately 20 acres of mature to old-growth mixed hardwoods, with a variety of oak species (Northern Red, Chestnut, White, and Southern Red) as major elements in the canopy. It has a sparse understory, with Flowering Dogwood and Spicebush common in the shrub layer.

Sussex County, Delaware's southernmost county, contains at least three types of mature to old-growth forest: Baldcypress swamps, Atlantic White-cedar swamps, and Loblolly Pine woods (McAvoy 1993, 2001). However, Sussex County has been ditched. As a result, the county is left, for the most part, with old trees rather than with functioning ecosystems (Martin 2001).

The James Branch, a tributary of the Nanticoke River, supports an extensive population of Baldcypress, near the northern limit of its native range. Researchers have found 60 to 70-foot trees with large, buttressed bases and tall, widely dispersed "knees" (McAvoy 1993, 2001). What appears to be the oldest and largest Baldcypress in James Branch is estimated to be over 540 years old (Kaden 1998) and is 50 inches in diameter above its buttress. The cypress, which grew along mill streams, are not reproducing, because of changes in the water regime (Martin 2001). James Branch Nature Preserve protects five miles of the riparian corridor of James Branch.

Most of Delaware's Atlantic White-cedar swamps are in Sussex County along stream corridors. Researchers have identified mature to old-growth stands with trees estimated to be more than 100 years old, with dbhs (diameters at breast height) of 20 inches, and heights of up to 90 feet (McAvoy 1993, 2001). A stand of Atlantic White-cedar near Milton is believed to be almost 250 years in age (Kaden 1998).

Mature to old-growth Loblolly Pine sites have been identified in the Inland Bays region and within the drainage of the Nanticoke River. Here the pine is near the northern limit of its native range, yet it reaches up to 30 inches in diameter and up to 80 feet in height. Mature specimens of Loblolly Pine are scattered throughout the Assawoman State Wildlife Area. A mature to old-growth Loblolly Pine site is **Barnes Woods**, a 23-acre state-dedicated natural area on a tributary of the Nanticoke. As far as is known, the only logging that Barnes Woods has suffered was selective cutting in the 1920s. Geologic investigations have shown that the soils of the Woods have never been tilled. Acreage of the Loblolly Pine sites is small (McAvoy 1993, 2001).

The Great Cypress Swamp in southern Sussex County is an approximately 9500-acre preserve of contiguous forest owned by the private conservation group Delaware Wild Lands. Though it is not now considered to be either old growth or mature, it includes remnant, mature, individual Baldcypress and Loblolly Pine trees up to 120 years in age (Martin 2001). Before timbering, fire, and agricultural drainage, the Great Cypress Swamp covered 50,000 acres.

Preservation of the 10,000-acre remnant ensures that in the future Delaware will have an extensive area with old-growth characteristics (McAvoy 1993).

Milford Neck Conservation Area,* eastern Delaware (Kent County)
Within the 10,000-acre Conservation Area, some 60-65 acres of old-growth Loblolly Pine spared by loggers (Martin 2003). The loblollies are 32 inches in diameter at the base, between 115 and 120 feet tall, and on average between 140 and 150 years in age (Kaden 1998). The stand may have originated after fire. Loblolly are scattered through hundreds of additional acres. Fire has been suppressed, and the Gypsy Moth has ravaged the oaks that grew up in the stand.

The pines are on 3600 acres belonging to Delaware Wild Lands. The state, The Nature Conservancy, and Delaware Wild Lands banded together to purchase the Conservation Area. They divided the land among themselves, but collaborate on land management. Delaware Wild Lands is unable to initiate prescribed burning in the area of the pines, because their land is split up into parcels among which houses and farms are interspersed (Martin 2003).

American Beech Forest, just west of Dover (Kent County)

An old-growth forest composed largely of American Beech. Additional trees include Tulip Tree, White Oak, and Northern Red Oak. The trees are estimated to be more than 140 years in age (McAvoy 1993). The old growth has been characterized as 8 acres (Line 2002) and as approximately 50 acres (McAvoy 1993). The private owner would like the site to be preserved; and, as of early 2003, the state was trying to find the money to purchase 300 plus acres that include the beech forest (Kaden 2003).

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FLORIDA

Florida has an impressive land acquisition program, which has preserved extensive old-growth tracts as well as other biologically significant lands. The main source of funding for purchases has been the state Preservation 2000 program and Florida Forever program. Preservation 2000 provided state funding of $300 million a year from 1990-1999 for conservation projects of various types. P2000, as it was called, made possible the purchase of one million acres of Conservation and Recreation Lands (CARL). In 1999 the Florida legislature extended formal, permanent protection to these lands and also established the successor to Preservation 2000, the Florida Forever program focusing on land acquisition, environmental restoration, and water resource protection. If funded as anticipated, Florida Forever will provided $300 million a year from 2000-2009 for projects in these areas.

A revision to the management plan for the National Forests in Florida was completed and a record of decision was signed in 1999. The revision designates as future old growth 10,200 acres of upland Longleaf Pine forest; 11,000 acres of southern wet pine forest, woodland, and savannah; 17,700 acres of cypress/tupelo swamp forest; 2900 acres of river floodplain hardwood forest; 24,200 acres of hardwood wetland forest; 2200 acres of dry and dry mesic oak/pine forest; 1700 acres of coast plain upland mesic hardwood forest; and 2100 acres of dry and xeric oak forest, woodland, and savanna (USDA 1999).

We do not describe individual mangrove stands, although Florida has an estimated 495,000 acres of mangrove swamps which include old-growth forest. The old-growth acreage is uncertain. The swamps, found along the coasts of the southern peninsula, are composed of Red, White, and Black Mangroves, and Buttonwood. Most of the swamps are in designated, protected areas, including Big Cypress Preserve, Everglades National Park, Rookery Bay National Estuarine Reserve, and various National Wildlife Refuges, National Monuments, and state aquatic reserves. Few swamps are in private hands, since most mangrove swamps are submerged sovereign lands that belong to the state.

Nobody knows how long individual mangrove trees live if not damaged by storms. Some species may live 250 years; others probably have shorter lives (Smith 1993). The size of trees varies with the habitat. Mature mangroves may be more than 60 feet or less than 4 feet tall. Mangrove swamps are important as habitat for many animals listed as Endangered, Threatened, or "of concern," including the American Crocodile, Hawksbill and Atlantic Ridley Sea Turtles, Florida Manatee, Bald Eagle, Brown Pelican, Atlantic Salt Marsh Snake, Eastern Indigo Snake, Key Deer, and Florida Panther (Odum and McIvor 1990).

Ariel Lugo discusses mangrove forests as old growth, and notes that the history of a site and the dynamics of the local coastal system help determine whether a particular mangrove forest is old growth. Furthermore, a distinction needs to be made between old-growth mangrove systems and old-growth mangrove tree stands. Old-growth systems consist of trees, which may be young or dwarfed, and of deep organic peat produced by generations of mangroves. A tree stand growing on young peat or on another substrate should be considered to be old growth if the age and stand characteristics so indicate (Lugo 1997).

In presenting old-growth sites below, we divide the state into three sections: the panhandle, the northern and central peninsula, and the southern peninsula and the Keys.

FLORIDA PANHANDLE

Apalachicola National Forest, southeastern Panhandle (Gulf, Franklin, Liberty, and Wakulla Counties)

--Pond Cypress Swamps. Thousands of acres of virgin Pond Cypress growing in patches that may be several hundred acres in size. The trees are gnarled, old, and generally stunted, but sometimes 50 feet tall. In some places they are like bonzai trees (Simons 1990).

--Tupelo Swamps. Probably uncut tupelo swamps, with Water Tupelo, Swamp Black Gum, and Ogeechee Tupelo, particlarly in the floodplains of the New River, Apalachicola River, and Ochlockonee River. Loggers did not find tupelo attractive until recently (Anglin 1993, Alderson 2001).

--Slash Pine Tracts, in Bradwell Bay Wilderness (Wakulla County). The Florida Natural Areas Inventory sets the size of a Slash Pine-gum swamp in Bradwell Bay at roughly 100 acres. Bob Simon thinks this tract may be the best virgin Slash Pine left, and that it is larger than 100 acres (NeSmith 1990, Simons 1990). Gary Hegg reports that there are probably also small, unlogged islands (drier areas within a swampy area) with Slash Pine. One particular

island he has seen is 7 to 10 acres, with Slash Pine, an understory of swamp species on the wet ground, and, on drier ground, a thick understory of Titi and Gallberry (1993).

Eglin Air Force Base, southwestern and south-central Panhandle (Santa Rosa, Okaloosa, and Walton Counties)

--Old-growth Longleaf Pine-Turkey Oak-grasses, within 400,000 forested acres. Eglin has 4 "Special Natural Areas" identified as remnant stands with significant old-growth Longleaf Pine, totaling 6795 acres. There are numerous other stands of old growth scattered throughout the reservation totaling an as yet undetermined acreage, likely ranging in the thousands of acres. In addition to Eglin's more pristine old-growth forests, approximately 200,000 acres have a Longleaf Pine old-growth component with a dense population of Red-cockaded Woodpeckers, and are frequently burned. These forests with old-growth characteristics typically contain 3 to 5 trees >150 years old per acre and have an uneven-aged size class distribution resulting from historical land use practices of the US Forest Service, the previous land management agency, from 1908 to 1940. Turkey Oak is the main species in the sparse understory, where it is often associated with Live Oak and Post Oak. Wiregrass is poorly represented except in areas with clayey soils --probably a natural situation. Several perennials, including dropseed and bluestem, fill its place beneath the Longleaf Pines and Turkey Oaks.

All four stands listed below were used as a minor source of timber products early in the century. They also underwent cutting to remove wind-damaged and fire-damaged trees. Roads and utility line right of ways pass through them. They have burned at times, sometimes because of fires started by weapons testing, but not enough to prevent the hardwood component of the stand from being thicker and larger than it would naturally be. The grasses in the ground layer have thus been, to varying degrees, shaded and suppressed.

Nevertheless, the four areas have not been heavily modified by forestry activities, and the Longleaf Pine-Turkey Oak-grasses system seems to be basically intact in terms of composition and structure. Management has reintroduced frequent fire as a maintenance and restoration tool. The four currently designated areas follow. Each of the first two harbors Red-cockaded Woodpeckers.

----Patterson Natural Area Old Growth. Next to a test range, 5018 acres of old growth. The area has enjoyed occasional wildfire. Prescribed burning was introduced during the growing seasons of 1991 and 92, resulting in some mortality to the old-growth Longleaf Pine. Longleaf Pine range in age from 100 to 500 years, with the average in the older part of the stand, 160 years. The average dbh (diameter at breast height) is 16 inches; the largest is 28 inches. The western "foot" of the area supports an excellent stand of Wiregrass as soils increase in silt content.

----Field One Old-Growth Sandhills. A 1252-acre area in which the absence of fire allowed mixed oaks and Sand Pine to grow up thickly. Aggressive fire reintroduction and Sand Pine removal in this stand has helped to restore the old-growth structure.

----Brandt Pond Old-Growth Sandhills. Three hundred eighty-two acres, it has had infrequent fire and has also become overgrown.

----White Point Flatwoods Old Growth. An "isolated 143-acre remnant stand" with dense groundcover of Wiregrass, Gallberry, and Saw Palmetto (Hardesty 1993, Claypool 1993). This stand's boundary lies along the Choctawhatchee Bay and has many individual trees in excess of 350 year old.

--**Sand Pine stands*** (in addition to the Longleaf stands) that have probably experienced very little human disruption. They are found "in a matrix of Sand Pine stands of different age classes" in a "strip parallel to the coast on old dunes." Outcalt sampled two stands as an example of old-growth Choctawhatchee Sand Pine. The biggest trees were 80 years old (1997a). Outcalt notes that a 1910 survey showed that the Choctawhatchee National Forest, which became Eglin Air Force Base, had 9040 acres of Sand Pine type. Before World War II when the National Forest was taken over by the military, there was "very little market for sand pine." Therefore the 9040 acres were presumably little disrupted (Outcalt 1998). Sand Pines have invaded some sandhills sites at Eglin due to the decrease in natural fire (Outcalt 1997a).

--**Floodplain and bottomland forest** on the south bank of the Yellow River. The strip of floodplain and bottomland on the military reservation is approximately 10 miles long and 1 to 2 miles wide. The most disrupted areas would be those nearest roads and the river. Probably the strip includes pockets that have not been cut at all; the remainder was probably cut selectively before 1900. Tree species include Baldcypress, Sweetbay, magnolia, Spruce Pine, and tupelo. The north bank of the river is in private hands (Eilers 1993, Hassell 2002).

Tate's Hell, southeastern Panhandle (Franklin and Liberty Counties)

Approximately 2000 acres of basin swamp, containing areas of uncut, stunted Pond Cypress. The two main areas are each about 230 acres in extent; several other areas support scattered Pond Cypress. The trees are commonly 4 feet in diameter at the base but less than 15 feet tall. The US Soil Conservation Service has estimated the age of the trees as 275 to 300 years. Since 1993 the state has acquired 145,000 acres of Tate's Hell to form Tate's Hell State Forest. The balance of the swamp is privately owned (Hegg 1993, Johnson 1993, Knight 1993, Dedrick 2002).

Yellow River Purchase,* western Panhandle (Santa Rosa County)

Possible old growth within an 11,000-acre area that in April 2003 the state was negotiating to purchase. Most of the 11,000 acres are flood plain in the basin of the Yellow River. The state did not know in April 2003 what it would find on the land, but biologist Harold Mitchell told us that it will "certainly be a magnificent property" (Mitchell 2003).

Torreya State Park, eastern Panhandle (Liberty County)

Within a park of approximately 10,000 acres, old-growth bottomlands and possibly upland old growth. The upland old growth would be a narrow band of 100 or more acres of beech-magnolia and Spruce Pine and oak on steep land. Dennis Hardin spoke of a possible 100 acres (1990). According to Jim Stevenson, the park has an upland area without stumps (1990). Bill Sweeney has written that the park may have as much as 200 acres of old growth on steep forested slopes (2003). Harold Mitchell does not think that the park contains upland old growth, but points out that a floodplain swamp next to the river in a corner of the park that was an out parcel, supports immense Baldcypress that were never cut and that a 400-acre addition to the park recently purchased from the Neal Lumber Company , is approximately half old growth, with Baldcypress, Water Oak, and American Sycamore (Mitchell 2003, Sweeney 2003). Torreya State Park contains numerous endemics, including *Torreya taxifolia*.

Edward Ball Wakulla Springs State Park, southeastern Panhandle (Wakulla County)

A park of approximately 5000 acres with about 1300 acres of beech-magnolia hammock, of which 200 or 300 acres have never been logged and 400 or 500 acres are a little over 100 years old. The hammock has an unusually high diversity of tree species though not of herbs. Because of the thick shade, the ground is almost bare. Trees include White Oak, Eastern Hophornbeam, Sweetgum, Laurel Oak, and Red Bay. Along a river are many Baldcypress. The older trees, probably 400 to 500 years in age, are in the deeper water and probably for that reason were not cut; overall, however, half of the cypress in the original stand have been removed (Whitehouse 1993, Gatewood 1993).

The state just added to the park approximately 2000 acres (the park was previously 2860 acres) around the Cherokee Sink area. There is speculation that the additional acres include uncut forest, but the area has not yet been surveyed for old growth (Mitchell 2003).

St. Joseph Peninsula State Park, southeastern Panhandle (Gulf County)

Unharvested areas within a 1761-acre wilderness preserve on a peninsula that used to be a barrier island. According to Leo Minasian, the Sand Pine scrub on dunes in the wilderness is undisturbed (1993). Jim Stevenson described the Slash Pine, also in the wilderness, as probably never cut. The Slash Pine stand contains no visible stumps and was not big enough to have appealed to loggers (1990). Anne Harvey, the park manager, agrees. Turpentine was collected; the Spanish may have cut hardwoods in the 1700s; and cattle grazed in the 1800s; but the pines do not appear to have been logged (2002).

Apalachicola Bluffs and Ravines Preserve on the Apalachicola River, eastern Panhandle (Liberty County)

Two to three hundred acres of old-growth mixed hardwoods and pine on the steep bluffs and ravines of the 6248-acre preserve. Oak and hickory were probably removed before 1940. Nevertheless, the preserve likely has trees 200 years old that are original. The site contains numerous endemic and disjunct species, and probably more species of plants and animals than any area of equivalent size in the Gulf Coastal Plain (Gatewood 1990 and 1993, Hardin 1990). Kwit et al. studied three ravines: Beaverdam Creek, Little Sweetwater Creek, and Kelley Branch. They found a difference in species between slopes with Florida Yew and those without. "Forests in midslope regions of north-facing steephead slopes that contain adult *T. floridana* more closely resembled the classical definition of the southern mixed species hardwood type," with "a mixture of evergreen and deciduous species in the overstory and understory," than did forests on other slopes in the Bluffs region. They speculate that human activity, including logging between ravines and along upper slopes, which caused erosion and drying of the soil, may have limited the

distribution of Florida Yew (Kwit et al. 1998). The preserve is owned by The Nature Conservancy. In 2002 American Rivers designated the Apalachicola River as one of America's Most Endangered Rivers (TNC 2002).

The state of Florida plans to buy three tracts of land on the upper Apalachicola River. One, the 9145-acre Sweetwater Creek Tract, which "includes some of the deepest steephead ravines in the state, with unique hardwood forests," will connect the Nature Conservancy preserve with Torreya State Park (FDEP 2002).

Naval Live Oaks Reservation, in Pensacola, southwestern Panhandle (Escambia County)

About 200 acres of old-growth coastal Live Oak within a reserve, now owned by the National Park Service (NeSmith 1990, Oetting 2002). There are many Live Oak hammocks along the Florida coast. These hammocks were usually logged for species other than Live Oak, and the oak left standing. Since the logging took place long ago, researchers looking at coastal hammocks have difficulty reconstructing their history (Simons 1990). Researchers assume the Pensacola hammock was selectively cut.

Topsail Hill, south-central Panhandle (Walton County)

A block of land fronting for about 4 miles on the Gulf of Mexico and extending a mile inland, with old growth. Walking away from the ocean, one crosses a beach; sand dunes as high as 44 feet with coastal oak scrub and magnolia; swales and globaly rare coastal dune lakes, one 50 and one 80 acres in extent and filled with pure water; coastal wet flatwoods; mesic flatwoods; and finally scrubby flatwoods. The canopy species in the flatwoods is Longleaf Pine. Patches of the pine are old growth, inhabited by Red-cockaded Woodpeckers, though with scars reflecting past tapping for turpentine. Within the block is an old-growth Live Oak, magnolia, hickory maritime hammock more than 10 acres in size. As of January 2003, the state owned 1700 acres of the area as Topsail Hill State Park and was continuing to acquire land there (Hardin 1993, Johnson 1993, Gatewood 1993, McKenzie 2003). Research is being conducted on the area's wildlife (Mitchell 2003).

Fred Gannon State Park,* near Niceville (Okaloosa County)

A 357-acre park, about one-third of which is Choctawhatchee Sand Pine, which Kenneth Outcalt describes as "a good example" of old-growth conditions for this species (1997a, 1998). According to a park ranger, the Sand Pine has apparently not been logged. Large, mature pines tower over shrub vegetation, including scrub oaks and Rosemary. The park is separated from Eglin Air Force Base only by a strip of privately owned land. The state obtained management of the 357 acres in 1996 through a lease with USFS (Peredoy 2002).

Woodyard Hammock, northeastern Panhandle (Leon County)

A 74-acre (30 ha) old-growth southern mixed-hardwood forest (Batista 1998). The area suffered some salvage but little if any cutting and supports trees more than 300 years old (Hermann 1990). American Beech, Southern Magnolia, and Spruce Pine are prominent in the overstory; American Holly and Sweetgum in the understory (Peters and Platt 1996). The site is owned by Tall Timbers Research Station (Hermann 1990).

THE NORTHERN AND CENTRAL PENINSULA

Waccasassa Bay State Preserve , on the Gulf Coast near Cedar Key (Levy County)

A 27-mile long, 30,784-acre preserve (of which 6775 acres are below water) with a coastal hydric hammock that was selectively logged for pine, cypress, and cedar around 1900 but that still shows many old-growth characteristics and is largely intact from an ecological standpoint. Trees in the hammock include Cabbage Palm, Southern Red-cedar, and Live Oak. Located between Georgia Pacific's Gulf Hammock property and the Gulf of Mexico, the hammock is sometimes flooded, but grasses cover much of the ground. On the edge of the hammock is a strip of coastal savanna. Along the Gulf are salt marshes, with occasional Cabbage Palm and islands of red-cedar. The Florida Department of Natural Resources owns the preserve (Gatewood 1993, Morgan 1993, Perry and Perry 1992).

William Beardsall Tosohatchee State Reserve (Orange County)

--Cabbage Palm Hammocks. About 2000 acres of Cabbage Palm hammocks, of which at least half are virgin, except for past cattle grazing and a somewhat lowered water table. The remaining acres originally bore a mixture of Cabbage Palm, Eastern Red-cedar, and Live Oak; fire or logging removed the Eastern Red-cedar and Live Oak. The

uncut areas were originally pure Cabbage Palm. The palms are tall, but they have no annual rings so their age is unknown. Research suggests that grazing would not have greatly affected this type of community (Simo ns 1990). The reserve is owned by the Florida Department of Natural Resources.

--Jim Creek Cypress Swamp. One thousand virgin acres in a 2000-acre floodplain cypress swamp. Baldcypress is the dominant tree. Other important trees are Black Gum, Red Maple, Pumpkin Ash and/or Carolina Ash, Dahoon Holly, and Cabbage Palm. The area has undergone hydrological manipulations and grazing; but, as with the Cabbage Palm hammocks, the grazing has not had a major impact. The cattle move through cypress-hardwood s wamp fast, because they do not find much to eat. They do more damage in areas dominated by pine and in hammocks other than palm (NeSmith 1990, Simons 1990, Stevenson 1990).

--Beehead Ranch Pine Flatwoods . Twenty to forty acres of Slash Pine mingled with Cabbage Palm in a 600-acre mesic flatwood area. The large trees are said to be 250 years old. The understory is Saw Palmetto-Wiregrass. The Florida Natural Areas Inventory characterizes this stand as "virgin" (NeSmith 1990). Jim Stevenson describes 40 acres of old-growth Slash Pine in Tosohatchee, probably the same stand, as having had selected trees removed, although the standing trees are original (1990). Florida's flatwoods were cleared decades ago, except for a few remnants, most of which are now surrounded by conifer plantations (Mitchell 1990).

Hendrie Ranch, central peninsula (Highlands County)

Approximately 1000 acres of Rosemary balds, Sand Pine forest, and oak scrub that has never been cut and probably has not been grazed by livestock. The old-growth scrub is on the southern tip of the Lake Wales Ridge. In a lowland is extensive additional acreage with bay tree swamp, pine flatwoods, and oak hammocks, which have been grazed by livestock. The ranch is privately owned (Lohrer 1993).

Archbold Biological Station, central peninsula (Highlands County)

At an independent ecological research facility on the southern end of the Lake Wales Ridge, 1050 acres, the Station's original property, that, according to the Station's Fred Lohrer, have never been lumbered, grazed, or tapped for turpentine. The balance of the approximately 5000 acres at the Station, the west sections, were logged for Slash Pine, and perhaps some Longleaf Pine, some time between 1933 and 1935, based on photographs in the Station archives, although not all trees were cut. The principal habitats in the uncut area are a) southern ridge sandhill (Slash Pine, Turkey Oak, Scrub Hickory, and an occasional Longleaf Pine in the tree layer, varied shrubs, and a ground layer in which Wiregrass is common); b) Sand Pine scrub (Sand Pine as the dominant tree, oaks or Rosemary in the shrub layer); c) scrubby flatwoods (an association of shrubs with an occasional Slash Pine); d) flatwoods (Slash Pine, Saw Palmetto, Gallberry, and Wiregrass); e) bayhead (evergreen forest of mixed bays); and f) swales and seasonal ponds. (The largest stand of bay trees in the Northwest Tract of the original property was burned, after a prescribed fire escaped, in 1999.) The Station harbored 12 plants on the federal Endangered and Threatened lists as of March 1993, including Lake Placid Scrub Mint, Wedge-leaf Button Snakeroot, Scrub Blazing Star, Hairy Jointweed, Carter's Mustard, and Papery Whitlow-wort. The Station uses fires to maintain fire-dependent communities. (Lohrer 1992, 1993, and 2002; Abrahamson et. al. 1984; Main 2003).

Platt Branch Mitigation Park,* central peninsula (Highlands County)

Two thousand acres of pine flatwoods, half Longleaf Pine and half Slash Pine, including old- growth savanna. The distribution of the trees is natural. The Slash Pine, which gradually takes over from the Longleaf Pine as the land gets wetter, is located in the wetter portion of the site. In the 1920s and 30s, turpentine was probably extracted. Probably some logging was done after the turpentining; and in the 1970s, 80 acres were logged. The Park was definitely grazed by livestock. However, it includes 500 to 600 acres of beautiful open savanna with tall, old trees and a fine understory. The pines are regenerating. Today the Longleaf Pine is not logged, although Slash Pine, which are too thick now, may be thinned. Red-cockaded Woodpeckers inhabit the area. The Florida Fish and Wildlife Conservation Commission purchased the Park from a private landowner with funds received as mitigation for disruptive activities elsewhere (Morrison 2002, Shattler 2002).

Dunns Creek State Park,* north-central Florida (Putnam County)

Possible old-growth floodplain forest along five miles of Dunns Creek that flows through the 6222-acre park. Based on aerial photographs, which show no signs of logging, the floodplain has not been logged for at least sixty years. Presumably it experienced logging prior to 1940 but how much and when is not known. Possibly large

Baldcypress were taken out a hundred years ago. Prominent tree species include Baldcypress, Black Gum, Red Maple, Carolina Ash, and Laurel Oak. The park, which the state acquired from The Nature Conservancy in 2001 , encompasses 21 natural communities.

The St Johns River Water Management District owns property for at least two miles on the other side of Dunns Creek Possibly there is old growth on this property also (Miller 2003).

Ocala National Forest, northeastern Florida peninsula (Marion and Volusia Counties)

--Mormon Branch Botanical Area, in Ocala National Forest, northeastern Florida peninsula (Marion County)

----Atlantic White-cedar Stand. About 100 acres of Atlantic White-cedar, in which only a few trees have been cut, as if in acts of vandalism. The cedar are up to 80 feet tall and 3 feet in diameter. Dominant trees in addition to the cedar are Cabbage Palm and Loblolly-bay. Red Maple and Florida Willow are present, as is Needle Palm in the understory. Undine is at its southernmost limit; and the Florida Anise Tree is abundant, even though it is a fairly rare plant (Simons 1990, Miller 2001).

----Hardwood Swamp. Six hundred acres that appear to be a virgin swamp, adjacent to the Atlantic White-cedar stand described above. Red Maple, Swamp Tupelo, and Black Gum are the dominant trees. Underneath is Needle Palm, a Florida endemic (Simons 1990, Miller 2001).

--Extensive areas of essentially undisturbed **Ocala Sand Pine scrub**. More than half of the forest is comprised of the "big scrub." In the big scrub, islands of Longleaf Pine are scattered through a "sea" of Sand Pine. Most of the settlement took place in the Longleaf islands. Thus, the Sand Pine scrub was essentially natural in origin and had not been disrupted by EuroAmericans before the National Forest was created in 1908. Wildfire created a mosaic of shifting age classes (Outcalt 1997a, 1998). Today clearcuts up to 320 acres in size have replaced wildfire in the scrub (USFS 1999) and fragmented the forest.

As of 2001, the Seminole District had 96,000 acres of Sand Pine scrub, of which 10,373 acres had never been logged. Of that 10,373 acres, 2500 acres were protected temporarily or permanently in special management areas such as Wilderness, 4000 acres were to be maintained intact for purposes of old growth, and 3600 acres were available for logging. (Hinchee 2001). The Lake George District has about 120,000 acres of Sand Pine. Five percent of the Sand Pine is to be left unlogged and probably never has been logged (Bailey 2001).

Baldwin Bay Property,* northeastern Florida (Duval and Nassau Counties)

Approximately 2000 acres of old-growth bottomlands within a private property of 7920 acres. The bottomlands show no signs of logging. Some stands there are smaller and younger than others apparently as a result of natural events such as hurricanes and floods. The uplands in the property support pine plantations (Moll 2002). Most or all of the property has been approved for purchase under the Florida Forever program (White 2003).

Old-Growth Hammocks in the Jacksonville Area,* northeastern Florida (Duval County)

Scattered old-growth Live Oak hammocks, generally along salt marshes. Researchers believe that, in what is now northeastern Duval County, fields were cleared for cotton in the 1700s and early 1800s. Here only scattered Live Oaks were left standing. Some small areas, however, were never cleared. The only commercial logging of these areas was the cutting of Live Oaks for ship construction; and the logging was not heavy. These maritime hammocks are still dominated by Live Oaks. Southern Magnolia and Pignut Hickory are the main additional tree species. The hammocks are found in the National Park Service's Timucuan Ecological and Historical Preserve and on adjacent public lands, including areas owned by the City of Jacksonville, by St. Joe's River Water Management Area (White 2003), and by the State of Florida (in particular, Big Talbot Island State Park). Examples are:

--Timucuan Ecological and Historical Preserve . A 46,000-acre area, between the Nassau and St. Johns Rivers. "Only 60 percent is protected public land" (TNC 2003). Parts are owned by conservation organizations, parts by other private entities, and parts by government agencies. The National Park Service is working to purchase unprotected areas within the Preserve boundary. The old growth is primarily located on:

----Fort George Island. A 600-acre island with a strip of old-growth maritime hammock along its eastern edge. Old maps of the island show where fields were cleared and where woods were left standing.

----Black Hammock Island. An island of several thousand acres with old growth maritime hammocks around the perimeter of its southern end, the 100-200-acre Cedar Point. No written records of the logging

history are known to exist (Bryant 2003). White estimates that many of the Cedar Point hammocks are at least 300-400 years in age (White 2003).

--Big Talbot Island State Park. A 2000-acre park, up to one-fourth of which may be old-growth hammock. The hammocks, which are mostly Live Oak, occur in patches across the island. No historical records indicate what was and was not logged (Strickland 2003).

Dun and Register Longleaf Tract, east-central peninsula (Volusia County)

Possibly as much as 800 acres of "old growth (virgin?)" Longleaf Pine. The Natural Areas Inventory found a healthy Wiregrass understory beneath the pine (NeSmith 1990).

Caladesi Island State Park, a barrier island on the Gulf of Mexico (Pinellas County)

A 630-acre uncut area, some of which is Slash Pine forest (Stevenson 1990).

Highland Hammocks State Park, central peninsula (Highlands County)

An approximately 500-acre hammmock that has apparently never been logged and is buffered by flatwoods and marshes. Tree species important in the temperate forest include Live Oak, Cabbage Palm, Sweetgum, and Pignut Hickory. Citrus trees in the subcanopy are species brought to Florida by the Spanish explorers. Hurricanes disturbed the hammock in 1928 and 1960, each time opening the canopy, and causing a surge in the development of the undergrowth. Fire exclusion and canalization have contributed to the expansion of bayhead vegetation into the mesic flatwoods and marshes (Alvarez 1993, Stalter 1981, Peroni 1986, Minno 1986).

Big Pine Tract,* west-central Florida (Hernando County)

A large, sandhill tract of old-growth Longleaf Pine, with individual trees up to 160 years old. Kush lists the site as 420 acres, but says that this estimate is probably high. The site has been burned infrequently, and the understory is not in good shape. However, a restoration program with burns and removal of hardwoods is underway. Animal species associated with Longleaf, including Gopher Tortoises, are present, as are numerous herbaceous species. The site is owned by the Florida Fish and Wildlife Conservation Commission (Kush 2001).

Santa Fe River,* north-central Florida (Alachua and Gilchrist Counties)

As much as 200-300 acres of possible old-growth forest along the 20-mile stretch of the Santa Fe River between O'Leno State Park and the Route 47 bridge. Live Oak, Water Oak, and Baldcypress dominate. The few stumps that are present apparently represent small cypress trees that were more solid than the older, hollow cypress that were left standing. Camp Kulaqua, opposite O'Leno, has a Live Oak that is 18.5 feet in circumference. Many of the Live Oak are between 13 and 15 feet around (Sweeney 2003).

Archer Karst Plain, northwestern peninsula (Levy County)

About 200 acres of scattered "low rocky calcareous hammock" on a linear karst plain. The plain is characterized by karst lakes and many small caves in addition to the hammock, which is composed of "magnificent live oaks," huge Red Bays, and a variety of other plants that like soils with lime. The area has been fragmented and grazed, but as of 1993 still functioned as an ecological community. A number of rural families owned the plain (Morgan 1993).

Wannee Natural Area, northwestern peninsula (Dixie County)

More than 160 acres of Water Hickory-Overcup Oak swamp forest on a terrace of the Suwannee River. Trees average 3 to 4 feet dbh and 100 feet in height. The area also has scattered large cypress. Probably it has been highgraded; but it definitely shows old-growth characteristics and is probably the finest of its type left in Florida (Gatewood 1993).

Gulf Hammock/Spring Run, northwestern peninsula (Levy County)

Approximately 40 acres of degraded oak/palm/magnolia old growth owned by Georgia Pacific and perhaps a total of 100 to 150 acres of old-growth inholdings within the lumber company's Gulf Hammock property. The 40 acres, along Spring Run justs before it enters Waccasassa Bay State Preserve, were selectively cut for pine and cedar around 1900; but Georgia Pacific has not logged them because of their inaccessibility and extreme rockiness. The

inholdings, which give glimpses of the former glory of Gulf Hammock, are owned by individuals who have built houses on them and/or use them for hunting (Morgan 1993).

Osceola National Forest, north-central peninsula (Baker County)

Two or three areas of never-logged Pond Cypress, each perhaps 100 acres in extent. One is in a 128-acre cypress-gum maple swamp within a 373-acre Research Natural Area. Another is in Fanny Bay, a 300-acre site (NeSmith 1990, Simons 1995, Spencer 2003).

San Felasco Hammock State Preserve , north-central peninsula (Alachua County)

Eighty acres of selectively logged old growth in a mature mesic hammock covering roughly half of the 6176 acre preserve. Mesic hammock is a mixed species, predominantly hardwood forest, apparently with more species of woody plants than any other community type in North America north of Mexico (Noss 1989). Sanchez Prairie Basin, outside the 80 acres but within the hammock, is comprised of about 500 acres of forest that looks like old growth, as it has not been logged much and not for a long time (Cole 2003).

Venus Flatwoods Preserve ,* central peninsula (Highlands County)

A hundred acres of remnant Longleaf Pine-Wiregrass flatwoods, owned by The Nature Conservancy. Fred Lohrer at Archbold Biological Station, which used to manage the property for The Conservancy, said that a forester told him that the Longleaf Pines are reported to have been left after logging around the turn of the century; but Lohrer has never seen any stumps. The ground cover is undisturbed. The Conservancy burned the site with prescribed fires twice between 1992 and 2002; the site also burned because of a wildfire around 2000. The adjacent land to the north was logged about five years ago. To the south and west is pasture with pines that were logged in the recent past. To the east is an orange grove (Lohrer 1993 and 2002; Morrison 2002).

Two smaller Longleaf sites in central Florida are **Crooked Lake Sandhill** (Polk County): a 24-acre site that looks unlogged, with large, old Longleaf Pines, owned by the Polk County Board of Commissioners (Morrison 2002); and **Babson Park Audubon Center** and **Webber College** (Polk County): adjacent 2- or 3- acre and 5-acre tracts respectively of apparently unlogged Longleaf (Morrison 2002, Gordon 2002).

Avon Park Air Force Firing Range,* central peninsula (Polk and Highlands Counties)

Fifteen thousand acres of natural Longleaf Pine and Slash Pine with varied histories. Most of the acreage has been “cutover” (Morris 2002) or “thinned” (Van Hook 2002). However, there is a beautiful savanna of old-growth cutthroat grass-Longleaf flatwoods, of “maybe 50” (Morris 2002) or “about 100 acres” (Van Hook 2002) and possibly other unlogged stands of pine. The cutthroat grass-Longleaf community has burned every 2 to 3 years (Van Hook 2002).

Andrews Wildlife Management Area, northwestern peninsula (Levy County)

A few dozen acres of old-growth upland hardwoods within a mile of the Suwannee River. The area has probably been lightly highgraded and grazed by livestock, but is otherwise fine. With its hickory, oak, ash, maple, and other species, it constitutes "one of the finest upland forests left in the state," Steve Gatewood says. The 3877-acre Management Area belongs to the Game and Fresh Water Fish Commission (Gatewood 1993, Minasian 1993, Perry and Perry 1992).

Orange Lake Cypress, east-central peninsula (Marion County)

Forty acres of Baldcypress, apparently undisrupted by grazing or logging, in three separate clusters within a basin swamp. The Nature Conservancy owns 107 acres, including the cypress. The cypress are up to 8 feet dbh and to 100 feet tall (Gatewood 1993, Schultz 1985).

Mitchell Sink , northeastern peninsula (Madison County)

Small hummocks of ancient, dwarfed Live Oak in the midst of white sand pan. Some of the oak have trunks 20 feet in circumference, yet are only 20 feet tall. Mitchell Sink, which covers several square miles, is part of a complex karst drainage system. The water table has apparently fallen sharply in the past twenty years; in other sinks nearby, old cypress trees have been left dry. Local residents have used the sink as a garbage dump (Morgan 1993).

THE SOUTHERN PENINSULA AND KEYS

Big Cypress National Preserve (Monroe and Collier Counties)

Unlogged scrub cypress on 158,000 acres of the 729,000-acre Preserve. The large cypress in Big Cypress were removed, but the "hat rack" Pond Cypresss were never cut, because they are no more than 33 feet tall (often only 10 to 20 feet) with dbhs under 6 inches, and are sparse--as much as 45 to 60 feet apart. Typically they grow on shallow sand or marl (clayey grey or white soil) (Snyder 1993, Beever 1993).

Twenty-three thousand acres of unlogged Florida Slash Pine (Snyder 1993). At Lostman's Pines, a 25,000-acre area in the southern part of the Preserve, are scattered islands of Slash Pine, mostly 50-250 acres in extent, on limestone outcroppings amid wetlands, usually marl prairies (Ross et al. 1997, Platt et al. 2000). The old-growth pines are, however, mostly on flatlands in the northeast section of the Preserve, which the loggers of the 1930s, 40s, and 50s did not reach. Beneath the Slash Pine grow Saw Palmetto, Cabbage Palm, Wax Myrtle, Florida Myrsine, and shrubs and grasses. Something over 50% of the Slash Pine may be growing under hydric conditions (Snyder 1993). Landers and Baldwin list Raccoon Point as a representative stand of old-growth Slash Pine (1999). Jim Beever points out that not all of the hydric Slash Pine flatwoods in Big Cypress are within the Preserve (1993).

Everglades National Park, south Florida (Monroe and Dade Counties)

An unknown number of undisrupted acres in at least 3 types of communities.

--Slash Pine. William Platt refers to Slash Pine savanna (1993), and R. F. Doren reported to Lucy Tyrrell that the National Park contains unlogged Slash Pine, 100 to 200 years in age, of uncertain acreage (Tyrrell 1991).

--Hardwood hammocks. Doren wrote of hardwood hammocks with mahogany (1991). Simons described small tropical hammocks, probably virgin, scattered through the Saw Grass (1990); and Myers and Ewel name as an example of surviving old growth; "some inaccessible tropical hammocks" in the Everglades (1990).

--Mangrove swamps. The seaward side of the Park has an enormous belt of mangroves (Odum and McIvor 1990). The mangrove forest, many thousands of acres in extent, is the largest area of forest in the Everglades (Simons 1995).

Southern Charlotte County (southwestern peninsula)

Thirty thousand acres of hydric Slash Pine flatwoods, up to 2360 of which are old growth. During the logging era, loggers cut pine growing on xeric and mesic sites in preference to pine on wet sites, because logging in the hydric areas was difficult and unpleasant and the trees were spaced farther apart and were more likely to be malformed than those on dry sites. Mature trees on hydric sites are typically 10 to 12 inches in diameter and 60 to 75 feet tall. Their canopies cover only 10 to 20% of the area of each unlogged stand. The older Slash Pine in the county are 150 years in age, and probably originated after fire. Prescribed burns are now used to maintain them. In the winter the flatwoods are dry, but in the summer they are under surface water of 6 to 12 inches.

The flatwoods in Charlotte County are found both on private land and on public land, in particular the 65,775-acre Fred C. Babcock-Cecil M. Webb Wildlife Management Area and the adjacent Charlotte Harbor Flatwoods Project. The latter is an 18,000-acre project, for which the state has already acquired more than 16,000 acres (FDEP 2002). Collier and Lee Counties also have hydric Slash Pine flatwoods (see entries on the Everglades and Big Cypress).

The Slash Pine flatwoods host many rare, Threatened, and Endangered species, including the Florida Panther, Black Bear, Florida Sandhill Crane, Eastern Indigo Snake, Big Cypress Fox Squirrel, Gopher Frog, Snowy Egret, Tri-colored Heron, and Wood Stork. Eighty-nine of the 112 known Red-cockaded Woodpecker colonies in southwest Florida live in healthy hydric Slash Pine flatwoods. All but one of the 92 active colonies forage in these flatwoods (Beever and Dryden 1992, Beever 1993 and 2003).

Jonathan Dickinson State Park,* southeastern Florida (Martin County)

A park of over 11,500 acres with 1500 acres of naturally seeded Sand Pine scrub (Parker et al. 1997). The only trees considered to be of value on the land before it became a park were the cypress and the Slash Pine, which were logged. The Sand Pine were without timber value as timber and were left alone (Schuh 2002).

Strand W of Cow Bone Island, Seminole Indian Reservation, south-central peninsula (Hendry County)

Approximately 700 acres of strand swamp with virgin cypress (NeSmith 1990). Strand swamp is a broad channel with peat over a mineral substrate, seasonally inundated with flowing water, tropical or subtropical in climate, and subject to occasional fires (Bettinger 1990).

Corkscrew Swamp Sanctuary, in southwestern Florida (Collier County)

Seven hundred acres of old-growth Baldcypress of which 200 acres are virgin, in an 11,000-acre sanctuary, owned by the National Audubon Society (Carlson 1990). The cypress are up to 130 feet in height and 25 feet in girth, and many are over 700 years old. The trees were spared from logging because their wood had a spiral grain (Stevenson 1990).

Fakahatchee Strand State Preserve , southern Florida (Collier County)

Within the 46,000-acre preserve, mixed hardwood swamp forest, some of it uncut, and a small amount of uncut cypress. The swamp forest supports tropical hardwoods, giant Baldcypress, the shrub Pond Apple, and many endemic orchids, among other species. Something less than 10% of the preserve may have escaped logging (Beever 1993). The preserve has around 20 acres of uncut Baldcypress (Minasian 1993). NeSmith wrote that there are about 40 acres of unlogged Baldcypress, some of which may be outside the preserve (1990). A 40-acre tract named "Big Cypress Bend" has a boardwalk through it (Gatewood 1993). The State Preserve is adjacent to Big Cypress National Preserve.

Coastal islands of southwestern Florida (Collier, Lee, and Charlotte Counties)

Uncut tropical hardwood hammocks on islands between the mainland and the barrier islands. The islands on which hammocks survive are those edged with mangroves rather than with beaches, because people chose to settle on the islands with beaches. The unlogged islands include Buck Key, Joselyn Island, and Mound Key. The last was a center of culture for the Caloose Indians, who lived on mounds of seashells, amidst hammocks. After the Indians left, the whole island grew up in hardwood hammock. (Horr's Island, an island that until recently was unlogged, is in the process of being developed.) Tree species are very diverse; two unusual trees common here are Gumbo Limbo and Pigeon Plum (Beever 1993).

Dade County Archipelago Project,* southeastern peninsula (Dade County)

Scattered sites in Dade County representing “outstanding examples of rockland hammock” and some of the “best remaining examples of the highly endangered pine rockland.” The sites include areas recognized as old growth, in particular **Castellow Hammock**. The Dade County sites were severely damaged by Hurricane Andrew but are recovering. The sites in the project total 1400 acres (Outcalt 1997b, Gatewood 1993, FDEP 2002).

The Florida Keys, around the southern tip of Florida (Monroe County)

In addition to old-growth mangrove swamps described above, the Florida Keys have old-growth tropical hammock and pine rockland habitat.

The best old sites of high hardwood hammock are almost all within three preserves on Key Largo in the Upper Keys, James Duquesnel reports: the 6606-acre **Crocodile Lake National Wildlife Refuge**, the 2500-acre **Dagny Johnson Key Largo Hammock Botanical State Park,*** and **John Pennekamp Coral Reef State Park**.* The last is largely underwater, but has a land base of a few acres with hammocks. **Lignumvitae Key State Botanical Site**, a 381-acre preserve (280 land acres) also in the Upper Keys, has a largely undisturbed hammock. According to Outcalt, Lignumvitae Botanical Site is, in fact, "the best remaining example of an old-growth hardwood hammock” (1997b). Early in the century land was cleared for a large house, which still stands, and the island is also the site of older blockhouses and a huge rock wall, but overall is healthy. The Division of Recreation and Parks owns it (Perry 1992, Simons 1990).

Species composition rather than tree height and girth characterize the older stands of hardwood hammock. In the Upper Keys native trees are generally restricted in height to 40 or 45 feet by storm winds; relatively recently introduced exotics that are taller are likely to be damaged in storms. Redberry Stoppers (*Eugenia confus*) larger than 12” dbh and lignum vitaes (*Guajacum sanctum*) in leaf litter 8-12 inches deep seem to be signs of the best forest stands, Duquesnel writes. Associated species may include *Calyptranthes* spp., *Guettarda* spp., *Manilkara jamiqui*, *Thrinax* palms, and epiphytic orchids (in particular *Encyclia boothiana* and or *Vanilla barbellata*) (Duquesnel 2003).

Hammocks in the Lower Keys tend to have the same species as those in the Upper Keys but to be lower. Twenty feet is the usual height of trees. Twenty-five feet would be tall. The hammocks are also dense. It would be difficult to imagine their being extensively logged, Randy Grau says. Probably only scattered homesteads were cut into the hammocks. Biologists and other researchers discuss whether specific sites in the Lower Keys are old growth, but actual evidence seems to be lacking, and opinions go both ways. Grau mentioned **Middle Torch*** and **Big Torch Keys*** as sites of possible old-growth hammock (Grau 2003).

The Lower Keys have a great deal of virgin old-growth pine rockland, perhaps 2000 acres of fractured or fragmented stands, Robertson estimated in 1990. Putting it in other terms, Tate wrote that "most pine rocklands" are likely to be old growth (1993). Widely separated Slash Pine dominate pine rockland communities. Palms are also present, and the ground cover is comprised of fairly lush grasses and herbs (Robertson 1990).

Phil Frank, Project Manager for the Florida National Wildlife Refuges, three of which are in the Lower Keys, estimates that the refuges include in total about 4000 acres of pine rockland and about 4000 acres of tropical hardwood hammock. He describes these hammocks as old growth, because they are hurricane dependent and tend to be scraped off every one hundred years. The pine rocklands are undergoing prescribed burning. The 8542-acre **National Key Deer Refuge** includes much pine rockland and tropical hardwood hammock. The **Key West** and **Great White Heron Refuges** are largely composed of mangrove islands (Frank 2003).

Owners of land in the Keys include the US Fish and Wildlife Service, the state of Florida, The Nature Conservancy, the National Park Service, and private parties. The state for one has made a major effort to protect habitat on the Keys. On North Key Largo the state has bought more than 4000 acres for the North Key Largo Hammocks project (FDEP 2002), and in the Lower Keys it has acquired 2100 acres that comprise the Florida Keys Wildlife and Environmental Area, managed by the Florida Fish and Wildlife Commission as a conservation area (Singleton 2003).

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GEORGIA

The US Forest Service (USFS) is in the process of revising its management plan for the Chattahoochee and Oconee National Forests. The agency plans to release for public comment a combined draft plan and draft Environmental Impact Statement in February 2003. The final plan is scheduled for completion by the end of September 2003. Congress has established this deadline by saying that it will cut off funding for the planning at that time, because the process has been going on long enough and the money is needed elsewhere. The notice of intent to revise the plans for these forests was issued in 1996 (Stephens 2003).

Jess Riddle has begun inventorying the Chattahoochee National Forest for Georgia Forest Watch. His findings will be included in an inventory and catalog of the Blue Ridge Province to be coordinated by Rob Messick. The Southern Appalachian Forest Coalition (SAFC) and The Wilderness Society are sponsoring the project. The final catalog is expected to be released in 2004 (Messick 2003).

The **Jones Ecological Researcher Center** at Ichauway in Baker County includes 14,800 acres (6000 ha) of open Longleaf Pine forest, 9,900 acres (4000 ha) of which have wiregrass as a component of the understory. At Ichauway, Drew et al. identified 1013 tax, including 392 species that had not been found elsewhere in the county. Because of the presence of wiregrass, the preserve is assumed to have experienced minimal soil disturbance and frequent fire. However, the forest was logged (Drew et al. 1998).

Significant small old-growth areas in Georgia include a slough and island with Baldcypress on the Lower Altamaha River (near Jessup); two Baldcypress sites on the Ocmulgee River: one of them the privately owned 20- or 30-acre **Big Eddy Slough**, the other, a smaller site (Wilcox County) (Stahle 1993); a privately owned bay swamp, perhaps 25 acres in extent, which has not been cut "for a long, long time" on Seventeen Mile Creek (Coffee County) (Wharton 1993); a small stand dominated by hickories, Tulip Tree, and Northern Red Oak at the base of a granite monadnock in the 760-acre Panola Mountain State Conservation Park)* (Rockdale County).

Ossabaw Island, off the coast of Georgia

A 25,000-acre barrier island, with 11,800 acres of upland, most of which is maritime forest that has apparently been only selectively cut in the past. Live Oak and Laurel Oak predominate in the canopy; palmetto and Wax Myrtle, in the understory. The island is owned by the Georgia Department of Natural Resources, which plans to keep it in a natural condition. Feral hogs are a problem, but the island has only one resident so cars do much less damage here than on Sapelo (Monroe 1993, Zoodsma 1998).

CHATTAHOOCHEE NATIONAL FOREST, in northern Georgia

As indicated above, Jess Riddle on behalf of Georgia Forest Watch, is in the process of identifying and delineating old growth in Chattahoochee National Forest. As of January 2003, not all the sites that he had identified had been digitized to obtain the acreage accurately. We include below the sites that he had discovered before 2003, for which the acreage had been determined, and that are over forty acres in size. To help orient readers, we also include most of the sites described in the 1993 edition of this work. We also include sites over forty acres in size identified by Paul Carlson. Carlson, who studied for USFS old growth in the Chattooga River Watershed, classified sites as “A,” “B,” or “C.” In sites for which he is our source, we include the classification.

Brasstown District

--**Brasstown Bald** (Union County). Varied old growth on the upper slopes, including, on the north face of the 4784-foot mountain, a "virgin" example of a mixed mesophytic, cool, moist cove forest. Yellow Birch in association with American Beech and Black Birch dominates the upper cove (Wharton 1978). This area is a boulderfield with Great Rhododendron and Mountain Maple in the understory (Riddle 2003a). Yellow Buckeye occurs at a lower elevation (Wharton 1978). Wharton estimates the old growth in the cove to be no more than 200 acres in extent, but says that the north face of Brasstown Bald has extensive additional old growth and that the south face supports some old growth, although here the trees are stunted (Wharton 1993). As of early 2003, Riddle had delineated 21 acres of old growth dominated by White Oak on the south side of the ridge south of Fodder Creek. In

the upper part of the stand, trees in the canopy are less than 50 feet tall and a half foot in diameter, but the stand shows no signs of human disturbance (Riddle 2003b).

--**Cooper Creek Scenic Area**, north-central Georgia (Union County). Old growth of uncertain extent within a 1240-acre area. Georgia's Mountain Treasures describes the "majority of the area" as "probably largely old-growth forest" (The Wilderness Society 1995). According to Ben Sanders, a Fisheries, Wildlife, and Range Staff officer, the Scenic Area supports at least 100 acres of old-growth cove hardwoods, probably lightly cut in the past--with crosscut saws, as indicated by stumps (1993). Charles Wharton reported that not all sections of the 1240-acre Scenic Area look old, but that presumably the area was cut only lightly if at all (1993). Riddle is inclined to agree with Wharton. "The generally young appearance of the hardwoods in the area could be related to highly acidic soils that would limit hardwood growth rates, but still allow conifers to prosper" (Riddle 2003a).

--Double Spring Knob* , within the Kelly Ridge Roadless Area (Towns County). An old-growth stand, likely slightly more than 100 acres in size, on the north side of the knob. Oak constitutes the overstory throughout the stand, but the prevalent oak species varies, as does the composition of the understory. Along the main ridge extending south from the knob, White Oak is most common in the canopy. Northern Red Oak is most prevalent on the upper slopes on the north side of the knob.

--Fork Ridge*, within the Kelly Ridge Roadless Area (Towns County). Two areas of old-growth forest, Fork Ridge East, 55 acres, and Fork Ridge West, 14 acres, separated by an area of younger forest that does not appear to have been logged. The old growth is dry oak and subxeric oak. White Oak and Scarlet Oak predominate in the canopy on the ridge crest. Chestnut Oak dominates the adjacent slopes; Black Oak is scattered throughout. The Scarlet Oak are present in multiple age classes, and reach more than 193 years in age. Their seedlings are abundant. Thus on this site, they are successfully competing with White and Chestnut Oaks, which reach ages of around 200 years, here as in other old-growth stands in north Georgia (Riddle 2003b).

--Buck Knob* (Towns County). Fifty-two acres of old growth on steep slopes on the southeast side of the mountain. Here patches of soil alternate with exposed rock. Chestnut Oak dominates; Pignut Hickory and Eastern Red-cedar are also important in the canopy. Above the rock outcrops, White Oak and Scarlet Oak as well as Chestnut Oak may appear in the canopy. Vaccinium species predominate in the understory. The steepness of the slope and the lack of saleable timber may have prevented logging (Riddle 2003b).

--Ramp Cove (Towns County). Old growth above 2800 feet, as only selective logging has occurred above this level. Scattered Tulip Tree, American Beech, and Northern Red Oak that are probably 100-150 years old grow between 2800 and 3200 feet. Some of these trees are unusually tall--Northern Red Oak up to 129 feet tall and Tulip Tree up to 159 feet. Above 3200 feet, Yellow Buckeye dominate, and, since these trees have relatively little commercial value, logging has been infrequent. Beech are common but are only in the understory and midstory. The tallest buckeye in Georgia, a 144-foot tree, grows here (Riddle 2002). Wharton and Duffy and Meier refer to an old growth stand of buckeye in a cove at an elevation of 3280 feet (Wharton 1993, Duffy and Meier 1992).

--Sosbee Cove Scenic Area (Union County). The Forest Service has described this 25-acre stand as "second growth" (Henderson 1990), but Duffy and Meier, saying that only "snags and downed or poorly-formed trees" had been removed, studied it as an example of primary forest (1992). Riddle writes that the cove contains "both old-growth trees and exceptional second-growth forest." A power line runs through the portion of the cove with the old-growth trees (Riddle 2001).

Cohutta District

--Grassy Mountain* (Murray County).On the north slope of the mountain, more than 200 acres of uncut old-growth acidic cove, dry pine, dry oak, and mesic oak forest with at least two areas of mixed mesophytic forest. Black Gum, Tulip Tree, hemlock, Chestnut Oak, and Northern Red Oak exceed 150 years in age. Pine-dominated forest on some of the ridges appears to be considerably younger, probably because of natural events. Chestnut was formerly common in the area. Rhododendron is abundant in the acidic cove forest (Riddle 2003a).

--Rocky Face Mountain,* on minor ridges on the west side, and on upper slopes is dry oak forest with a canopy of Chestnut Oak, White Oak, Red Maple, and White Pine. Submesic cove, which forms a transition between the dry oak forest and acidic cove forest, is in coves draining into the main stream on the west side of the mountain and on lower slopes. Acidic cove forest is along the main watercourse draining the west side of the mountain below 700 m and extending down to at least 600 m. Chestnut Oak, Eastern Hemlock, and Tulip Tree are common here. A dense understory of Great Rhododendron is present. The undelineated forest that is likely to be old growth includes two boulderfields to the north and the upper slopes between the east-west ridge and USFS road 64 (Riddle 2003b).

--**Rich Knob*** (Fannin County). Forest above 2800 feet that has been only selectively logged. Forest types are dry oak, rich cove, and submesic oak. Tulip Tree and Northern Red Oak ages 100 to 150 years grow below 3200 feet. Two old-growth sites with a southeastern aspect have been delineated: Rich Knob South, 26 acres, and Rich Knob North, 17 acres (Riddle 2003b).

--Betty Mountain North* (Gilmer County). Old-growth forest, 129 acres in extent, lining the drainage that parallels Betty Creek to the north. The stand extends from at least 2240 feet (possibly as low as 2080 feet) up to 2700 feet. Tulip Tree is the dominant species in the mixed mesophytic forest that dominates most of the stand. In the lower reaches, the forest becomes acid cove, and Eastern Hemlock becomes more commmon. In the upper part of the stand, the understory is composed of scattered seedlings of canopy species; and the herbaceous layer includes ferns. In the lower part, *Rhododendron maximum* is thick; and the herbaceous layer is absent (Riddle 2003b).

Tallulah District

--**Redside Mountain*** (Rabun County). A total of 599 acres of Class A forest and Class B forest. On steep, rocky slopes and seepages the primary canopy species are Northern Red Oak and Chestnut Oak. Scarlet Oak, Chestnut Oak, White Oak, and Black Oak with some Pitch Pine dominate roughly 75 acres. Forty-four acres of forest are primarily Eastern Hemlock and Eastern White Pine on a very steep slope. The Class B forest included in this total was significantly disturbed as a result of the chestnut blight. Approximately 364 acres of forest are undisturbed (Carlson 1995).

--Big Mountain* (Rabun County). Four stands totaling 249 acres. The first stand, a Class A forest located at the top of the mountain, includes 68 acres of submesic, mixed oak forest. Though no evidence of logging was found, a recent fire killed the understory species. Chestnut Oak in this area were aged at 250 years. The second stand comprises 22 acres of Class A mesic and submesic forest dominated by Tulip Tree and oak. The average diameter for the poplar was 48" dbh (diameter at breast height). No evidence of human disturbance was found in this stand. The third stand consists of 24 acres of Class B xeric forest. This stand is primarily pine-oak with Pitch Pine and Shortleaf Pine. This area has been selectively logged. The fourth stand comprises 135 acres of Class B submesic forest. The stand is primarily mixed oak. The area has apparently been selectively logged (Carlson 1995).

--**Lower Big Ridge*** (Rabun County). A Class B, 170-acre submesic forest with 200+ year Chestnut Oak and White Oak prevalent. Black Oak, Scarlet Oak, Pitch Pine, and White Pine are also common canopy species. There is evidence of a American Chestnut salvage harvest, though the disturbance was minimal (Carlson 1995).

--Oakey Top* (Rabun County). Approximately 127 acres of Class B forest. A nearly pure stand of Chestnut Oak resides at the peak of Oakey Top. A cove area just below the peak hosts White Oak and Black Oak with diameters averaging 33" dbh. The south-facing slopes are much drier and harbor a "beautiful stand of very old Pitch Pine" (Carlson 1995). Chestnut salvage and selective pine logging have occurred within the stand.

--Big Ridge North/Upper Sarah's Creek* (Rabun County). Two Class B stands totaling 102 acres of old growth forest. The first stand consists of 45 acres of submesic forest atop Big Ridge. Canopy species include Chestnut Oak, White Oak, Scarlet Oak, and Pitch Pine. The second stand, located on the north side of Sarah's Creek, is a 57-acre, mixed oak forest dominated by Chestnut Oak. Evidence of selective logging in both stands led to their Class B status (Carlson 1995).

--**Overflow Creek*** (Rabun County). Two stands totaling 76 acres. The first stand is 26 acres of Class A forest with Tulip Tree and mixed oak. Several trees were aged at over 200 years. The second stand is a 50-acre Class B forest dominated by mixed oaks and Eastern White Pine. There were no signs of human disturbance in either stand (Carlson 1995).

--**Hale Ridge*** (Rabun County). Sixty-two acres of Class B, subxeric forest. Large Pitch Pine and Chestnut Oak dominate the canopy, though Scarlet Oak, Blackgum, and White Pine are common canopy species. There is evidence of selective logging within the stand (Carlson 1995).

--Upper Holcomb Creek* (Rabun County). Two stands totaling 61 acres. The first stand is a 31-acre forest, designated Class A by Carlson, located along the creek bottoms between Holcomb Creek and Ammons Falls. The dominant canopy species are Eastern Hemlock, Tulip Tree, Mixed Oak, Red Maple, and White Pine. Higher on the slopes Chestnut Oak and White Pine dominate. The stand was aged at 150 to 255 years. Carlson did not observe any signs of logging in this stand, but Riddle found a cut stump that may indicate that some White Pine were removed (Riddle 2003a). The second stand is a 30-acre, Class B forest adjacent to the first stand. The dominant

canopy species are Tulip Tree, Northern Red Oak, Chestnut Oak, and White Oak. A chestnut salvage harvest and some selective oak logging occurred in the stand (Carlson 1995).

--Brown Mountain* (Rabun County). Fifty-three acres divided into two stands. The first stand comprises 30 acres of Class A forest. This undisturbed forest is dominated by "striking stands" of Chestnut Oak aged at 200-300 years. The second and adjacent stand is 23 acres of primarily Chestnut Oak with many Eastern White Pine, Pitch Pine, and Scarlet Oak in the canopy. Some logging has occurred within this stand (Carlson 1995).

--Rabun Bald* (Rabun County). Old-growth forest, at least 50 acres in extent, "covering much of the broad top of 4696 foot-high Rabun Bald, the second highest mountain in Georgia (Riddle 2001).

--Beck Ridge* (Rabun County). Forty-eight acres divided into two stands due to differences in levels of disturbance. The first stand is a ridge top harboring a narrow band of White Oak and Chestnut Oak. One White Oak was aged at 290 years. The second stand has the same species composition, but old American Chestnut stumps and pockets of younger trees suggest some past disturbance (Carlson 1995). **--Ellicott Rock Stand**, in Ellicott Rock Wilderness (Rabun County). An "apparently virgin cove forest" described by DuMond in 1970. The forest was hardwood-hemlock with a rich herb layer and evergreen heath thickets. Wharton later tried unsuccessfully to find the stand (1993). The Forest Service says that since 1970 changes could have occurred in the forest that cannot be traced in the records (Jenson 1993).

Toccoa District

--Montgomery Creek* (Lumpkin County). On steep slopes in the upper portion of the Montgomery Creek watershed, 554 acres of old growth of varying forest types. The large ridges support communities with a significant component of pine, along with occasional gnarled, old Chestnut Oaks. Here Virginia Pine is the most abundant tree. The pines in these communities are relatively young, apparently because of fire or wind. The upper slopes and low ridges support dry oak forests. The dry forests on the highest elevations are dominated by Chestnut Oak; those on partly sheltered spur ridges, by White Oak. In the lower parts of the steep coves, are submesic oak forests in which Chestnut Oak associates with Tulip Trees. Mesic oak communities dominated by Tulip Tree and Northern Red Oak; and a few rich cove forests are also present. The rich cove forests include Tulip Tree, Northern Red Oak, White Basswood, and scattered Sweet Birch and Yellow Buckeye (Riddle 2002).

--**Long Mountain*** (Lumpkin County). On the southern aspect, 120 acres of contiguous old growth, largely confined to a steep slope. The dominant canopy species over much of the area is Chestnut Oak, but White Oak, Northern Red Oak, Black Oak, and hickory may be locally abundant. The stand does not have a well-defined shrub layer, and the herbaceous layer is sparse in much of the stand. Several Chestnut Oak are more than 10 feet in circumference at breast height. Additional old growth of as yet undetermined extent is located on the slopes with an eastern aspect (Riddle 2002).

Cumberland Island National Seashore,* off the southern end of the Georgia coast

In the 36,506-acre Seashore, some 3000 acres of oak-palmetto that has been only selectively cut. Settlers grew cotton, indigo, olives, `oranges, and other produce` on the island, but saved the oak, particularly the Live Oak, for ship building. Since timbers were selectively removed, much of the oak-palmetto forest, which best represents the Live Oak, is still intact. The 4800 acres of mixed oak with pine or hardwood are second growth. The island has exotics, but very few are found in the oak-palmetto (Bjork 1998, Hillestad et al. 1975). Bratton and Miller found that island sites not known to have been farmed differ from areas that had been cultivated, as the unfarmed areas have a dense cover of Saw Palmetto with Redbay, few vines, and almost no grasses or forbs (Bratton et al. 1994). Native Longleaf Pine, including large trees, grow on the northern end of the island (Ferguson 2003).

The Seashore is comprised of two islands, Big and Little Cumberland Islands. The National Park Service owns approximately 20,000 acres. The state of Georgia, the Navy, the Army Corps of Engineers, and private parties also own land on the islands. All of the land is protected, Andy Ferguson, Management Analyst, told us. The responsibilities of the private owners are codified by law, and the military owners have entered into memoranda of understanding on the use of the land (Ferguson 2003).

Wassaw Island, within Wassaw Island National Wildlife Refuge, off the coast (Chatham County)

A 2000-acre coastal island covered with a maritime forest that has never been cut. On the north end of the island Live Oak dominates. In the south, the more recently formed part of the island, Slash Pine and Loblolly Pine are

the predominant species. Between the two areas is a mixture of pine and hardwoods, including Slash Pine and Cabbage Palm. The US Fish and Wildlife Service burns the pine on the south end in winter to prevent summer wildfires. The people who once owned the island retain a 180-acre tract (Robinette 1993 and 2003).

Ebenezer Creek Swamp, east-central Georgia (Effingham County)

A 1350-acre swamp, all or most of which supports old-growth cypress-gum forest. The 1350-acre figure is sometimes given for the swamp and the old growth (Ambrose 1989, Harmon 1992), but Jonathan Streich describes the old growth as covering less than 1000 acres (1993). The virgin Baldcypress date back as far as the year 990 (Cleaveland 1992), yet are dwarfed (Wharton 1978). Diameters of the buttresses can exceed 10 feet. Above the swell, diameters are typically around four feet. None of the cypress reach 100 feet tall (Riddle 2003a). The dwarfing apparently results from the cypress living in a backwater stream, where they lack sufficient nutrients and oxygen (Wharton 1978). The swamp has more than one hundred private owners (Lutz 2003).

Sapelo Island, off the coast

A 16,000-acre barrier island with an estimated 1000 acres of maritime forest that has only been selectively cut. Live Oak and Laurel Oak are interspersed with Sweetbay. The understory is palmetto. The island also has 6000 acres of marsh, and extensive pine forest growing on land that was once farmed. The Georgia Department of Natural Resources owns the island. Feral hogs are a problem, as are island residents and visitors who drive through the forest. With these exceptions, the forest is being kept in natural condition (Monroe 1993, Zoodsma 1998).

Bear Island, eastern Georgia, within Savannah National Wildlife Refuge (Effingham County)

A 680-acre island with about 200 acres of unlogged forest. The old growth is bottomland hardwoods, mainly Sweetgum-cypress. The island, which was only recently purchased by the US Fish and Wildlife Service, is in the Savanna River. Feral hogs are a problem (Robinette 1993 and 2003).

Greenwood Plantation,* southwestern Georgia (Thomas County)

Within the 5200-acre plantation in the Clayhills, a stand of 500 acres of high-quality Longleaf Pine, often spoken of as "The Big Woods" (Kush 2001). Individual trees are up to 500 years in age, and many of them are very big. The stand is regarded as exemplary Longleaf and generally characterized as old growth (Ambrose 1989, Hermann 1990, Kush 2001, for example). However, it has been subject to limited logging, as it has been managed according to the Stoddard-Neel Selection Method for the past fifty years. In this method, single trees are selected for cutting "based on age (retaining old-growth), species (sparing longleaf in mixed pine stands), defects and crown size (first eliminating those with sparser crowns)." The method includes prescribed burning; and burning has been carried out at Greenwood for more than a hundred years (TNC Web 2002). As a result, the site supports "all native flora and fauna typical of pinelands" (Kush 2001). Residents include the Endangered Red-cockaded Woodpecker, Pine Snake, Gopher Tortoise, Bachman's Sparrow, Wire-leaf Dropseed, and Yellow Fringeless Orchid.

In addition to the old growth, the plantation includes the Plateau, a Longleaf Pine sandhill community; Heard's Pond, a 700-acre wetland; and a slope forest on the Ochlocknee River. The Greentree Foundation founded by Mrs. John Hay Whitney, which owns the property, plans to transfer ownership of it to The Nature Conservancy in September 2003. To prepare for the transfer, The Nature Conservancy assumed management and began working with the Greentree staff in September 2002 (TNC Web 2002).

Wade Tract Preserve, southwestern Georgia (Thomas County)

Old-growth Longleaf Pine-Wiregrass savanna, 206 acres in extent (Kush 2001). The land is privately owned, but managed by Tall Timbers Research Station of Tallahassee, Florida. The site has experienced salvage logging (Hermann 1990). Flora and fauna are "intact" (Kush 2001). The Wade Tract is generally regarded as the highest-quality remaining Longleaf Pine-Wiregrass stand. The stand has been extensively studied (for example, Noel et al. 1998); and researchers visit it to learn what Longleaf Pine-Wiregrass should look like (Ambrose 1989, Hermann 1990). A dirt road bisects the preserve, a paved road runs along it on the East. Beyond the road and on other sides of the tract is Longleaf Pine managed by single tree selection (Engstrom and Sanders 1997).

Thomasville Plantations,* southwestern Georgia (Thomas County)

Various privately owned stands of old-growth Longleaf Pine in the Clayhills, totaling around 1000 acres. Many are under easements from The Nature Conservancy and/or Tall Timbers Research Station. Most are managed for Bobwhite Quail and other pinelands fauna and flora. As a result, they are subject to frequent prescribed burns (Kush 2001).

Blackbeard Island National Wildlife Refuge, off the coast (McIntosh County)

About 200 acres of virgin Slash Pine on a large island. The US Fish and Wildlife Service protects the forest on Blackbeard as on Wassaw and Bear Islands. Feral pigs were eradicated ten years ago, but in 1997 a few more appeared, probably from Sapelo. The Service burns the pines in winter (Robinette 1993 and 2003).

Murder Creek Research Natural Area (RNA), in Oconee National Forest, central Georgia (Putnam County)

A 996-acre RNA, about half of which is bottomland hardwood forest, apparently including old-growth stands. John Moore, District Ranger, thinks that the land on which the floodplain forest stands was all farmed at some time before the resettlement period (1993). Riddle writes that only "four or five trees" appear to have "escaped agricultural and logging activities" (2002). Nevertheless, Ben Sanders believes that the bottomland was not all clearcut, that parts of the forest are likely to have old-growth characteristics, and that the forest has the best bottomland hardwoods he has seen in Georgia (1993). According to Wharton, the RNA has at least "patches of old growth," and trees 200 to 300 years old (1993). Species include Sugarberry, Loblolly Pine, Sweetgum, Tulip Tree, and hickory. Cottonwood are scarce, but one of the cottonwood trees is 17 feet one inch across and 134.6 feet tall (Riddle 2003a). The RNA has a problem with exotics such as Trifoliate Orange, which the creek washes in (Moore 1993).

Magnolia Bluff, southeastern Georgia (Camden County)

An approximately 100-acre seepage slope forest, in which Southern Magnolia and Spruce Pine grow next to floodplain species such as Water Hickory, Planertree, and Pond Cypress. The forest, which is state owned, may have been lightly cut (Wharton 1978 and 1993).

Marshall Forest Preserve , northwestern Georgia (Floyd County)

Ninety acres of virgin pine-oak and mixed hardwood forest (Rolls 1990, Hodges 2003) on a 311-acre tract owned by The Nature Conservancy. The Large-flowered Skullcap lives there. A trail for the blind passes through the pine-oak forest (Ambrose 1989, TNC Web 2002).

Titi Hammock , southwestern Georgia (Thomas County)

Approximately 75 acres of old-growth bluff or slope forest in private ownership. There is no evidence of its having been logged. The Nature Conservancy has an easement on the property (Hermann 1990, Hodges 2003).

Fernbank Forest, in metropolitan Atlanta (DeKalb County)

Mesic hardwood forest of 62 acres (Martin et al. 1993) or 65 acres (Ambrose 1989). Tulip Tree, White Oak, hickory, Loblolly Pine, Shortleaf Pine, and Northern Red Oak dominate. The forest is owned by Fernbank, Inc., a non-profit corporation dedicated to preserving the land. Fernbank, Inc. leases the forest under strict regulations to the DeKalb County Board of Education for educational purposes (Ambrose 1989, Martin et al. 1993).

Fifteen acres of little disturbed mesic hardwood forest, originally contiguous with Fernbank Forest, are now a part of the 26-acre Deepdene Park, about 200 meters to the south of Fernbank and owned by Fernbank, Inc. (Martin et al. 1993).

Moody Forest Natural Area, southeastern Georgia (Appling County)

A 3500-acre tract that includes an old-growth Longleaf Pine-Blackjack Oak forest 320 acres in extent. The oldest trees are more than 250 years in age. The stand has been "somewhat fire-excluded," but "most floral and faunal elements remain, including abundant wiregrass, gopher tortoises, and red-cockaded woodpeckers" (Kush 2001). The site is on the Altamaha River and also includes forested bluffs, cypress-tupelo sloughs, and, in the floodplain, bottomland hardwoods. The sloughs support trees more than 600 years old (TNC Web 2002). Some of the bottomlands were high graded, but cypress and tupelo as much as 10 feet across were left (Hodges 2003). Stahle reports that the area is "outstanding," although it has been selectively cut (1993). The terrace swamp forest has yet to be studied for old growth (Hodges 2003).

In 2000, The Nature Conservancy purchased the Natural Area from the Moody family, which had protected it for several generations. The Georgia Department of Natural Resources (DNR) then bought about 1700 acres of it from The Conservancy. The Conservancy and DNR will manage it jointly. Through prescribed fire, they are restoring the Longleaf ecosystem. The site is open to the public, but visitors must contact the Georgia office of The Nature Conservancy prior to visiting. "Managed hunting" is allowed (TNC Web 2002).

Adjacent swampland owned by Georgia Power in connection with its Edwin I. Hatch nuclear power plant supports forest similar to the lowland forest in the Natural Area (Riddle 2003a).

Lewis Island Natural Area, in southeastern Georgia (McIntosh County)

Two virgin patches of Baldcypress in the middle of a 5890-acre island in the Altamaha River. The old growth totals approximately 50 acres (Wharton 1978, Hodges 2003). Man-made canals are adjacent to both stands. The cypress, which are unquestionably ancient, are consistently 95 to 105 feet tall, and the largest exceed 6 feet dbh. They are columnar and not buttressed (Riddle 2003a). The island's remaining vegetation is second-growth cypress-gum swamp and bottomland hardwoods. Rare/sensitive species present are the American Swallow-tailed Kite, the Limpkin, and several endemic clams (Ambrose 1989). Sheet flow over the island may occur during storms; the only ground above water then is the raised land made from the earth dug from the canals (Riddle 2003a). The Georgia Department of Natural Resources owns the island (Ambrose 1989).

Okefenokee Swamp, southeastern Georgia and northeastern Florida

At least two pockets of old growth within the 438,000 acre swamp. Sara Brown, biologist with the Okefenokee National Wildlife Refuge, is aware of only two small old-growth stands within the Refuge, both cypress: one, a peat island about 3000 feet in diameter, well known to researchers; the other a more remote site, perhaps 25 acres in size (1992). The Refuge occupies nine-tenths of the swamp, which was almost completely clearcut in the early twentieth century. John Dennis refers to two specific areas he believes were spared logging: Number One Island, and a cypress swamp between Billy's Island and Minnies Lake in the northeast. The first, at least, is not one of Brown's sites. He also describes the swamp's recovery. The swamp has fewer and smaller cypress than previously, but "as C. T. Trowell has aptly stated, `The overall character of the Okefenokee has not changed significantly during the past 7,000 years'" (1988).

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MARYLAND

The Maryland Department of Natural Resources (DNR), in cooperation with the Wildlife and Heritage Service, the State Forest and Parks Service, and the Forest Service began an inventory of Maryland old growth in the summer of 2002. The inventory is expected to last about three years. A DNR Old Growth Committee has established a definition for the inventory: "an old growth forest is a minimum of five acres in size with a preponderance of old trees, of which the oldest trees exceed at least half of the projected maximum attainable age for that species, and exhibits most of the following characteristics": presence of shade tolerant species in all age/size classes, random distribution of canopy gaps, structural diversity, presence of snags and an accumulation of dead wood, and, if soil conditions permit, pit and mound topography (Therres 2002).

Sites already believed to include small areas old growth include **Headwaters of the Potomac River** (Garrett County): a few remote patches (Boone 1993); **Finzel Swamp*** (Garrett County): more than 15 acres of old-growth larch in a peat bog, part of a 326-acre preserve owned by The Nature Conservancy (Hotopp 2002; Bailey 1992); **Plummers Island** (Montgomery County)in the Potomac River National Park: possibly 12 acres of old growth on an island owned by the National Park Service (Long 1957, Perry 1993); **Swallow Falls State Park** (Garrett County): variously described as probably 20 to 30 acres of forest with old-growth characteristics, though lightly cut(Boone 1993) and 37 acres of hemlock-White Pine within the 300-acre State Park Robinowitz 1993); **Cranesville Swamp Preserve*** (Garrett County): five acres of Eastern Hemlock/Red Spruce in a 1600-acre preserve belonging to The Nature Conservancy (Hotopp 2002); **Ravine systems along Broad Creek*** (Harford County): areas of old-growth Eastern Hemlock "in two of the three primary ravines" (Farr and Tyndall 1992). One or more small, possibly old-growth, populations of southern disjunct Northern White-cedar occur along the Potomac River near Sheperdstown, West Virginia, and Sharpsburg, Maryland (Washington County) (Walker 1987, Larson et al. 2000).

Patuxent Wildlife Research Center, east of Washington, DC (Anne Arundel County)

Old-growth bottomland forest of uncertain acreage, some of it probably virgin. A road was cut through the forest 50 years ago. Most of the trees felled were around 70 years of age at that time. The Center's Matthew Perry estimates that more than 500 acres of uncut floodplain forest may remain in the 4700-acre main parcel at the federal Research Center, largely on some of the islands in the Patuxent River. Lumber would have been difficult to remove from these islands, as the river was not suited either to fording by horses or to the floating of logs. The trees are enormous, with an American Sycamore 6 feet in diameter, a Tulip Tree over 5 feet in diameter, a Willow Oak 5 feet in diameter, and a Swamp Chestnut Oak more than 4 feet in diameter (Perry [nd], Perry 1993). Biologist Dan Boone estimates that there are over 100 acres of old growth in the floodplain (1993).

The Research Center acquired 8000 acres that used to be part of Fort Meade. Bill Harmire believes that there may be 200 to 300 acres of old growth on this tract in the form of a beech-oak climax forest along the steep north bank of the Little Patuxent River (1993). He also is familiar with three smaller stands that are mature climax forest if not old growth: 50 or 60 acres of floodplain hardwoods with Overcup Oak, Black Gum, and a little sycamore on some of the swales toward the north end of the Patuxent side of the river; 35 or 40 acres of big oak and beech on an east-west ridge; and a 50- to 60-acre stand with mature beech, next to a former homesite (1993).

Chesapeake and Ohio Canal National Historical Park, between Washington, DC and Cumberland, Maryland

Uncut areas within the 20,000-acre Park. The acreage undisrupted by Euro-Americans is not known, because most, if not all, signs of cutting over a hundred years ago would have disappeared and because research in historical records of the area has not yet been done. A twenty-foot-wide strip of land between the towpath and the river was probably cleared. Areas that were not cut would be in three types of forest:

Floodplain forest: some 11,000 acres of floodplain with sycamore, cottonwood, Green Ash, American Elm, Silver Maple, and Black Walnut, likely to include original forest tracts. Few trees in these areas would be very old, because flooding kills trees, and the floodplain forest is inundated every one to five years. The floods destroy many trees while they are still young. Blocks of intact floodplain forest are widely scattered throughout the Park, and some are visible to visitors walking the C&O Canal towpath.

Upland forest: small patches of Northern Red Oak and Chestnut Oak. Of unknown size but definitely less than 40 acres each, these primary remnants are on steep, inaccessible slopes.

Bedrock river terrace forest: approximately 200 acres. The bedrock river terrace is pre-Pleistocene floodplain and river bed left high above the river when, during the last ice age, the river rapidly dug a deep and narrow channel through rock. The terraces are flooded only every 20 years to hundreds of years, but these rare floods scour the land. The soil is poor and the vegetation stunted. Some areas resemble savanna, with low trees and grassland. White Oak, Post Oak, Northern Red Oak, and Virginia Pine are the predominant species.

Olmsted Island and **Falls Island** (together 35 acres), **Sherwin Island** (20 acres), and almost all of **Bear Island** (140 acres) have not been cut by humans, although they experience severe flooding. The dominant vegetation is bedrock terrace forest (oak-hickory-Virginia Pine), but Sherwin Island and south Bear Island also have some floodplain forest (sycamore-ash-elm).

The bedrock terrace forest has one of the highest concentrations of rare species east of the Mississippi (Lea 1993). Bear Island harbors Yellow Nailwort (*Paronychia virginica* var *virginica*)and Rock Skullcap (*Scutellaria saxatilis*), candidates for federal listing as Endangered. At least twenty species on the island are listed by the Maryland Department of Natural Resources as endangered. They include Yellow Water-crowfoot (*Ranunculus flabellaris*), Narrow-leaved Horse-gentian (*Triosteum angustifolium*), Rough rushgrass (*Sporobolus clandestinus*), and Rustling wild-petunia (*Ruellia strepens*) (Ingram 2002).

Crabtree Woods , in Potomac State Forest, western Maryland (Garrett County)

More than 500 acres of old-growth mixed Appalachian hardwood on the northwest side of Backbone Mountain. Probably the stand was salvage cut for American Chestnut. Indicators are that any logging has been selective. McCarthy and Bailey write that whatever its past disturbance history, it is Maryland's "best example, compositionally and structurally, of natural hardwood vegetation on the Allegheny Plateau." Sugar Maple, Northern Red Oak, and American Basswood dominate the overstory. However, Red Oak is not among the seedlings and saplings, and does not seem to be regenerating (McCarthy and Bailey 1996). A Chestnut Oak that recently fell across a road and was cut had 275 growth rings, 40 feet from the roots (Boone 1993). The site supports at least 39 species of herbs, including *Dicentra canadensis, Impatiens pallida*, and *Urtica dioica* (McCarthy and Bailey 1996). The site stretches for a couple miles along a ridgetop and slope, at the base of which a railroad line was constructed in the mid-nineteenth century (Boone 1993).

Savage River State Forest, western Maryland (Garrett County)

--**South Savage Wildland Area**.* A total of more than 100 acres of type B old growth, within a Wildland composed of 2427 acres in the Savage Ravines and 1934 acres on South Savage. As of mid-2002, researchers were continuing to search for old growth in the Wildland Area. The known old growth consists of scattered mixed oak stands, White Oak stands, Sweet Birch stands, and one diverse mesic stand. It is located on the southern end, southern and eastern aspects, of Big Savage Mountain (known as South Savage), mostly among sandstone outcrops and screes. Ed Thompson discovered the initial stand in this region, Coleman Hollow; Ken Hotopp discovered additional areas (Hotopp 2002). Coleman Hollow is a 74-acre (30 ha) area with two distinct forest types. A Chestnut Oak association thrives on the upper slopes, which represent about a third of the total area. The upper slopes do not appear to have been logged (Dodds and Smallidge).

In March 2002 the Maryland State Legislature passed a bill creating the South Savage Wildland; the governor signed it in May 2002. Savage Ravines now has true wilderness status; on South Savage, research and educational activities are allowed. Mark Diehl and the Western Maryland Group of the Sierra Club led the fight to save the wild land (Hotopp 2002; Diehl 2002).

--**Poplar Lick**.* Probably more than 15 acres of type B old growth with Chestnut Oak, White Oak, Northern Red Oak, and hickory. The old growth runs from the ridge top to north of the mouth of Poplar Lick on southern and eastern aspects. As of mid-2002, the stand was unstudied, undocumented, and unprotected (Hotopp 2002).

Sherwood Forest,* in east-central Maryland (Anne Arundel County)

A private community with as much as 75 acres of original beech, Tulip Tree, and Red and Black Oak forest near Severna Park (Sweeney 2002).

Belt Woods , southeastern Maryland (Prince George's County)

A 624-acre preserve owned by the state of Maryland, in which are approximately 40 acres of old-growth mesic upland hardwood forest. The dominant canopy trees are Tulip Tree and White Oak. Flowering Dogwood,

Spicebush, Sweet Haw, and Ironwood are prominent in the understory. The herbaceous layer, which is dense in the spring, includes *Collinsonia, Dioscorea,* and Broad Beechfern. As far as is known, the only possible disruption of the 40 acres has been the removal of dead trees. As the outcome of an eighteen-year battle between conservationists and the Episcopal Diocese of Washington (to whom the land's owner, Seton Belt, had willed the property), Belt Woods is now protected under Maryland's Wildlands Preservation system. Access is limited and by permit only (Waggoner 1973, Boone 1993, Horton 1997, Rucker 2001). The planned Intercounty Connector, Interstate 370, would pass within a quarter of a mile of Belt Woods and would destroy buffering forests and wetlands (Connector 2002).

Fort Hill Preserve ,* western Maryland (Allegany County)

--At the south end of the 332-acre preserve, Grade B old growth probably exceeding 30 acres in extent on limestone slopes. The old growth faces the North Branch of the Potomac River. Chinquapin Oak, with the largest trees greater than 400 years in age, dominates.

--A ribbon of old growth, totaling more than 10 acres, on the ridge top. The old growth includes Eastern Red-cedar and Chestnut Oak.

The old growth was discovered by Ken Hotopp. The preserve, which is owned by the Maryland/District of Columbia Chapter of The Nature Conservancy is open only to researchers and only by permission (Hotopp 2002).

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MISSISSIPPI

The usual response to a query about old growth in Mississippi is a statement that Mississippi was cut from one side to the other. The term "old growth" tends to be used for any forest over 120 years old (Jones 1993); and forests may recover so rapidly that what appears today to be a climax forest may have been selectively cut less than fifty years before (Jones 1993, McGinnis 1993).

Most but not all of the land now comprising the National Forests of Mississippi was cut before the federal government purchased it in the 1930s. As of 1990 few stands in the forests were over 80 years old (Sirmon 1990), and many were younger because stands that have matured since the National Forests were created may have already been logged (McGinnis 1993). Nevertheless, "cut from one side to the other" is not quite true.

Delta and DeSoto National Forests contain large exceptions to the general youthfulness of the National Forests, as described below. In addition, eleven stands in the Homochitto Ranger District of the **Homochitto National Forest** are considered to be one hundred or more years old, and two of these may be somewhat similar in character to the original vegetation: a thick stand of Baldcypress some 32 acres in extent that originated in 1892, possibly after a blow down; and a 25-acre stand of mixed pine and hardwoods that originated in 1895 but from which pines were removed (Price 1993). The Holly Springs Ranger District in **Holly Springs National Forest** includes a 5-acre stand of Baldcypress that as far as the Forest Service is aware, has never been cut (Inmon 1993).

Revision of the management plan for the National Forests of Mississippi was initiated in early 2000, but was almost immediately interrupted by the withdrawal of funding. Public scoping will be reinitiated in 2003. The agency expects that a final plan will be published in 2006 or 2007. In March 2000, the Forest Supervisor wrote to us of inventorying and developing management strategies for old growth based on USFS definitions (Siderits 2000). The inventory began in 2000, but was stopped when funding was withdrawn and, as of January 2003, had yet to be restarted (Long 2003).

Along the **Pearl River** on the Mississippi-Louisiana border, in private hands, are Baldcypress dating back to 1546 (Cleaveland 1992 and 1993, Stahle 1996). Another small site is an unlogged hammock with Redbay, Swampbay, and Sweetbay within the 70-acre **Hillside Bog preserve** owned by Crosby Arboretum (Blake 1993).

Pockets of old growth may be found in the state's zone of very thick loess along the Mississippi River. This zone, with loess 15 or more feet deep, is a slender (15-25 miles across) "peninsula" that extends all the way from western Kentucky and Tennessee into the Tunica Hills of central Louisiana. Trees are diverse—oaks, hickories, magnolias, beeches, locusts, Loblolly Pines—with influences from bottomland hardwoods and upland types. The loess is silt-like material that is essentially wind-deposited glacial dust, often accumulated on the downwind side of big rivers. The soil erodes easily to form deep, steep-sided gullies known in Mississippi as "bayous." The steep sides of the gullies as well as the escarpment in the loess area may support pockets of unlogged forest. The gullies may also support herbaceous plants that are Pleistocene relicts (Conrad 2003, Meier 1997). Laurel Hill Plantation and Clark Creek Natural Area, described below, are in the loess zone. Presumably other old growth pockets remain to be discovered. However, whether or not old growth is present, the fragile loess zone with its rich forests is in need of preservation.

Longleaf Pine areas that are not old growth may represent rare and valuable habitat. In Longleaf Pine ecosystems, the herbaceous layer may support hundreds of species. Thus the Longleaf is easier to restore to a site than is the ground layer; and a site with a good ground layer despite past logging is more valuable from a biological perspective than is a site that has not been logged but that has lost its natural ground layer. An example of the latter is the **Bienville Pines Scenic Area** in Bienville National Forest (Scott County), which, due to lack of fire, has a thick midstory, primarily comprised of hardwoods (Kittrell 1993, 2003). Two examples of the former in Louisiana are The Nature Conservancy's 287-acre **Willie Brown Preserve** (open to visitors by permission only; Hancock County) and portions of lands once owned by the University of Mississippi.

In the nineteenth century the US Navy owned approximately 22,000 acres of land in southern Mississippi. It cut the Longleaf for planks and masts. When steam became ascendant, the Navy donated the land to the University of Mississippi. The donation occurred before the 1920s-1930s when the general area, which was virgin timber, was clearcut. The University selectively logged its land; and, after 50 years of fire suppression, instituted burning every three years (Sorrie and Wieland 1997). As a result of the selective logging, the mature Longleaf on land that belonged to the university is relatively widely spaced, too widely for even-aged management, industry believes; but "probably

'overstocked' with regard to continuous natural regeneration." These stands have very high plant diversity in the groundcover (Brewer 2003).

The Nature Conservancy sponsored a biological review of the University lands in the 90s and recommended the maintenance of seven or eight conservation sites (Wieland 2003). They are mature, second-growth Longleaf Pine flatwoods and Longleaf Pine "claypan" savannas with pitcher plant bogs (Brewer 2003). Notable among these sites are Henley Park and Little Railroad Creek Headwaters. Both have high quality Longleaf with old-growth characteristics. Henley Park, though the site of the management and lodging facilities for university staff, has about 500 acres of mature Longleaf pine flatwoods (Brewer 2003). The 1200-acre Little Railroad Creek Headwaters (Stone County), as described by researchers in 1997, is composed of "undulating uplands dissected by numerous streamheads." Longleaf Pine woodland with a dense graminoid-herbaceous layer and a poorly-developed shrub layer is the dominant vegetation. The Longleaf are 70 or more years old. Land between the Longleaf and the drains is moist to boggy, with Slash Pine and seepage bog associations. In the drains are tupelo, magnolia, and maple, with abundant shrubs. Species diversity in the Headwaters is high, with well over 200 species in the uplands alone. Researchers ranked all three communities in Railroad Creek Headwaters "A" (Sorrie and Wieland 1997, Wieland 2003).

The University sold 20,857 acres of what Robbie Fisher of The Nature Conservancy describes as "good Longleaf Pine habitat" (2003) to DeSoto National Forest in 2000 and 2001. Before the sale, it clearcut 250 acres of Little Railroad Creek Headwaters, but in the process did not greatly disrupt the soil/herb layer except for skidding marks (Sorrie and Wieland 1997). As of February 2003, USFS had managed the lands received from the University only by prescribed burning. No logging had been done, and the agency was in the process of developing a management plan for the land (Smistik 2003).

J. S. Brewer studied two upland hardwood "old-growth forests" in Oxford (Lafayette County). The larger, a 49-acre site called **Bailey Woods**, with abundant Sweetgum and Southern Red Oak, may possibly be unlogged. The oldest trees that were aged, White Oaks and Post Oaks, were more than 150 years old. The smaller, **Jackson Strip**, is only a narrow strip of woods along a major road. Like Bailey Woods, this site had mature trees in the 1930s. However, Brewer hypothesizes that the area before settlement supported open oak woodlands and savannas that were unlike these two forests (Brewer 2001).

Grand Bay Savanna, southeastern Mississippi (Jackson County) and southwestern Alabama (Mobile County)

An extensive, probably partially unlogged savanna, grading into an estuary. The Mississippi Wildlife Viewing Guide characterizes Grand Bay as "the largest and least disturbed wet savanna in the United States" (Miss [2002]). Cecil Frost, who remembers the site as occupying more than 100 square miles, describes marshes along the coast and Longleaf Pine growing on slight rises inland. Where the soil inland is too wet and clayey for the pine, Pond Cypress savanna, shading into dense stands of Pond Cypress, is found. Between the marshes and the pine/cypress is natural Slash Pine savanna or forest. Frost cored Slash Pine and found it "quite old and uneven aged," and he believes that the Slash Pine is "probably old growth." Also he thinks that some of the Longleaf Pine and Pond Cypress areas have probably never been cut (1993). J. M. Valentine describes as "pretty much pristine" maybe 20,000 acres of intermingled savanna, forest, swamp, and low pocosin within Grand Bay. Construction of roads and powerlines destroyed a much larger area of the savanna to the north, he says. To Scott Hereford, Grand Bay is as an extensive "natural" savanna, "the last remaining expanse" (1993). Will McDearmin is cautious. The trees in the savanna were probably at least selectively cut, he says; and in a few areas people have tried to grow soy beans or Slash Pine. Nevertheless, overall the ground cover "is still good" (1993). Ron Wieland of Mississippi Natural Heritage believes that the area has been logged, possibly clearcut, but that the habitat is of "exceptional quality" (2001).

The US Fish and Wildlife Service is in the process of buying land for the Grand Bay National Wildlife Refuge. The Refuge currently totals 14,000 acres; eventually it should be more than 16,000 acres in size (Miss [2002]). The Refuge overlaps with the 18,400-acre Grand Bay National Estuarine Research Reserve, established in 1999 and managed by the Mississippi Department of Marine Resources (Wieland 2003).

Mississippi Sandhill Crane National Wildlife Refuge, southeastern Mississippi (Jackson County)

Up to 3200 acres of wet savanna, divided among several areas that have possibly had a minimum of logging and some tapping for turpentine. The Refuge as a whole occupies 20,000 acres and is composed of three separate units.

The timber companies did not begin planting trees in the coastal area of Jackson County until the 1950s, according to Valentine, who is the retired Fish and Wildlife Service biologist whose research led to the establishment of the Refuge. The 3200 acres looked the same to Valentine in 1963 as it did to a state geologist in 1855 and as it appears in aerial photographs from 1942 (Valentine 1993, Smith and Valentine 1985). Deferring to Valentine for details, Hereford, the Refuge's Wildlife Biologist, agrees that the Refuge includes uncut savanna (1993). Wieland, on the other hand, doubts that there is unlogged land (2001).

This savanna is a remnant, left because Slash Pine does not grow well in the wetlands. In the 1950s and 1960s thousands of acres of wet and mesic savanna were destroyed to create Slash Pine plantations for pulpwood. Between 1942 and 1981, for ten nesting areas of the Mississippi Sandhill Crane (approximately the southern half of the county), savanna decreased from 74% to 14%, while woodland increased from 18% to 70%. Now, because the crane likes to nest in wet savanna, the US Fish and Wildlife Service is restoring the land by bulldozing the Slash Pine, burning, and hand clearing. In the past, fires set by Indians and natural fires or, in some areas, the wetness of the land probably maintained the savanna.

In the wet savanna grow scattered Longleaf Pine, Pond Cypress, and, where planted, Slash Pine. Plants in the ground layer include wiregrasses, pitcher plants, sundews, yellow-eyed grasses, Toothache Grass, clubmosses, and Golden-crest (Valentine 1993, Valentine and Noble 1970, Smith and Valentine 1985, Hereford 1993).

Sky Lake,* central Mississippi (Humphreys County)

Some 500 or 600 little-logged acres with giant old Baldcypress trees surrounding a horseshoe-shaped lake. The trunks may be 10, 12, or 14 feet in diameter. The largest has a circumference of 48 feet 10 inches. The oldest trees are well over one 1000 years in age. Below the cypress grow Water Elm, Bitter Pecan, Water Locust, and a few other species.

Sky Lake is a former distributary of the Mississippi River, now largely silted in. The area where the cypress grow is under water for at least ten months of each year. The cypress grow slowly and live long, because the water is black, with tannic acid and relatively few nutrients. Little logging took place because the area is remote and the trees were relatively inaccessible, also because the area was not settled until after the Civil War. By that time the cypress were too large to be readily cut down and hauled away. The logging that did take place was of the smaller trees (Herring 2003).

The Mississipi Department of Fisheries and Wildlife, with the help of the National Fish and Wildlife Foundation, purchased 731 acres of land and water, divided among several parcels, which is now the Sky Lake Wildlife Management Area. About 300 of these acres support old cypress. The state land is at the northern end of the lake; private parties own the land at the southern end. Most of the land in the center of the horseshoe, is also in private hands and is used for agriculture (Tindall 2003). The US Army Corps of Engineers and the US Environmental Protection Agency are acquiring land in the area, mostly fields, and reforesting it. Plans are to eventually protect 20,000 acres in state and federal ownership (Herring 2003).

DELTA NATIONAL FOREST, Delta Ranger District, in west-central Mississippi (Sharkey County)

Bottomland old growth of uncertain extent within what is now a 60,000-acre National Forest. The US Forest Service (USFS) purchased 13,200 acres in the Mississippi River Delta in 1936. Most of the land acquired at that time was virgin forest. In 1940, it obtained additional acreage. USFS removed timber by selective cutting between 1938 and 1960, and then began to clearcut areas. It has set aside three, or possibly four, never-logged stands. The three are Research Natural Areas; the other a Botanical Area.

The forest adjacent to them has been selectively cut and looks "much like the virgin forests--only a few inconspicuous stumps show it was once logged" (McGinnis 1993). The Forest Service does not have available the acreage of the selectively logged forest (Hunter 1993). According to Albert Meier, the Forest could include as much as 1000 acres of only “very lightly cut” forest, plus additional acres of more heavily selectively cut forest (1997). Steve Leonard indicated on a map for us a small area of old-growth hardwoods with Baldcypress in sloughs (2003).

Since the construction of a levee system on the Mississippi River in the late l9th century, the hydrology of the area has been changing. Flooding is usually less severe than it once was, a change that may have an impact on succession. Delta National Forest is the only representative of a southern floodplain forest in the entire National Forest system (McGinnis 1993, Devall and Ramp 1992). Therefore the Forest needs not only protection from logging; but also, if possible, restoration of the hydrology.

--Cypress Bayou Botanical Area. A forest of 320 acres, with a birth date of 1874. The area was apparently not cut, and the trees there now probably originated after fire and disease (Youngblood 1993). Dominant trees are Overcup Oak, Green Ash, Sugarberry, Bitter Pecan, and Nuttall Oak. Associated with them are Sweetgum, Box Elder, Red Maple, and American Elm. Shrubs include Swamp Privet, Swamp Snowbell, and Green Hawthorn (Covington 1986).

--Green Ash Research Natural Area. 70 acres of virgin bottomland hardwood forest, dominated by Nuttall Oak, American Elm, and Green Ash. Also of importance are Baldcypress, Sugarberry, and Overcup Oak. Greenbriers and an occasional Dwarf Palmetto are the main species in the sparse understory. The area is usually flooded 1-3 weeks each year with 3-4 feet of water.

--Red Gum Research Natural Area (also known as Sweetgum RNA). 40 virgin acres, dominated by Sweetgum, 250 to 300 years old, Box Elder, Sugarberry and American Elm. Dwarf Palmetto and Cane are the chief shrubs. Among the plants in the herbaceous layer are blackberries, sedges, honeysuckle, and grasses. The RNA supports scattered Pondberry, a species listed federally as Endangered. A clay ridge underlies the northern three-fourths of the RNA and drains into a slough at the southern end. The ridge is seldom flooded (Devall et al. 2002).

--**Overcup Oak Research Natural Area**. 40 uncut acres in which Overcup Oak, Nuttall Oak, and American Elm dominate the canopy. Red Maple, Green Ash, and Sugarberry are of intermediate importance. In the understory greenbriers and an occasional Dwarf Palmetto predominate. The ground layer is similar to that in Red Oak RNA, but sparser because of more frequent and longer periods of flooding. Overcup Oak RNA is under water each spring for one to three weeks, although the water is seldom deeper than 3 feet (Devall and Ramp 1992).

DESOTO NATIONAL FOREST, in southeastern Mississippi (Jones County)

The Forest is 506,000 acres in size. (For the lands formerly owned by the University of Mississippi, see the introduction to this chapter.)

--Chickasawhay Ranger District. Within the district, approximately 235 acres of bottomland and scattered pockets of pine that the Forest Service believes were spared when massive logging occurred in the area in the 1930s. As far as the Forest Service knows, these acres were never cut. Trees prominent in the bottomland include White Oak, Water Oak, Black Gum, Swamp Chestnut Oak, American Beech, Southern Red Oak, and Baldcypress. The bottomland is part of a proposed 475-acre Tiger Creek Botanical Area. Also included in the area are a pitcher plant flat, Slash Pine flats, and a small ridge with Longleaf Pine. The proposed Botanical Area will in all probability not be logged even though it enjoys no formal protection, because private land blocks USFS's access to the site. Logging it would necessitate first building a bridge with a 60 foot or 70 foot span (Barwick 2003).

According to District Ranger Brady, the forest probably has some additional old growth, or at least sites without signs of logging, up and down Thompson Creek. One such site was previously identified in Thompson Creek bottoms; but before being notified of the site's importance the Forest Service logged it, Brady says. The creek runs for 12 miles through National Forest land, and the bottom is up to one mile wide (1993).

--Black Creek Ranger District.* Within the district, a 148-acre site that includes a "loblolly-bay forest and associated uplands." The loblolly-bay forest is listed as a representative site in the USFS booklet "An Old-Growth Definition for Evergreen Bay Forests . . ." The author M. R. McKevlin believes "it may be appropriate to assign old-growth status to those plant communities with individuals whose propagating parts are long-lived, whether the aboveground shoot is old by currently accepted standards." The site has been nominated as a Research Natural Area (McKevlin 1996).

Pascagoula River Wildlife Management Area, in southeastern Mississippi (George and Jackson Counties)

Possible old growth of unknown extent within 36,000 acres of bottomland hardwood forests and cypress-tupelo swamps. The forests are interspersed with nearly 50 oxbow lakes, and the Pascagoula River traverses the Area for more than 30 miles (Miss [2002]).

Stahle has cored two small areas of old-growth Baldcypress on the lower Pascagoula (1993). According to Murrah, the Wildlife Management Area has had spot, selective logging, but was never clearcut. Here are Baldcypress up to 35.5 feet in circumference, and Live, Red, and Water Oak 15 feet to 20 feet around (1993). Jones described the area as a fine example of bottomland hardwoods, although portions have been high graded. Parts of the area are considered to be old-growth bottomland hardwoods or bottomland swamp hardwoods, he says (1993). Gordon, on the other hand, said that the land has been high graded four or five times and has no old growth (1993).

More recently Wieland expressed the view that the area includes old growth, although significant large areas were high graded (2003).

The Mississippi Department of Wildlife, Fisheries, and Parks owns and manages the area (TNC [nd]). The forests have no lasting protection. The Area includes state-designated Natural Areas that are "fairly protected," but the state could remove their designation (Wieland 2003).

Laurel Hill Plantation* southwestern Mississippi (Adams County)

Old growth of uncertain extent on the escarpment of a loess bluff within a 1560-acre privately-owned plantation. The escarpment, has not been logged for 130-150 years, if ever. Trees here are typical of oak-hickory forests with added Southern Magnolia, Loblolly Pine, and abundant Water Oak. The entire property is protected by a conservation easement, which is held by both the Mississippi Department of Archives and History (because of historic buildings on the property) and the Mississippi Wildlife Fisheries Commission. By the terms of the easement, 350 acres that include the possibly uncut escarpment cannot be logged; the balance of the forest, which has been abused, can be sustainably logged (Moody 2003, Conrad 2003).

Wrenwoode Natural Area,* northeastern Mississippi (Monroe County)

Within a 176-acre property, upland forest that is possibly old growth. The Presbyterian Church bought the land in 1945 for a summer camp and conference center. The church constructed a reservoir and buildings. However, it did not disrupt the forest outside the construction area, and possibly that forest was little disrupted earlier, as the topography is rough. A seventy-foot bluff is one of the tallest in Mississippi. The forest, approximately 75% hardwood and 25% pine, is of "very high quality," Wieland states (2003). Twenty plants that are on the Natural Heritage Program's special plant list are found on the property. In 2002, the Presbytery of Mississippi donated the property to Wrenwoode Trust and donated a conservation easement to the Mississippi Land Trust (Cummins 2003).

Flat Rock Reserve ,* southwestern corner of Mississippi (Wilkinson County)

A sixty-five-acre tract of Longleaf and Loblolly Pine that reportedly has been little logged. Ninety-year old Cletus McCurley recalls that his father and a coworker asked the Crosby Lumber and Manufacturing Company, which employed them, to set aside the tract. They wanted to save "a small area of virgin timber for people to see in later years." St. Regis Lumber Company acquired the reserve in 1965 and Georgia-Pacific Corporation in 1985. Both St. Regis and Georgia-Pacific agreed orally to protect the reserve. In 2001, Plum Creek Timber Company acquired the reserve from Georgia-Pacific (McCraine 2002). As of January 2003, the company was trying to learn more about the history of the reserve before deciding whether to cut any of the trees (Hart 2003). The area is in need of restoration, since hardwoods have grown up (with fire suppression) and shade out pine seedlings (McCraine 2002).

Raglan Hills,* southeastern Mississipppi (Forrest and Perry Counties)

Some 60 acres of possibly unlogged beech-magnolia forest along a bluff on the Leaf River. Some three hundred acres that were part of the same site as the 60 acres but across a highway from it have been logged. The site is privately owned (Gordon 1993, Wieland 2003).

Clark Creek Natural Area,* southwestern Mississippi (Wilkinson County)

Small areas of possible old-growth forest within a 7000-acre natural area with steep loess-bluff hills. J. Herring told us that the forest, though of fine quality, was logged before the state purchased it (2003). However, he also noted that the bluffs rise as much as 330 feet with 70-80% slopes. J. Conrad writes that loggers presumably took all they could but that the many ravines cut into the bluffs are so steep that they are unlikely to have been touched. The hills support a mixed hardwood-pine forest in which beech and magnolia dominate (Conrad 2003).

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NORTH CAROLINA

In much of North Carolina, particularly in the mountains, mapping old growth is difficult, as Michael Schafale of the Natural Heritage Program has explained. In the past much of the logging involved removing the best trees. As a result, we find today extensive areas of forest that have been highgraded. The number of trees that escaped cutting, because they were (from a logger's perspective) undersized, malformed, inaccessible, or of unwanted species, varies with the site. On ridge tops and some upland slopes, which are prone to fire, researchers find many pockets of trees that look as though they were never logged. In moist gorges and coves are old hemlock, left when hardwoods were removed. No matter what the environment, however, we find today "a range of remnant forests, from those that clearly seem to have the characteristics of old-growth, to those that clearly don't" (Schafale 1992).

The chestnut blight further complicates the situation. American Chestnut that died in the early part of the century because of the blight were often removed. Today, stands that show evidence of logging may have experienced only the salvage cutting of chestnut; and some entire stands are now young, only because of the death of chestnut. "All of these factors make it hard to know what to classify as old-growth, even when you know everything you want to about a place," Schafale explained (1992).

In May 2000 a report on "Old-Growth Forest Communities in the Nantahala-Pisgah National Forest," compiled by Rob Messick, was released. For the report, Messick adopted a classification system that takes into account the problems of which Schafale speaks. The report documents 77,000 acres of Class A and Class B old growth in the Pisgah and Nantahala National Forests. Some fifty researchers in total contributed to the catalog.

Messick, weary of climbing through rhododendron thickets and of crunching acreage numbers, entitled the work a "Final Report," but, after a brief respite, he is again in the field. An inventory and catalog of the Blue Ridge Province has been funded for 2003. Rob Messick will head up the field work. He will receive much assistance from grassroots forest watch groups. It will mainly cover US Forest Service (USFS) lands in Georgia (Chattahoochee National Forest) and Tennessee (Cherokee National Forest). It will also include corrections and additions to the North Carolina catalog (Nantahala-Pisgah National Forest) that have come in since the report was released. Researchers have made new primary forest discoveries that need to be cataloged and digitized for acreage estimates. A final Blue Ridge Province catalog will be prepared in 2004. The Southern Appalachian Forest Coalition (SAFC) and The Wilderness Society are the sponsors (Messick 2002).

Because North Carolina has a large number of old-growth sites within vastly different regions, we have grouped the state's sites into two geographic sections: Mountains, Outlier Mountains and Piedmont, and Coast and Coastal Plain.

MOUNTAINS AND PIEDMONT

Two broad classes of rock types occur in the Blue Ridge Province of western North Carolina: predominantly crystalline substrates and predominantly metasedimentary substrates. The rock types differ markedly from one another, and their presence helps explain some of the broad-scale differences among forest types in the province. The Unicoi Mountains, Smoky Mountains, and parts of the Unaka Mountains, the Nantahala Mountains, and the Grandfather Window are in the metasedimentary category. The Black Mountains, Balsam Mountains, Cowee Mountains (Blue Ridge), parts of the Grandfather and Linville Mountain areas, and parts of the Unaka Mountains and Nantahala Mountains are in the crystalline category. An 1898 North Carolina Geological Survey map shows these basic rock types, and they are reflected more precisely in a map of the "Ecoregions of North Carolina" produced and reviewed in 2002 by the United States Forest Service, Environmental Protection Agency (EPA), North Carolina Natural Heritage Program, and other agencies. The rock types explain in part why the Great Smoky Mountains and the Grandfather District of Pisgah National Forest are as dissimilar as they are (Messick 2002 personal communication).

Great Smoky Mountains National Park

Extensive but undetermined acreage of old-growth forest exists within the 520,000-acre park. Estimates of acreage vary. Robert Leverett writes that the park has approximately 150,000 acres of old growth; that is, approximately 29.8% of the Park is old growth (Leverett 2002). "Trees and Forests," a brochure copyrighted in 1998 by the Great Smoky Mountains Natural History Association states that biologists estimate that the Park contains "over 100,000 acres [of never logged forest](about 20 percent of the park)." In 1992 the National Park Service, by overlaying satellite derived data on data regarding disturbances to the forest, produced a map indicating that 35.9% of the Park (187,000 acres) is uncut. NPS's Keith R. Langdon thought that these statistics were "probably 'ballpark' correct." Based on the map, the areas of the various types of old growth and the percentages of all old growth in the Park for these types follow: spruce/fir, 10,623 acres (5.7%); northern hardwood, 28,649 acres (15.3%); cove hardwood, 72,334 acres (38.7%); mesic oak, 12,948 acres (6.9%); mixed mesic hardwood, 24,782 acres (13.3%); Tulip Poplar, 3,188 acres (1.7%); xeric oak, 15,100 acres (8.1%); pine/oak, 1636 acres (0.9%); pine, 15,590 acres (8.4%); heath bald, 1438 acres (0.8%); grassy bald, 35 acres (0.02%); grape thicket, 220 acres (0.12%) (Langdon 1992).

Charlotte Pyle (1988) calculated that 20% of the Park is "high in virgin attributes." Her figure was based on "the absence [for a given area] of written records concerning historical human impacts on the forest and the absence of any mapped record of human land use" rather than on ground truthing. Her methods may not have taken into account Class B old growth, Messick notes (2002). The Park Service used her disturbance history in making its map (Langdon 1992). Pyle found that 20 of the 28 major watersheds contain acreages high in virgin forest attributes, but that 70% is in six watersheds: in Tennessee, the Middle and West Prongs of the Little Pigeon River (67% and 44% virgin forest attributes); and in North Carolina, Deep Creek (68%), Bradley Fork (54%), Raven Fork (97%), and Cataloochee Creek (32%). In Tennessee, the lower boundary of the virgin forests is generally 3000 feet; in North Carolina it is variable, as logging in places went into the spruce-fir zone, which starts at about 4500 feet in the eastern and central areas of the Park (Pyle 1988).

Among the numerous trails along which old growth lies are **Alum Cave Bluff Trail*** (Yellow Birch, hemlock, and Red Spruce**); Applachian Trail*** between Newfound Gap and Clingmans Dome (spruce-fir forest); **Boogerman Loop Trail*** (Tulip Trees, hemlocks, and White Pines that are among the Park's largest and tallest); **Cove Hardwood Nature Trail**; **Fork Ridge Trail*** (northern hardwood forest); and **Ramsay Cascades Trail*** (varied stands with Black Cherry conspicuous)(Earley 1992; Leverett 2001; GSM Natural History Association 1998).

The Park Service has mapped in the field a sampling of mesic oak and hemlock old growth in order to get baseline data on oak and hemlock stands before the arrival of the Gypsy Moth and the Hemlock Wooly Adelgid. Researchers delineated a total of 959 ha in 86 stands. The hemlock stands, unlike the oak, included areas showing little or no anthropogenic disturbance. Because of the loss of the American Chestnut, only two oak forests received the staff's highest rating (Yost 1994). William Blozan, one of the report's authors, has continued his research in the Park and has identified more than a dozen national champion trees there.

Non-native insects and fungi are killing trees in the Smokies. The Balsam Wooly Adelgid has decimated the mature Fraser Fir; and Dogwood Anthracnose has killed thousands of Flowering Dogwood (GSM Natural History Association 1998). In mid-May 2002 the arrival of the Hemlock Woolly Adelgid was confirmed. Park biologists have released the tiny predator beetle, *Pseudoscymnus tsugae* in an attempt to control this insect (Gray 2002). Other factors adversely affecting the Park include acid precipitation, ground-level ozone, and crowds of visitors, particularly those driving automobiles. Most of the visitors do not, however, leave their cars or go deep into the Park, which helps to keep the back country intact.

On a more cheerful note, scientists are conducting at the park the All Taxa Biodiversity Inventory, the first complete natural inventory of any US National Park. They estimate that the park supports 40,000 to 70,000 multicellular species, only some 10% of which had been identified when the inventory started. The inventory began in 1999 and is expected to last ten to fifteen years (Braasch 2000, Henderson 1999).

NANTAHALA-PISGAH NATIONAL FORESTS

Old-Growth Forest Communities in the Nantahala-Pisgah National Forest: Final Report (May 2000), compiled by Rob Messick, presents 77,418 acres of delineated old growth in the two forests. The forests have a total land base of 1,033,999 acres. Thus 7.5% of the land base is verified old growth. The 77,418 acres represent 141 sites that 15 field researchers, each with much experience, have verified and delineated. The report also lists 267 candidate sites deemed worthy of a visit.

The report characterizes forests as Class A, B+, B, or C. Class A is forest "where no significant signs of human disturbance to the forest canopy or understory could be determined. Canopies are dominated by older trees generally over 150 years of age." Class B is forest in which either 1) "the canopy is dominated by old-growth trees, yet signs of past human disturbance to the forest canopy or understory were found (generally a half century ago or longer)." These stands have often been impacted by American Chestnut blight; or 2) "no sign of past human disturbance could be confirmed, yet the forest canopy is dominated by younger forest. These stands can range from 100 to 150 years in age and were possibly affected by natural disturbances." Class B+ forest has Class A and Class B characteristics. "Sites in this class tend to be large, with numerous forest communities." Class A, B+, and B forest is considered to be old growth. Class C forest, "with obvious signs of past human disturbance" is not. "Forests in this class are suitable for old-growth recovery," Messick states. The system is an adaptation of that used by the Great Smoky Mountains National Park's Old-Growth Team in its study of mesic oak and hemlock forests.

Of the 77,418 acres of old growth listed in the May 2000 report, 36,379 acres are Class A; 23,839 are Class B+; and 17,200 are Class B.

In the Nantahala-Pisgah National Forest, the Southern Appalachian Assessment (1996) presents 32 inventoried roadless areas for a total of 152,378 acres. Twenty-one of these roadless areas include a total of 28,506 acres of old growth. Thus 37% of the delineated Nantahala-Pisgah old growth lies with inventoried roadless areas.

The report considers 30 forest types and presents 779 occurrences ("an occurrence can be defined as a forest type found in a definite location in the landscape"). Eight forest types account for 84% of the occurrences: dry oak (172), submesic oak (113), rich cove (108), acidic cove (81), high elevation northern red oak (71), northern hardwood (43), dry oak-pine (38), pine-oak heath (26).

For the report, Messick grouped the listed sites into ten clusters. We present these clusters below, by National Forest. Messick identified the clusters with capital letters of the alphabet and numbered the sites within the clusters. We give these designations in parenthesis to assist readers in referring to the report. We describe only selected sites within each cluster: those with 500 acres or more of old growth (30 sites in total) and, to provide continuity with the 1993 Survey of Eastern Old Growth, sites that were presented in that guide, most of which were smaller. We list sites in the geographic order that Messick presented them rather than in order of size. We include information on protection status, if provided by the report. We also give elevations when the report states them for an entire site. Unless otherwise indicated, all information comes from the "Site Specific Catalog of Old-Growth Forest Communities in the Nantahala-Pisgah National Forest: Final Report," compiled by Rob Messick.

We should note that identification of old growth did not come to a halt with the publication of Messick's report. Researchers continue to find undocumented old growth. In 2001 and 2002 Messick and others made significant new discoveries of old growth in the following mountain ranges: Balsam Mountains (4), Black Mountains (3), Grandfather Mountain (1), Unaka Mountains (1). With the help of Jess Riddle, two state champion trees were nominated in November 2002, Fraser's Magnolia and Great Rhodendron. In July 2001, the North Carolina Vegetative Survey did large repeatable plots in many old-growth areas in Pisgah National Forest (mainly the Grandfather District).

NANTAHALA NATIONAL FOREST

--Unicoi Cluster (A) in the Tusquitee and Cheoah Districts, Hiwassee and Little Tennessee River Basins (Cherokee and Graham Counties)

A total of 8 delineated sites with 8313 acres of old growth. The cluster has 12 candidate sites.

----*Santeetlah Bluffs* (A 11) with 718 acres of Class A old growth. Forest types are acidic cove, hemlock, hemlock-mixed mesophytic, high elevation Northern Red Oak, and rich cove.

----*Little Santeetlah Creek / Upper Slickrock Cree*k* (Joyce Kilmer Wilderness) (A 13) with 5926 acres of Class A old growth. Forest types include hemlock-mixed mesophytic (along Memorial Loop Trail), acidic cove, northern hardwood or rich cove, and hemlock forest. The entire 5926 acres is preserved as Wilderness.

----*Yellowhammer Branch / Ike Branch** (A 18) with 844 acres of Class B+ old growth. Forest types include acidic cove, dry oak, hemlock-mixed mesophytic, submesic oak.

--Topton Cluster (B) in the Cheoah, Tusquitee, and Wayah Districts, Hiwassee and Little Tennessee River Basins (Cherokee, Clay, Graham, Macon, and Swain Counties)

A total of 24 delineated sites with 16,827 acres of old growth. The cluster has 25 candidate sites.

----*Cheoah Bald* *(B 8) with 4831 acres of Class A old growth, at elevations of 2000 -4550 feet. Forest types are northern hardwood (at upper elevations), high elevation Northern Red Oak, mesic oak, submesic oak, dry oak, rich cove, low-elevation rich cove, basic mesic forest, and pine-oak heath.

----*Briertown Mountain** (B 9) with 988 acres of Class A old growth. Forest types are mesic oak, dry oak, low elevation rich cove, and basic mesic forest (pp. 21-23). The Briertown Mountain site includes Blowing Springs, a USFS Special Interest Area, which supports numerous calcareous herbaceous species and some American Elm.

----*Upper Nantahala George** (southwest side) (B 11) with 906 acres of Class B+ old growth. Forest types are hemlock-northern hardwood and mesic oak.

----*Upper Dicks Creek** (B 17) with 846 acres of Class A old growth. Forest types are acidic cove, alluvial birch-poplar, dry oak, high elevation Northern Red Oak.

----*High Peak-Snowbird Mountains** (B 23) with 1946 acres of Class B+ old growth. Forest types are high elevation Northern Red Oak, mesic oak, dry oak, rich cove, acidic cove, hemlock-mixed mesophytic, and subxeric oak.

----*Valley River Mountains / Tusquitee Mountains** (B 26), with 1110 acres of Class A old growth, 2699 acres of Class B+ old growth, and 137 acres of Class B old growth. Forest types include northern hardwood, hemlock-northern hardwood, high elevation Northern Red Oak, submesic oak, dry oak, rich cove, acidic cove, and subxeric pine. This site includes the Big Choga Creek area with unspecified acreage of hemlock-northern hardwood and rich cove old growth.

----*Wesser Bald** (B 34) with 909 acres of Class A old growth and 322 acres of Class B old growth. Forest types are high elevation Northern Red Oak, submesic oak, dry oak, dry oak-pine, rich cove, acidic cove, pine-oak heath.

----*Wayah Bald Area--Upper Big Laurel Creek* (B 45) supports 15 acres of Class B+ old growth. The forest type is northern hardwoods. Ray Branch (B 43) has steep upland slopes that may be unlogged. Wayah Bald (south slopes) (B 44) includes the candidate old-growth sites Upper Camp Creek and Upper Bear Cove Creek. (Wayah Bald is mentioned in the 1993 edition of this guide.)

--Southern Nantahala Cluster (C) in the Wayah and Tusquitee Districts, Hiwassee, Little Tennessee, and Savannah River Basins (Clay and Macon Counties)

A total of 3 delineated sites with 2220 acres of old growth. The cluster includes 18 candidate sites.

----*Bearpen Gap** (C 4) in the Coweeta Hydrological Laboratory, described in the 1993 edition of this guide, under the names of Bakers Creek and Dryman Creek, as approximately 270 acres of old-growth upland hardwood forest (Dahl 1990). Messick, who lists Bearpen Gap as a candidate site, notes that these two names do not appear on standard topo maps but that "the area in question is most likely on steep headwater slopes on the east side of Nantahala Mountain ridge."

----*Beech Creek* (C 8) in the Southern Nantahala Wilderness, described in the 1993 edition of this guide as 50 or more acres of old-growth forest, dominated by Northern Red Oak, on cliffs at the head of Beech Creek (Wharton 1993). Messick, who lists Beech Creek as a candidate, notes that it "is likely other steep sections of this watershed were missed by early logging operations."

----*Blue Ridge / Chunky Gal Mountain* *(C 12), with 1347 acres of Class B+ old growth. Forest types are high elevation Northern Red Oak and rich cove.

----*Boteler Peak** (C 17), with 794 acres of Class B + old growth. Forest types are dry northern hardwood, mesic northern hardwood, high elevation Northern Red Oak, rich cove, acidic cove, subxeric oak.

--Highlands Cluster (D) in the Highlands District, Nantahala National Forest, Savannah and Little Tennessee River Basins (Jackson, Macon, and Transylvania Counties).

A total of 26 delineated sites with 2842 acres of old growth. The cluster has 21 candidate sites.

----*Whitewater River Gorge* (D 3) with 30 or 40 acres, described in the 1993 edition of this guide as having never been logged. Here Carolina Hemlock grows next to Eastern Hemlock. Also White Pine, Tulip Tree, hickory, and oak grow on the deep, rich soils (Cawrse 1993). Stephen Sonderman found many downed trees in parts of the area.

----*Chattooga Cliffs* (D 8) is described in the 1993 guide under Chattooga Wild River Gorge as having patches of old growth. Some small ridge tops and "rugged cliffy areas" seem to be old growth (Pittillo 1993). Remnants survive down in the gorge, in particular in the Iron Bridge area, and on the top of Glade Mountain. Near the juncture of the Chattooga and another gorge is a 5 or 10-acre pristine area, dominated by hemlock, with many other species (Cawrse 1993). Messick and Zahner list Chatooga Cliffs as a candidate area: "Steep cliffs north and south of Bullpen Mountain likely have old-growth forests." The cliffs are in the protected Chattooga Wild and

Scenic River Corridor. Paul Carlson searched for old growth in the Chattooga River Watershed for a 1995 report for USFS. This report was among Messick's sources.

----*Fodderstack Mountain* (D 19) with 157 acres of Class A old growth, mentioned in the 1993 version of this guide. The forest types are subxeric pine, represented by Pitch Pine (Big Fodderstack Mountain), hemlock forest (in the saddle between Big Fodderstack and Little Fodderstack and on a ridge to the west), and dry oak (on Little Fodderstack Mountain). The oldest Pitch Pine are about 400 years old and are dwarfed and gnarly. Between the groves of Pitch Pine is open slick rock with rare and endemic mosses and lichens. In 1875, the Ravenel family bought what was later known as the Fodderstack Mountain Estate Preserve as part of a 100,000-acre estate. It was passed down through the family who preserved it in its original condition. Windfalls have been the only disturbance (Zahner 1993, Gaddy 1992). The Nature Conservancy recently bought the land and turned it over to USFS. It is a protected area (Zahner 1998).

----*Whiterock Mountain* (including Whiterock Gap and the Bartram Trail Natural Area) (D 32) with 389 acres of Class B+ old growth, mentioned in the 1993 edition of this guide. The site is in the Fishhawk Mountain Range. Forest types are hemlock-northern hardwood and high elevation Northern Red Oak, the latter found near 4300 feet on the northeast side of the main ridge joining Little Fishhawk Mountain and Whiterock Gap. A big White Oak felled near the Bartram Trail had 400 to 450 rings. The only tree removal has been the salvage with horses of dead chestnut in the 1930s (Zahner 1993).

----*Piney Knob Fork Natural Area* (D 33) with 125 acres of old growth. The 1993 edition of Old Growth in the East described it as a 125-acre Eastern Hemlock-White Pine community within a deep ravine through which a stream named Piney Knob Fork runs. The upstream portion of the site supports old-growth Eastern Hemlock and White Pine to almost 3 feet in diameter. Catawba Rhododendron, which dominates the understory, is as much as 25 feet tall. Downstream, loggers in recent decades cut several areas where young trees now grow. However, the largest hemlocks on the site occur just east of these young patches. Some of these are more than 100 feet tall and almost 4 feet in diameter. Piney Knob Fork is a Natural Area of the Society of American Foresters and is protected (Gaddy 1992, Zahner 1998).

----*South Skitty Branch* (D 41), mentioned in the 1993 guide as having 30 acres of Class A old growth. The 30 acres include hemlock forest and high elevation Northern Red Oak. The lower part of the site has Eastern Hemlock over 90 cm (about 3 feet) in diameter at breast height (Gaddy 1992, Zahner 1993).

----*Kelsey Tract* (D 43), with 271 acres of Class B+ old growth, mentioned in the 1993 edition of this guide. The Kelsey Tract is a remnant of Ravenel's Woods, and was once almost 1000 acres of old-growth Eastern Hemlock and Carolina Hemlock, northeast of Highlands. The southern part of the Kelsey Tract is dominated by Eastern Hemlock up to 120 cm dbh (diameter at breast height). The main ridge top, which cuts through the middle of the site, supports a mixture of Eastern Hemlock and Carolina Hemlock and also forests with Carolina Hemlock, Table Mountain Pine, and mixed northern hardwoods. The slopes above 4000 feet on the east side of Ammons Branch support Carolina Hemlock forest with some Tulip Trees and Eastern Hemlock. The upper Ammons Branch watershed near 4000 feet has acidic cove forest. The Kelsey Tract provides habitat for four species of rhododendron, and a rare disjunct species of moss from the Dominican Republic (Gaddy 1992, Zahner 1993). The Kelsey site is a protected natural area (Zahner 1998) and is adjacent to the privately owned Henry Wright Preserve (Pittillo 1998).

----*Shortoff Mountain / Cole Mountain* (D 45) with 502 acres of Class B+ old growth. Forest types are dry oak, high elevation Northern Red Oak, and northern hardwood (pp.83). Zahner described Cole Mountain Natural Area in 1993 as having approximately 200 acres of old-growth northern hardwoods on the north slopes of the mountain and old-growth White Oak and Northern Red Oak on the south slopes. The trees are not ancient but are very big and have old forest characteristics, including uneven age. The only disruption has been the salvaging of some big chestnut trees on the south slope in the 1930s. The Natural Area, which is protected, shelters many endemic and rare herbaceous plants (Zahner 1993, 1998).

----*Yellow Mountain* (D 46), described in the 1993 edition of this guide, as 50 to 100 acres of wind-blown, bonzai-type White Oak, growing on rocky ground. A few trees may have been cut to clear the view when a fire tower was put up, but Ranger David Cawrse suspects that the trees, which are not very tall, were short enough to have been left alone (1993, Pittillo 1993). Messick adds that the mountain has "steep dry slopes that were likely avoided by early logging operations."

--Cowee Cluster (E) in the Highlands and Wayah Districts, Nantahala National Forest, Little Tennessee River Basin (Jackson and Macon Counties)

A total of 5 delineated sites with 211 acres of old growth. The area has 15 candidate sites.

--Balsams Cluster(F) in the Highlands and Wayah Districts, Nantahala National Forest, Little Tennessee River Basin (Jackson County)

A total of 5 delineated sites with 401 acres of delineated old growth. The area has 16 candidate sites. Four of the candidates, Lone Bald, Wolf Mountain, Upper Greenland Creek, Bonas Defeat, were listed in the 1993 edition of this guide under other names.

----*Lone Bald** (F 9), near the site listed in 1993 as Cherry Cove, with well over 100 acres of old growth (Leverett 1990). Messick writes that, according to a USFS map, dated May 2001, Cherry Cove is not on USFS land. The site is northeast of Lone Bald. Alan Smith describes the site as supporting Red Spruce forest, northern hardwoods, and two rare plant species. The old growth is in pockets; fire slides and erosion have affected some areas (Smith 1993).

----*Wolf Mountain* (Northwest) (F 18) on steep slopes between Cold Creek and Horseshoe Rock on USFS land. This site may be the location of the Wolf Creek Gorge listed in the 1993 guide. As of 1998, however, the Nantahala Power Company, a subsidiary of Duke Energy Corporation, controlled much of the land within Wolf Creek Gorge (Pittillo 1998).

-----*Bonas Defeat* *(F 20), likely described in 1993 as Tuckasegee River Gorge with a possible 500 acres of old growth. Pittillo related in 1993 that Herbert Nicholson, the former caretaker for Liberty Properties (which owned the area) and the son of a logger for the timber company, told him that the loggers "were [told] to stay 500 feet from the river" (Pittillo 1993). The vegetation in the gorge is primarily cove forest: Eastern Hemlock and Carolina Hemlock, the latter only on bluffs and on the edges of the stream bed; Fraser's Magnolia; Tulip Tree; and other cove species (Pittillo 1976). Scott Wood of Raleigh nominated Bonas Defeat for the survey. Messick notes that it is an area of rough topography between reservoirs on USFS land.

----*Upper Greenland Creek** (F 21), described in 1993 as Panthertown Valley with a few remnant stands of old growth. Loggers clearcut most of the valley in the 1920s and 30s, and fire went all through the valley. Nevertheless, dwarfed White Oak and Table Mountain Pine remained near the rock outcrops of Little Green, Big Green, and Blackrock Mountains. Also, a couple of acres of old hemlock forest grew along waterfalls (Pittillo 1993, Cawrse 1993).

PISGAH NATIONAL FOREST

--Mount Pisgah Cluster (G) in the Pisgah District, French Broad River basin (Buncome, Haywood, Henderson, and Transylvania Counties; p. 92)

A total of 5 delineated sites with 2559 acres of old growth. The cluster includes 52 candidate sites, five of which were mentioned in the 1993 edition of this guide.i

----*Mount Hardy* (Middle Prong Wilderness) (G 4), referred to in the 1993 guide as Fork Ridge, Mount Hardy with "one of the best quality mature beech buckeye forests in the Southern Appalachians" (Dahl 1990).

----*Yellowstone Falls* (G 10) referred to in the earlier edition under Side of Graveyard Ridge, with at least 75 acres of old growth dominated by hemlock (Leverett 1990). Messick lists Yellowstone Falls as a candidate site.

----*Pisgah Ridge** (G 20), with 1867 acres of Class A old growth and 240 acres of Class B+ old growth. Forest types are spruce-northern hardwood, red spruce forest, northern hardwood (mesic, dry, and boulderfield), high elevation Northern Red Oak, mesic oak, dry oak, acidic cove, and rich cove. This area has the largest diameter Red Spruce found on Pisgah National Forest land, 43 inches dbh.

----*Pilot Rock / Upper Bradley Creek* (G 43) and Buttermilk Mountain (G 5), referred to as Bradley Creek in the 1993 guide. Bradley Creek was described as having old-growth hemlock scattered through an unlogged 5 to 10-acre area (Rowe 1993).

----*Mount Pisgah* (G 50), mentioned in the earlier edition as supporting at least 100 acres of old-growth. A figure of close to 500 acres is more accurate (Smith 1993). Messick points out that Alan Smith, in a Natural Areas Inventory for Haywood County (1993), described Red Spruce forest grading to high quality high elevation Northern Red Oak forest on upland slopes of many aspects on Mount Pisgah. Cove areas that are more moist grade to northern hardwood with dominant Yellow Birch. Shrubs are often abundant in the understory (Messick 2002).

--Grandfather Cluster (H) in the Grandfather District of Pisgah National Forest, Catawba River Basin (McDowell, Caldwell, Burke, and Avery Counties)

A total of 57 delineated sites (plus 18 candidate sites worthy of a visit) with 38,937 acres of delineated old growth (15,233 acres of class A, 11,472 of Class B+, and 12,232 of Class B).

The Grandfather District encompasses 189,000 acres, at least 20% of which is old growth. Messick subdivided the cluster into three areas: Black Mountain, Linville, and Grandfather.

Black Mountains Area, with 11 delineated sites and 11,102 acres of delineated old growth [not to be confused with the Black Mountains Cluster, see below].

----*Heartbreak Ridge* *(H 7) with 3055 acres of Class B+ old growth at elevations of 2200-4700 feet. Forest types are high elevation Northern Red Oak, mesic oak, submesic oak, dry oak, acidic cove, alluvial-birch-poplar, Carolina Hemlock, rich cove, hemlock-mixed mesophytic, hemlock-northern hardwoods. The site, which is part of USFS old-growth patch #26, is not in the timber base. Almost all of it is within the 7500-acre Jarrett Creek Roadless Area. On most edges, it is bordered by other USFS land and the Blue Ridge Parkway.

----*Mackey Mountain / Chestnutwood Mountain* (H 9) with 5008 acres of Class B+ old growth at elevations of 2000-3990 feet. Messick divides the site into two sections: Mackey Mountain and Chestnutwood Mountain.

Forest types in the Mackey Mountain Section are similar to those in H7 above, with the addition of pine-oak heath. The Mackey Mountain Section is part of old-growth patch #27 and is not in the timber base. Most of the delineated old growth is within the 5934-acre Mackey Mountain Roadless Area. Other USFS land surrounds it on almost all sides.

Forest types in the Chestnutwood Mountain section are submesic oak, dry oak, dry oak-pine, pine-oak heath, acidic cove, rich cove, lower elevation rich cove, hemlock-mixed mesophytic, and Carolina Hemlock. The Chestnutwood Mountain Section is part of old-growth patch #27 and is outside the timber base except for old growth on toe slopes near Curtis Creek. Most of it is in the Mackey Mountain Roadless Area.

----*Horsetrail Gap** (H 11) with 398 acres of Class B+ old growth and 149 acres of Class B old growth at elevations of 2200-4000 feet. Forest types are high elevation Northern Red Oak, mesic oak, submesic oak, dry oak, dry oak-pine, subxeric pine, acidic cove, and rich cove. Horsetrail Gap is within large old-growth patch #27 and is not in the timber base. All of this site should be part of the Mackey Mountain Roadless Area.
Now only a small portion is in this area. Other USFS land and the Blue Ridge Parkway lie along most of the site's border.

----*Upper Armstrong Creek** (H 12) with 690 acres of Class B old growth at elevations of 2600-3680 feet. Forest types are high-elevation Northern Red Oak, mesic oak, submesic oak, dry oak, pine-oak heath, and rich cove. This site is part of USFS old-growth patch #27, and is not in the timber base. Most of it lies within the 9606-acre Woods Mountain Roadless Area. Other USFS land and the Blue Ridge Parkway surround it.

Linville Area, with 14 delineated sites and 18,734 acres of delineated old growth. Five candidate sites were deemed worthy of a site visit.

----*Linville Mountain** (H 23) with 292 acres of Class A old growth and 394 acres of Class B old growth at elevations of 2200-3650 feet. Forest types are submesic oak, dry oak, dry oak-pine, pine-oak heath, acidic cove, and hemlock forest. The site is part of old growth patch #28 and is not in the timber base.

----*Dobson Knob** (H 24) with 4042 acres of Class A old growth and 279 acres of Class B old growth at elevations of 1600-3700 feet. "Dobson Knob is a massif with many ridge slopes and valley slopes dropping off from two peaks. It is at the terminus of Linville Mountain Ridge." Most of the mountain was not logged, because the timber was not saleable, slopes were steep, and "acidic quartzite boulderfields" were present. Researchers have found the following forest types: dry oak, dry-oak-pine, pine-oak heath, subxeric pine, acidic cove, and Carolina Hemlock. The site comprises most of the 6128-acre Dobson Knob Roadless Area. It is also part of USFS's large old-growth patch #28. Except for an area on the west side at the foot of Dobson Knob, the site is not in the current timber base.

----*Linville Gorge* (H 25) with 10,039 acres of Class A old growth and 193 acres of Class B old growth at elevations of 1300-4000 feet. No industrial logging took place in Linville Gorge. Forest types are submesic oak, dry oak, dry oak-pine, pine-oak heath, subxeric pine, acidic cove, hemlock forest, mixed riverine, beech-Sweetgum . The last may be a relic of the mixed mesophytic and northern hardwood forests that were common in the area during glaciation to the north. Three patches of the rare Mountain Heather (*Hudsonia montana*) are present. The gorge is part of USFS old-growth patch #28 and is the only designated Wilderness Area in the Grandfather District. In 1984 the Wilderness was expanded southward to include much of Shortoff Mountain (H 26) and the Pinnacle. A trail extends along the ridge of Shortoff Mountain. The steep slopes near the trail are largely unlogged.

----*Upper Creek Gorge** (H 34) with 698 acres of Class B old growth at elevations of 1450-2500 feet. Forest types are submesic oak, dry oak, and acidic cove. The site is part of USFS's old-growth patch #29 and is not in the timber base. It is not in an official roadless area, however, and is surrounded by USFS roads and clearcuts.

----*Steels Creek Gorge** (H 35) with 860 acres of Class A old growth and 689 acres of Class B old growth, at elevations of 1400-2850 feet. Forest types include submesic oak, dry oak, dry oak-pine, acidic cove, alluvial birch-poplar (Class C only). A very small patch of rich cove exists in the gorge. Also, Pawpaw, unusual for this area, is found on a shelf in the gorge. Most of the site is in the timber base. It is not part of old-growth patch #29, although parts of Ripshin Ridge are physically within the patch. Steels Creek is one of 17 old-growth sites in the Nantahala-Pisgah that are 1000 or more acres in size, but the site does not have roadless area status. It is surrounded by clearcuts, roads, and "wildlife openings."

Grandfather Mountain Area, with 32 delineated sites and 9101 acres of delineated old growth.

----*Lost Cove** (H 38) with 1098 acres of Class B old growth at elevations of 2600-3900 feet. Forest types are high elevation Northern Red Oak, mesic oak, submesic oak, dry oak, acidic cove, low elevation rich cove. Lost Cove, which is within USFS large old-growth patch #29, is not in the timber base. The site is in the Lost Cove Roadless Area, a Wilderness Study Area. Wilderness bills for Lost Cove have been introduced in Congress several times, but Congress has failed to pass them. The site is bordered on the west by the Blue Ridge Parkway and on the north by Roseboro Road, which divides it from the Web Creek (H 39) site with 287 acres of Class B old growth.

----*Upper Mulberry Creek** (H 53) with 1123 acres of Class B old growth at elevations of 1800-3150 feet. Forest types are submesic oak, dry oak, dry oak-pine, acidic cove, and low elevation rich cove. Upper Mulberry Creek is part of USFS large old-growth patch #30 and is not in the timber base. It is not, however, part of a roadless area.

----*Horsepen Creek** (H 67), with 500 acres of Class B+ old growth at elevations of 1500-2250 feet. Forest types are submesic oak, dry oak, dry oak-pine, low elevation rich cove, and hemlock-mixed mesophytic. The site is only half in large USFS old-growth patch #29 and thus only half of it is outside the timber base. Horsepen Creek is not in a roadless area. In the 1980s and 1990s, the Forest Service clearcut areas on the west and south sides of the site. "It is a clear example of US Forest Service clearcutting in old-growth forest," Messick points out. The Horsepen Creek watershed was not previously logged.

----*Tarklin Ridge** (H 72) with 509 acres of Class B old growth at elevations of 1400-2400 feet. Forest types are submesic oak, dry oak, pine-oak heath, acidic cove, and low elevation rich cove. Although Tarklin Ridge is not part of an old-growth patch or a roadless area recognized by USFS, most of it is not in the timber base.

Tarklin Ridge has a beautiful companion in Johns River Gorge (H 73) with 423 acres of B+ old growth. The Gorge is more interesting from a botanical point of view than Tarklin Ridge. Pinchgut Creek supports the lowest elevation occurrence of intact rich cove forest found in the survey, and the largest Black Walnut found during the survey (at 29.6 inches dbh).

--Black Mountains Cluster (I) in the Appalachian District, Pisgah National Forest, French Broad River Basin (Buncombe and Yancey Counties)

A total of 8 delineated sites with 5108 acres of old growth. The cluster has 27 candidate sites worthy of a site visit. Messick divides the cluster into three areas: Craggy Mountains, also known as Big Ivy (since the mountains are in the Ivy River watershed), Black Mountain Ridge, and Blue Ridge.

Craggy Mountains (Big Ivy)

----*Big Fork Ridge Area* (cove, hemlock, hemlock mixed with Northern Red Oak, high elevation Northern Red Oak, beech gap, and northern hardwood. The Big Fork Ridge Area includes Upper Mineral Creek (I 8 a) and Carter Creek / Waterfall Creek (I 8 b) (Messick, pp. 212-15). I 8) with 1066 acres of Class A old growth and 511 acres of Class B old growth. Forest types are acidic

----*Walker Branch Area* (I 10) with 45 acres of Class A old growth and 16 acres of Class B old growth. Walker Branch includes Walker Cove Research Natural Area (I 10 a), 45 (+) acres of rich cove old growth. The tallest Sugar Maple in the survey was measured by Bob Leverett here at 144.7 feet. The Nantahala-Pisgah has only three Research Natural Areas.

----*Big Butt Area* (I 11) with 290 acres of Class A old growth, 10 acres of Class B+ old growth, and 842 acres of Class B old growth. Forest types are spruce-northern hardwoods, northern hardwoods (dry and mesic), rich cove, high elevation Northern Red Oak.

Black Mountain Ridge

----*Middle Creek Research Natural Area* (also known as Black Mountain Research Natural Area) (I 24) with 1296 acres of Class A old growth. Identified forest types are spruce-fir, northern hardwood, hemlock, rich cove, high elevation Northern Red Oak, submesic oak, dry oak, and heath bald.

The Middle Fork of Upper Creek was investigated by Messick and Josh Kelly in the summer of 2002. Class A old growth of undetermined acreage was found in and above a gorge in the midsection of the watershed. Forest types included hemlock, hemlock-northern hardwood, beech gap, heath bald, and high elevation Northern Red Oak.

Blue Ridge

Since the release of the May 2000 report, Messick has discovered a significant mid-size patch of class A old growth in the upper section of the **Big Lost Cove Creek*** watershed. The find was later corroborated by early land acquisition reports found at the National Archive II. A 1932 photograph by C. A. Abell of the Appalachian Forest Experiment Station also confirms this. Forest types include spruce-northern hardwood, hemlock-northern hardwood, northern hardwood, and mesic northern hardwood (Messick 2003).

-- **Unaka Cluster** (J) in the Appalachian District, French Broad River Basin (Avery, Haywood, Madison, Mitchell, and Yansey Counties)

A total of 63 candidate sites worthy of a site visit. No sites have been delineated. Significant rich cove old growth was found in Nolichucky Gorge in 2001.

Plott Balsam Mountains (Jackson County)

Up to 1000 acres of old growth as of 1993. At that time, the south and east slopes had small patches of old growth, including a 5-acre stand of Red Spruce. The upper north slopes had heath with scattered trees; hemlock/heaths; northern hardwoods, in particular Yellow Birch; and related communities. Most of the range was privately owned. Lots were for sale on both sides of the crest, and roads were being repaired (Pittillo 1993).

In 1998 The Nature Conservancy purchased a 1600-acre tract with a "few patches of large old-growth stands in the more remote areas." The 1600 acres protect the eastern crest of the Plott Balsams between Waterrock Knob and Pinnacle Park (Pittillo 1998). The tract has a two-mile common boundary with the Blue Ridge Parkway, a heretofore isolated 500-acre USFS tract, and the 1100-acre Pinnacle Park (created by the town of Silva on land in the Plott Balsams that was formerly the source of the town's water). Pinnacle Park, which has been leased to a private foundation for twenty years for management, contains "some relatively mature hardwoods" (Pittillo 1998). The Nature Conservancy plans to turn the 1600 acres over to an entity that pledges to protect it, likely the North Carolina Wildlife Commission for dedication as a nature preserve (Lynch 2002).

Grandfather Mountain, northwestern North Carolina (Avery, Caldwell, and Watauga Counties)

Probably 200 or more acres of old-growth hemlock, spruce, and northern hardwoods in Lynn Cove (Leverett 1992), plus boulderfields with Black Cherry. The mountain is privately owned (Tager 1992). The North Carolina Vegetative Survey did extensive plot work on this mountain in the summer of 1995.

Rocky Mountain and Chimney Top, southwestern North Carolina (Jackson County)

More than 200 acres of old growth on the crest and fringes of these mountains: White Pine, various oaks, hemlock, dogwood, and a thick understory of rhododendron and laurel are present. The land is protected by private owners (Pittillo 1993, McKee 1993, Zahner 1998).

Baldrock Mountain and Ravines, southwestern North Carolina (Jackson County)

Perhaps 200 acres of old growth in ravines and on steep slopes and ridge tops on this mountain. The land is protected by private owners (Pittillo 1993; Zahner 1998).

Chimney Rock Park* (Rutherford County)

Dry oak, submesic oak, pine-oak heath, and subxeric pine old growth within this privately owned park of a little over 1000 acres. Rough terrain prevented logging in numerous sections of the park. Dry oak, in which Chestnut Oak dominates, is found at higher elevations and on slopes with dry conditions. Submesic oak forest is found on talus slopes below some of the Hendersonville gneiss rock faces. Chestnut Oak, Northern Red Oak, Tulip Tree, and

Mockernut Hickory achieve the largest diameters. Owners of the park are determined to protect its plant and associated animal communities. Over 550 species of vascular plants, 32 of them ferns, have been identified in the park (Messick 1999).

Paddy Mountain,* northwestern North Carolina (Ashe County)

Within a 230-acre tract, which comprises the top of Paddy Mountain, some 150 acres of old growth. The ground is very rocky and steep, and the trees, stunted. The 150 acres have probably therefore never been logged. The Nature Conservancy purchased the 230 acres in large part because they support two plant species that are endangered at the federal level (Lynch 2002).

Mount Jefferson State Natural Area, * northwestern North Carolina (Ashe County)

Unlogged forest and woodland on "most of the slopes" of Mount Jefferson above 4000 feet. The mountain is an isolated peak reaching 4684 feet (Frankenberg 2000). The slopes facing south, east, and west are dominated by oak forests, with an understory of Mountain Laurel, Flame Azalea, dogwood, and Catawba Rhododendron. On the north-facing slopes is a cove forest with Red Maple, Yellow Birch, basswood, and Tulip Tree, among other species. Trees on the north slopes and ridge are stunted. Mount Jefferson State Natural Area is a 550-acre state park managed by the North Carolina Division of Parks and Recreation. It was created in 1956 as the result of strenuous efforts by local residents to set aside land on the mountain (NC Div. of Parks 2002).

Moses H. Cone Memorial Park, northwestern North Carolina (Watauga and Caldwell Counties)

Numerous pockets of old growth within a 3600-acre tract that is part of the Blue Ridge Parkway. Unlogged hemlock forest occurs along an easy walking trail on Sims Creek. Areas of unlogged northern hardwood forest are also present. In 1997 the National Park Service asked Rob Messick to assist in verifying a remote section of hemlock forest in the park. He cored Eastern Hemlock 372 years old and Tulip Trees 170 years old there.

In 2000 an option to purchase a 192-acre islanded tract of land that is contiguous with the park and the upper Johns River watershed opened up. Through the work of the Conservation Trust of North Carolina, the tract was purchased and became part of the park. The purchase links three old-growth areas in the nearby National Forests with Moses H. Cone Memorial Park, an unofficial roadless area that stretches from the Continental Divide (near 3700 feet) to lower Thunderhold Creek (near 1700 feet) (Parkway 2001).

Henry Wright/Madison Wright/Lindsay Olive Preserves, in the Tennessee River drainage (Macon County)

Fifty acres of old-growth hemlock-Tulip Tree-Red Maple, divided among three coves within a few miles of each other. The tracts are adjacent to the Kelsey Tract and, like the Kelsey Tract, were part of Ravenel's Woods. Each of the three uneven-aged stands supports huge Eastern Hemlock, Red Maple, and Tulip Tree, up to 5 feet in diameter and up to 400 years in age. The Henry Wright Preserve also has Carolina Hemlock and Table Mountain Pine (Gaddy 1992, Zahner 1993 and 1998, Schafale 1989). The coves are wet to moist with thick understories of rhododendron. They are also rich in mosses and herbaceous plants. In 2001 The Nature Conservancy transferred the Henry Wright Preserve to the Highlands Land Trust. The University of North Carolina Botanical Gardens owns the 4-acre Lindsay Olive Preserve. The Madison Wright tract is privately owned (Zahner 1993; Bucher 1993).

The North Carolina Botanical Gardens also owns the separate 7-acre Pinky Falls, likewise part of Ravenel's Woods and in Macon County (Jones-Roe 2002).

Little Sealy Mountain* (Macon County)

White Oak over 400 years old in a stand perhaps 40 acres in size. The oaks are on the main ridge and on a south-facing slope with shallow soil. They are in a stressful environment that causes them to grow slowly. The Unitarian Church owns and protects the area (Cawrse 1993; Zahner 1998).

Wolf Creek Gorge* (Jackson County)

Some old growth near the falls, although most of the area was cleared (Pittillo 1993). The Forest Service owns a part of the gorge, but the Nantahala Power Company, a subsidiary of Duke Energy Corporation, controls much of the slopes within the gorge and along the creek (Cawrse 1993, Pittillo 1998).

South Mountains Game Land,* southwestern North Carolina in the Catawba and Broad River Basins (Burke, Cleveland, McDowell, and Rutherford Counties)

Old growth of unknown extent within the 17,829 acres formerly known as the Rollins Tract. In 1996 Messick surveyed nine distinct areas in the tract. He found Class B+ old growth (2 occurrences) and Class B old growth (15 occurrences) in 44% of the forests he entered. The old growth included a small patch of rich cove forest, and submesic oak, dry oak, mesic mixed hardwood forest, dry oak-pine, mesic oak, Carolina Hemlock bluff, and White Pine forest. An uncut stand of mesic oak/hickory was found near Negro Creek Cascade. In this forest, numerous White Oak, Northern Red Oak, Black Oak, and Black Locust were 30 inches dbh and above. In the summer of 2001 an outing with the North Carolina Vegetative Survey revealed more potential acreage and additional occurrences of a federally listed plant species on the tract.

The Foothills Conservancy of North Carolina, in cooperation with the North Carolina Wildlife Federation and the North Carolina Chapter of The Nature Conservancy, raised funds to purchase the land from a private company. The Conservancy made the purchase in 1998 and has transferred ownership to the North Carolina Wildlife Resources Commission. The land is open to the public for hiking, fishing, and hunting. Areas in the game land that are considered sensitive, old growth, or inhabited by rare or uncommon species, will not be logged. Light logging may occur elsewhere for specific purposes; but large commercial timber sales will not be allowed.

The South Mountains Game Land is in the Broad River basin on the south side of the South Mountains. To the north, the portion of the mountain range that is in the Catawba River basin is protected in the 7225-or-more-acre South Mountain State Park (Messick 1996 and 2001).

Mason Farm Biological Reserve ,* Chapel Hill (Orange County)

Within the 367-acre reserve, 289 acres of forests that "were probably woodlots on a tract first farmed during the earliest European settlement in about 1740." The forest is comprised of two adjacent tracts, Big Oak Woods, a bottomland forest, and the Southern Shagbark Hickory Slope. The canopy of Big Oak Woods include Swamp Chestnut Oak, Shumard Oak, Overcup Oak, and Willow Oak, and Sweetgum. The Shagbark Hickory Slope is dominated by hickories, oaks, and other hardwoods. Trees are up to 200 or more years old. The reserve is part of an 800-acre area left to the University of North Carolina by two members of the Mason family in 1894. It is managed by the North Carolina Botanical Garden, which has set it aside for research and study. A permit is required for entry (White 1996; Frankenberg 2000).

White Pines Natural Area, central North Carolina (Chatham and Lee Counties)

Several old-growth communities within a 258-acre preserve owned by the Triangle Land Conservancy and on adjacent private land. The preserve is located at the confluence of the Deep and Rocky Rivers, and grades from floodplain forest to ridges. White Pine over 180 years old and 20 inches in diameter grow on the slopes above the rivers, as do 200-year-old American Beech. The pines are reproducing. The dry ridge top supports an old-growth oak-hickory community. Pockets of White Pine also grow on neighboring private land on both sides of the Deep River. In 1995 Hurricane Fran caused some damage, and it is possible that the private owners did some salvaging. The Conservancy property has not been logged or grazed by livestock (Roe 1987, Nicholas 2003).

Shocco Creek Preserve ,* in north-central North Carolina (Franklin County)

A 1283-acre preserve within which are 100 acres of old-growth alluvial forest. The forest has been lightly, selectively cut in the past. Trees include Green Ash, American Sycamore, Swamp Chestnut Oak, Tulip Tree, and Sweetgum. The Nature Conservancy bought the 1283-acre tract from Georgia Pacific and transferred it to the Wildlife Resources Commission (Lynch 2002).

COASTAL PLAIN AND COAST

Small old-growth sites include **Shumard Oak-Shagbark Hickory-Swamp Chestnut Oak on the Roanoke River** (Halifax County): more than 25 acres of alluvial terrace forest that has been lightly selectively cut (Lynch 1993); **Big Pine Woods** (Hertford County): 19 acres of old-growth Loblolly Pine and mixed hardwoods, set aside as a natural area by the owner Union Camp Corporation (Roe 1987); **Scuppermong River Preserve** (Tyrrell County): a 15- to 20-

acre site of large, uncut Atlantic White-cedar, from which Loblolly Pine was removed, within a 260-acre preserve (Lynch 1993).

Croatan National Forest (Craven, Jones, and Carteret Counties)

Some 10,000 acres of unlogged pocosin within a 157,000-acre National Forest. Pocosins are peatlands with a dense shrub layer dominated by a characteristic set of species and maintained by fire. The various types of pocosin range from communities on wet, deep peat, with only shrubs and occasional dwarfed trees (low pocosin) to quite tall forests on shallower, drier peat dominated by Pond Pine or Atlantic White-cedar. Two thirds of Croatan Forest's pocosin is high pocosin with sizeable Pond Pine and bay trees along with thick evergreen shrubs. The remaining one-third is low pocosin, mostly Gallberry and various bay trees. Much of the pocosin is within designated Wilderness Areas. The trees in the unlogged areas are generally not old, because of the frequency of fire.

Sand ridges, most of them uncut. They support old-growth Longleaf Pine-Wiregrass communities with blueberries and Gallberry in the understory (Kaylor 1993, Davis 1993). Michael Schafale names two small sites that have never been logged and have a good ground cover: **Millis Road Savanna** in the Pringle Road Sand Ridge and Pocosin Complex, a set of ridges; and **Catfish Lake Sand Ridge**. At Millis Road, which is subject to periodic burns, the maximum tree age is about 180 years (Kush 2001). The National Forest's sand ridges total an estimated 2000-3000 acres; obtaining an accurate figure would be difficult. These areas are small and isolated and they have not been computer mapped. Kush estimates 50 acres of old-growth Longleaf for Millis Road, but states that this figure is a conservative estimate and that "a more exhaustive field survey is needed" (Kush 2001). The Forest has numerous rare and endangered plants, some of which are carnivorous and occur in the borders between the pocosin and the sand ridges. They include Venus Flytrap, pitcher plants, sundews, and Rough-leaf Loosestrife. Red-cockaded Woodpeckers make their homes in the pines (Davis 1993, Kaylor 1933).

As of October 2002, USFS had gone through most of the process to revise the forest's management plan, but no record of decision had been signed.

Green Swamp (Brunswick County)

A 16,400-acre preserve of unlogged low pocosin with very stunted Pond Pine, and both wet and dry Longleaf Pine savannas. The savannas were logged about 60 years ago, but the ground layer is in unusually good condition. The wet savannas are scattered on ridges within the pocosin. In 2000 The Nature Conservancy, which owns the preserve, purchased and added to it 537 acres that provide a wildlife corridor between Green Swamp and nearby areas. Those wishing to visit the preserve should request permission from the Conservancy (Roe 1987, Bucher 1993, "Landmarks" 2000).

Holly Shelter Gameland (Pender County)

A 48,500-acre Gameland, more than 30,000 acres of which are Pond Pine woodland and pocosin, an undertermined portion of which was never logged. Merrill Lynch speaks of many pockets of old-growth Pond Pine pocosin (2002); John Finnegan describes the pocosin as probably unlogged (2002). The Gameland also supports Longleaf Pine communities, covering perhaps 10,000 acres (Finnegan 2002). These communities include a portion of what was known as the old-growth Southwest Ridge Longleaf Pine-Wiregrass Savanna, part of which is owned by The Nature Conservancy (see below). In 1986 a vast, hot fire killed many of the trees in the Gameland including those in the Southwest Savanna (Schafale 1993). The North Carolina Wildlife Resources Commission owns the gameland (see below).

Angola Bay Gameland* (Pener and Duplin Counties)

A 20,052-acre gameland of Pond Pine woodland and pocosin, at least part of which has never been logged (Finnegan 2002). Angola Bay is to the north of Holly Shelter Gameland.

In 2002 The Nature Conservancy bought about 29,000 acres of land to link Angola Bay and Holly Shelter Gamelands. The acquisition was part of a 38,000-acre purchase from International Paper Company. Some 8000 of the 29,000 acres with scattered Pond Pine and various bay trees may never have been logged, but they were ditched in the 1970s and early 80s in an attempt to drain and convert the land to pine plantation (McIver 2002). The Nature Conservancy has not decided exactly what to do with the 38,000 acres but may retain part and transfer part to the North Carolna Wildlife Resources Commission to form additions to the gamelands, which the Commission already owns (Lynch 2002).

Air Force-Navy Bombing Range (Dare County)

Pond Pine woodland, a form of pocosin. The extent is uncertain, but is probably at least several thousand acres. The logging history is also unknown. Schafale notes that the several thousand acres include both disrupted and undisrupted acres (1998). Lynch has written that any cutting was probably light and selective. Occasional natural and man-made fires have maintained the ecosystem (Lynch 1993). The land is owned by the federal government. For additional old growth in the Bombing Range see Alligator River National Wildlife Refuge below.

Bald Head Island, in the Smith Island Complex (Brunswick County)

Some 400 acres of old-growth maritime evergreen forest. Bald Head Island is one of three "highlands" of the Smith Island barrier island complex at the mouth of the Cape Fear River. Salt marshes separate the "highlands" from one another. (NCNERR Web 2002). The Bald Head forest has experienced intermittent logging for timber for ship building, but it nevertheless has the largest trees on the North Carolina barrier islands, with some trees more than 200 years old. The canopy is composed of Live Oak and Laurel Oak (Taggart 2002). Under the oaks grow American Holly, Yaupon, and Catbrier, and shade-tolerant herbaceous plants such as Ebony Spleenwort (NCNERR Web 2002). Cabbage Palm, at its northernmost occurrence, is scattered through the forest. The North Carolina Division of Coastal Management owns 177 acres on Bald Head and preserves them as Bald Head Woods Coastal Reserve, a dedicated State Natural Area (Finnegan 2001). At least two hundred acres of maritime forest are unprotected (Taggart 2002). Some maritime forest has already been lost to development. The western part of the island has already been developed and the rest of the island is threatened (Finnegan 2001).

Currituck Banks,* northeastern North Carolina,(Currituck County)

Relatively undisturbed maritime forest in two natural areas within Currituck Banks, "an undisturbed barrier island and low-salinity estuarine system" (NCNERR Web 2002). 1) The 1385-acre Swan Island Natural Area supports an "authentic cluster of maritime communities," including maritime forest. The Swan Island Natural Area is one of five tracts that comprise the Currituck National Wildlife Refuge, owned by the US Fish and Wildlife Service. 2) The 925-acre Corolla Natural Area is the site of a "rare maritime swamp forest," among other communities (Finnegan 2002). The Nature Conservancy, US Fish and Wildlife Service, and the state Division of Coastal Management each own part of the area (Taggart 2002).

Kitty Hawk Woods* (Dare County)

At 1562 acres, the largest maritime forest on the North Carolina coast. The forest was probably never clear cut, although it was selectively logged. John Finnegan of North Carolina Natural Heritage describes the site as one of the best of the few examples globally of maritime deciduous forest and maritime swamp forest (2002). John Taggart of the North Carolina Coastal Reserve speaks of 600 acres of mature maritime forest (2002). The 891-acre Kitty Hawk Woods Coastal Reserve, owned by The Nature Conservancy (95 acres), the town of Kitty Hawk (462 acres), and the state of North Carolina, protects a portion of the forest. (The town land is under a conservation easement with the state.) The balance is unprotected. The North Carolina Division of Coastal Management is constantly working on enlarging the reserve, which is managed by its North Carolina Coastal Reserve Program (Finnegan 2002).

Theodore Roosevelt State Natural Area* (Carteret County)

A 273-acre State Natural Area with old-growth maritime forest. The forest may have been selectively cut for Live Oak and may have had some grazing, but has never been clear cut (Finnegan 2002). Shrub and forest communities flourish on dunes and swales that slope off to marshes along Bogue Sound. The land belonged to the family of Theodore Roosevelt, which donated 308 acres to the state. The state used 35 acres of the gift for construction of access roads and the North Carolina Aquarium. Two trails wind through the forest. The Natural Area is the property of State Parks and Recreation and is managed as a unit of Fort Macon State Park (Taggart 2002).

Nags Head Woods Preserve* (Dare County)

Possibly 100-200 acres of old-growth pine and hardwood maritime forest growing on ancient, 60-foot high dunes within a 1092-acre preserve. The woods have never been surveyed for old growth. They include areas where Loblolly Pine and dogwoods were selectively cut, but elsewhere there was only selective and low-intensity logging that removed a few trees (Lynch 2001). Trees up to five hundred years old can be found. The preserve is on the

western edge of a portion of Bodie Island, a barrier island. A marsh system, which extends into Roanoke Sound, borders the preserve on the west. The Run Hill and Jockey's Ridge sand dunes border the preserve on the north and south respectively. The preserve is composed of lands owned by The Nature Conservancy and by the towns of Nags Head and of Kill Devil Hills (TNC Web 2002).

Black River Preserve ,* southeastern North Carolina (Pender and Bladen Counties)

Baldcypress, some more than 1600 years of age, within a 3614-acre preserve owned by The Nature Conservancy. The Black River is a blackwater tributary of Cape Fear River. Merrill Lynch estimates that one third to one half of the preserve is old-growth Baldcypress (2002).

Devil's Gut Preserve (Martin County)

Two old-growth communities within a 1046-acre preserve on a stream that flows into the Roanoke River. One is a Water Tupelo swamp forest more than 200 acres in size. Selective harvesting of Baldcypress about 50 years ago has been the only cutting. The other, nearby on slightly higher terraces, is a Loblolly Pine-bottomland oaks-American Beech forest, at least 50 acres (20 ha) in size. Here the only logging has been selective cutting of Loblolly Pine (Lynch 1993). The higher site includes pines more than 150 years old and beech up to 100 years in age. Shear et al. describe the site as an example of "older-growth red river bottom forests" (1997). The Nature Conservancy owns the preserve.

Hammocks Beach State Park* (Onslow County)

More than 100 acres of old-growth maritime forest divided between Bear and Huggins Islands. The 892-acre Bear Island is a barrier island, 3.5 miles long and 1 mile across. Its northeast end supports 45 to 50 acres of Live Oak and Red Bay woods that shade into Loblolly Pine on dunes. The 225-acre Huggins Island is just east of Bear Island in the mouth of Bogue Inlet. Lowland marsh surrounds 115 acres of upland, most of which is home to a maritime swamp forest, also dominated by Live Oak and Red Bay. Neither forest is known to have suffered any substantial logging, although a few trees may have occasionally been removed when the forests were in private ownership. Both forests have experienced varying degrees of hurricane damage (Senter 2002; Bland 2002).

Alligator River National Wildlife Refuge (Dare County)

Within a 118,000-acre addition to the Refuge, about 100 acres of old-growth Baldcypress-Loblolly Pine-Swamp Black Gum-Atlantic White-cedar. Apparently this old-growth tract has never been cut. It is in a non-riverine swamp forest over deep organic soil within a pocosin. The federal government owns the land. Other patches of old-growth forest of this type, some 50 to 100 acres in extent, exist along the Alligator River in Hyde and Dare Counties on federal land used by the National Wildlife Refuge and the Air Force-Navy Bombing Range (Lynch 1993).

The Refuge and the Bombing Range together have nineteen clusters of pure, mixed, and scattered stands of Atlantic White-cedar for a total of 6000 acres, giving Dare County the most extensive White-cedar acreage of any county in the state. The inventory of the state's remnant stands describes many of the Dare County stands as "mature," but none as unlogged (Davis and Daniels 1997). Kelly Davis, the inventory's primary author, wrote that he did not think "any of our sites were virgin; most were regrowth from logging. . . . The most pristine sites are probably located on the Alligator River" refuge (Davis 1999).

Indiantown Creek/North River Cypress Forest* (Currituck County)

A 1991-acre expanse that includes an approximately 90-acre stand of never-logged cypress-gum swamp and an approximately 35-acre old-growth nonriverine wet hardwood forest. The majority of the site is mixed wetland forest formerly dominated by Atlantic White-Cedar and now with scattered remnants of that species. A portion is owned by an individual; the remainder by the North Carolina Wildlife Resources Commission, which has dedicated it as a state nature preserve (Finnegan 2001).

Jones Lake State Park, in Bladen Lakes State Forest (Bladen County)

--Bushy Lake. A Carolina bay--an egg-shaped depression, filled with a peat bog--within a 2275-acre satellite area of Jones Lake State Park. Pond Pine that has presumably never been cut, and shrubs like Fetterbush and blueberry, grow in the bog (Helms 1993, Bucher 1993, Roe 1987). On xeric sand ridges around the rim (most

pronounced on the southeast) are second-growth Longleaf Pine and stunted Turkey Oak (Frost 1993). White Wicky Laurel, Rough-leaf Loosestrife, and Venus Flytrap are among the rare and endemic plants at the site.

--Jones Lake and Salter Lake. Carolina bays that still include open water as well as areas filled with peat. The bays and peatlands around the lakes support high and low pocosin, Pond Pine woodland, and a few Baldcypress. Sand ridges are similar to those next to Bushy Lake. Presumably the pocosin deep in the bays, like that deep within other Carolina bays in the forest, has not been cut (Helms 1993, Bucher 1993, Roe 1987, Patterson 1999).

Alluvial forest on the Roanoke River (Halifax County)

Around 100 acres of Eastern Cottonwood-American Sycamore-Green Ash-Sugarberry alluvial forest. The site includes cottonwoods 150 or more feet tall, with diameters up to 5 feet. A privately owned tract, it has suffered some selective logging of ash, but has not been cut for more than 75 years (Lynch 1993).

Lassiter Swamp, in Merchants Millpond State Park (Gates County)

An apparently uncut Baldcypress-Water Tupelo swamp forest. Size is uncertain, but is probably greater than 100 acres. The cypress are up to 117 feet in height and 8 feet in diameter (Lynch 1993, Roe 1987). Up Bennetts Creek, which runs through the swamp, are additional old-growth Black Gum and tupelo (Schafale 1999).

Northeast Cape Fear River Floodplain* (New Hanover County)

A "drowned blackwater river corridor" with tidal freshwater marshes at the lower end and tidal cypress-gum swamp communities at the upper end. The area includes some 70 acres of apparently unlogged old-growth Longleaf Pine on sandy islands. It also has mature to old-growth examples of wetland communities including 300 acres of Atlantic White-cedar on peatland and cypress-gum swamp (Schafale 1998). Ownership is varied. What is known as the Bellhammon Property (1143 acres) is owned by the North Carolina Wildlife Resources Commission, but much is in private hands. The Longleaf Pine is owned by an individual who has enrolled it in the Forest Stewardship Program (Finnegan 2001; LeBlond 1995 and 2002).

Southwest Ridge Preserve (Pender County)

A 180- to 200-acre unlogged, dry Longleaf Pine savanna owned by The Nature Conservancy. Most of the Longleaf Pine died in a wildfire and the backfire set to stop it. The trees are beginning to grow back, and the ground cover is good. Among the herbaceous plants is the federally Endangered Rough-leaf Loosestrife. The Nature Conservancy restricts access. Another portion of Southwest Ridge is within the Holly Shelter Gameland (Bucher 1993).

Weymouth Woods State Natural Area, also known as Weymouth Woods Sandhills Nature Preserve, southeastern North Carolina (Moore County)

Within the 164-acre Boyd Estate Section of the 900-acre Nature Preserve, a sandhills and clayhills site with 60 acres of old-growth Longleaf Pine-mixed oaks (Kush 2001). The stand is "near virgin" (Lynch 1993) and some trees are greater than 350 years in age (Kush 2001). However, about eighty years of fire suppression allowed oaks to codominate. Now, prescribed burning is taking place in the winter, and hardwoods are being cut back.

Red-cockaded Woodpeckers inhabit the upland portions of the Nature Preserve, including the old growth. The North Carolina Division of Parks and Recreation manages the Preserve for the state. Contact the Preserve (910-692-2167) for information about visiting it (Schafale 1992, Roe 1987, Hartley 2002).

Bonnie Doon Natural Area, southeastern North Carolina (Cumberland County)

A clayhills, 160-acre old-growth tract of Longleaf Pine. In the recent past a dense subcanopy of Turkey Oak grew up; and Wiregrass was suppressed. To restore the site, a program of prescribed burns began around 1997. The city of Fayetteville owns the site, which is part of the city's watershed and not open to the public (Schafale 1992, 1993; Kush 2001; Finnegan 2002).

H. H. Bate Tract (Craven County)

An old-growth upland American Beech-Tulip Tree-mixed oaks and hickory forest around 75 acres in size. The oaks have had very light selective logging, but there has been no cutting for the past 75 to 100 years. The forest, which is across a river from Croatan National Forest, is privately owned (Lynch 1993, 1999).

Baldcypress tract (Currituck County)

Fifty to one hundred acres of tremendous old Baldcypress with some Swamp Black Gum and Red Maple. The stand, which is privately owned, apparently escaped several bouts of logging in the early 1900s. It adjoins the Indiantown Creek/North River Cypress Forest (see above)(Lynch 1993 and 2002).

Camp Lejeune Tract * (Onslow County)

Approximately 50 acres (20 ha) of old-growth Longleaf Pine on a sand ridge. The stand is frequently burned. The US Department of Defense (Marine Corps) owns Camp Lejeune (Kush 2001).

Conoho Creek Slopes and Floodplain (Martin County)

A 1656-acre tract with pockets of old-growth cypress-tupelo. Remnant trees are up to 1000 years old. Small areas of old bottomland hardwoods are also present. Conoho Creek flows into the Roanoke River; and 414 acres of the tract are part of the Roanoke River Wetlands Gameland. A portion of the other 1242 acres is privately owned and unprotected, but the remainder is owned by the North Carolina Wildlife Resources Commission and constitutes a dedicated state nature preserve (Lynch 2001; Finnegan 2001).

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SOUTH CAROLINA

In South Carolina, trying to identify old-growth sites creates a dilemma, Dale Soblo of The Nature Conservancy told us in 1993. If one adheres to a strict scientific definition of old growth, which he prefers, the state has none, he said. However, if one concentrates on old-growth characteristics rather than on the history of disruption, the state has an overwhelming number of sites. By 2003 researchers had found in South Carolina old growth that would fit a strict scientific definition. On the other hand, the number of sites that are not strictly old growth but have old-growth characteristics is decreasing because of logging. The shrinking is particularly obvious in relation to bottomland forests.

Albert Pittman of the Heritage Trust reported in 1993 and again in 2001 that extensive mature forest with many old-growth characteristics is under attack along the red water rivers, the chief of which are the Great Pee Dee, Santee, Savannah, Broad, Catawba, Congaree, and Wateree. (Red water rivers arise in the Piedmont, have extensive drainages, and carry huge loads of silty mineral soil. In contrast, black water rivers rise in the coastal plain and run through mucky, organic soils. Consequently the forests of the black water rivers are harder to reach and to cut.) The red river bottomland is owned by private parties, mostly lumber companies. Around 1900 to 1920 most of the virgin cypress, plus some ash, was removed from them. Between the 1930s and the 1950s, they suffered from highgrading operations, mostly selective cutting of bottomland hardwoods (1993, 2001). Clearcutting began in 1965 and continues today.

The obvious damage from the early logging healed quickly; given South Carolina's moist equable climate, in 40 years a tree can grow to a size of 18 to 40 inches in diameter. By the 1960s and 1970s timber companies had the means to cut entire stands. Basically the forests are now being managed on a 40-year rotation by means of clearcutting, which precludes the development of old-growth characteristics.

John Cely of the South Carolina Wildlife and Marine Resources Department, researched timbering on the Congaree Wateree Santee River and found that in ten years (1979-1989) 25% of the bottomland was logged. He reports that foresters say that a lot of the forest that grew back was composed of cull trees, but he does not agree (Cely 1993, 2001). The forests still have high species diversity, Pittman says. However, with paper mills taking both hardwoods and softwoods, he fears that the bottomland forests will be gone in a generation (1993, 2001).

Steven Jones located 40 small old-growth stands in upland hardwood forests of the Piedmont, an area that had been largely cleared for agriculture in the nineteenth and early twentieth centuries. Most of the 40 stands were undisrupted remnants, about 1/4 acre in size, within bigger disrupted areas; but some were 5 acres in extent. They ranged from xeric sites on exposed ridges and upper slopes, with Post Oak-Black Oak-Lowbush Blueberry, to mesic sites on lower slopes, with American Beech-Northern Red Oak-Christmas Fern. At least one site has now been logged, but many, owned by the federal or state government, are informally protected (1988).

As of early 2003, the US Forest Service (USFS) was in the process of revising the management plan for Sumter National Forest. A draft plan and a draft Environmental Impact Statement were scheduled to be mailed to the public in February or March. The agency expects to complete the revision process within a year. The management plan for the Francis Marion Forest was revised in 1995 (White 2003).

Greenville Watershed Property, northwestern South Carolina (Greenville County)

Twenty-eight thousand acres of varied forest communities with old-growth characteristics in two tracts: 9000 acres, surrounding Table Rock Reservoir, that have been closed to the public for 80 years and 19,000 on the North Saluda River that have been closed for 60 years. According to Gaddy, the 9000-acre area "is a vast expanse of wild land with few paths and acres of old-growth forests." Much of this area is "inaccessible and poorly known" (Gaddy 2000). The two tracts are owned by the Greenville Water Commission, which has given a conservation easement to The Nature Conservancy. At least the forest in the North Saluda River area was selectively cut in the past and at one time had some homes within it. The forty natural communities on the watershed property include northern hardwoods cove forest, acidic mesophytic forest, xeric Shortleaf Pine-oak forest, and Southern Appalachian-northern hardwood forest (Soblo 1993). Riddle writes that the old-growth area on the top of Table Rock (see below) probably extends north into the Greenville Watershed (2003).

Congaree Swamp National Monument, central South Carolina (Richland County)

Approximately 11,000 acres of old-growth bottomland hardwoods on the floodplain of the Congaree River, within the 21,888-acre National Monument. About 17% of the monument has been clearcut or selectively cut. Most of the bottomland hardwood forest consists of Sweetgum and mixed hardwoods. Lower elevations along creeks and sloughs contain cypress and tupelo trees. Eighty-seven species of trees have been identified at the monument.

The monument is actual or potential habitat for several Endangered or Threatened species. It is potential habitat for the Eastern Cougar. The American Alligator is occasionally seen there. The Bald Eagle is a transient, and one or two colonies of Red-cockaded Woodpecker live on the high ground or bluff.

Hiking trails through the monument are concentrated in the northwestern section (McDaniel 1990).

SUMTER NATIONAL FOREST, northwestern South Carolina

The forest is composed of three widely separated ranger districts. Most of the old growth is in the mountainous Andrew Pickens District, which adjoins North Carolina on the north and Georgia on the west.

Andrew Pickens District

--**Ellicott Rock Wilderness*** (Oconee County). More than 1000 acres of old growth divided among numerous sites in South Carolina. The Wilderness, which lies in three states and totals more than 9000 acres, includes more than 2000 acres of old growth. It and the adjacent extension (see below) have the greatest variety of old-growth types in the Chattooga Basin, as a result of the varied terrain.

----*Fork Mountain*. Seven stands totaling 530 acres. The first stand comprises 73 acres of Class B mesic forest along the riparian zones of Indian Camp Branch. The riparian zones contain Eastern Hemlock, Eastern White Pine, Tulip Tree, and American Holly. A cathedral stand of Eastern White Pine and Eastern Hemlock rises 150' on the flats. One American Holly with a diameter of 15" was aged at 330 years. Selective timber harvest was evident; however. The second stand comprises 248 acres of selectively logged forest. The third stand comprises 26 acres of Class A forest dominated by oak with scattered old Pitch and Shortleaf Pines. No signs of major disturbance were found. The fourth stand consists of 30 acres of Class B mixed mesophytic cove forest. While no signs of logging were present, the canopy has been disturbed by loss of American Chestnut due to chestnut blight. The fifth stand comprises forty-two acres of Class A submesic forest on the upper southern slope. No signs of unnatural disturbance were present. The sixth stand comprises 49 acres of Class B forest on the steep northern slope and in coves. This area was severely affected by the chestnut blight. The seventh stand comprises 62 acres of Class A submesic forest on steep slopes. Eastern White Pine dominated this stand, which exhibited no signs of disturbance (Carlson 1995).

----*Medlin Mountain*. Five mesic stands totaling 244 acres of Class B forest. The first stand comprises 22 acres of cove hardwood forest. The upper cove area boasts a cathedral stand of Eastern Hemlock (53.2 inch dbh), American Basswood (30 inch + dbh), American Beech (35 inch dbh), and Black Birch (22 inch dbh). Eastern Hemlock (some trees aged at 434 years) grows along the riparian zone within the cove. The stand has experienced selective harvesting. The second stand, of 181 acres, exhibited no evidence of logging; however, disturbance by chestnut blight was apparent and widespread. Dominant canopy species are Chestnut Oak and Tulip Tree. The third and fourth stands together comprise 30 acres. Both stands are located in coves rich in Northern Red Oak (40-47 inch dbh) and Tulip Tree. Each stand once held an abundance of American Chestnut. The fifth stand consists of 11 acres of Eastern Hemlock (30-45 inch dbh) and Eastern White Pine (20-30 inch dbh). The National Champion Pepper-bush (*Clethra acuminata*) at 11" grows within this stand. A picnic area with a boardwalk bisects the stand (Carlson 1995).

----*Cove South of Bad Creek*. Forty-five acres of cove hardwood forest aged at 210 years. Northern Red Oak, hickory, Easter Hemlock, White Oak, Black Oak, and Chestnut Oak are the dominant canopy species. Tree diameters range from 18-24 inches. Some highgrading of Northern Red Oak, Tulip Tree, and American Chestnut has occurred within the area (Carlson 1995)

----*East Fork of the Chattooga*. An old-growth White Pine-hemlock stand of approximately 5 acres in a stream flat near the Walhalla Fish Hatchery, which is in the National Forest. Trees are over 100 feet in height and 4 feet in diameter. The understory includes Fraser's Magnolia, Sweet Birch, and Sassafras over one foot in diameter. The shrub layer is composed of huge Mountain Laurel and Great Rhododendron (Gaddy 2000). The stand is more than 200 years old (Gaddy 1993).

--Ellicott Rock Extension* (Oconee County). Three stands of old growth totaling 278 acres in an area that Paul Carlson names "Dark Branch/Slatten Ridge/Ellicot Mountain South."

The largest stand is 260 acres of an "exceptional old-growth submesic oak/pine forest." White, Chestnut, Black, and Scarlet Oaks dominate. They are mingled with White Pine and Pitch Pine. The stand includes the oldest Chestnut Oak that was aged during the Chatooga Project. At the time, it was 365 years old. Many White Oaks were more than 300 years old; the old Pitch Pines were around 220 years old. The "stand likely continues south" toward Walhalla Fish Hatchery, perhaps to the edge of old growth on Chinquapin Mountain.

The smaller stands are a "steep, narrow mesic cove" and "an old-growth shrub forest" under a canopy of Eastern Hemlock, Tulip Trees, and other species. One Tulip Tree was aged at 387 years. No signs of human disruption were evident, and the stands were categorized as "A" (Carlson 1995). Other small stands include two southwest-facing, steep-sided slopes (Roecker 2003).

The old growth in the Extension is not formally protected. In its 1985 forest plan, USFS recommended the Ellicott Rock Extension for Wilderness designation, and Senator Strom Thurmond introduced legislation to implement the recommendation; but it did not pass. The Ellicott Rock extension lies between the South Carolina portion of Ellicott Rock Wilderness and Highway 107.

--**Lower Chauga River Basin**,* southeastern part of Andrew Pickens Ranger District (Oconee County)

Sixteen stands meeting the USFS minimum age criteria for old growth, and sixty-one potential old-growth sites. L. L. Gaddy, a private consultant, aged and identified the stands for the nonprofit group Forest Watch. Gaddy classified as potential old growth, mature stands that did not meet USFS criteria but were at least, if pine-dominated, 75 years old or, if hardwood dominated, 100 years old. The largest old-growth areas surveyed were 50 to 100 acres in size. Near ridge tops where USFS roads usually run and on upper slopes where old logging roads exist, trees tend to be young. On steep bluffs, in ravines, in coves, and on lower, inaccessible slopes, they tend to be older.

The 77 old-growth and potential old-growth stands represent 18 forest types. The types most frequently encountered are White Oak-Black Oak-Northern Red Oak, Tulip Tree-White Oak-Northern Red Oak, Shortleaf Pine-oak, and Shortleaf Pine. Only a thin corridor in the 3300-acre Chauga River Scenic Area is protected (Gaddy 1998), but the corridor is proposed for expansion in the draft Revised Land and Resource Management Plan. Additionally, when the plan is revised, all stands meeting the USFS criteria for existing old growth are likely to be protected based on a Forest Plan standard, Robin Roecker of USFS reports (2003).

--White Rock Scenic Area,* in the northeastern corner of the district (Oconee County). According to USFS, a possible 223 acres of old growth in White Rock Cove, which is within the 3416-acre Scenic Area (Roecker 2003). The mixed forest is dominated by Tulip Tree with Black Walnut and Persimmon. Pawpaw is in the understory. Gaddy, who described the site in a 1992 report, does not characterize it as old growth (Gaddy 1992).

--Tamassee Knob and Coves* (Oconee County). Extensive possible old growth on Tamassee Knob and in the northeasterly facing coves, to the north of it. On the upper slopes of the Knob and in the coves grow Black Walnut, White Ash, Tulip Tree, Northern Red Oak, Red Maple, American Beech, Yellow Buckeye, and hickories. Gaddy reported that “although there are pockets that have been cut within the last 50 years, much of this entire site is old-growth forest” (Gaddy 1992, 2000).

--**Mill Mountain,*** Chatooga River Watershed (Oconee County). Two stands totaling 103 acres. The first stand comprises 63 acres of Class A submesic forest. This area was never logged, due to steep west-facing slopes. White Oak and Chestnut Oak are the dominant canopy species, with Eastern White Pine and Eastern Hemlock growing on rocky areas. The second stand is 40 acres of Class B subxeric forest. Pitch Pine was the dominant canopy species, with Southern Red Oak, White Oak, Chestnut Oak, and Scarlet Oak scattered throughout the forest. Although no logging was observed, Chestnut Blight caused much disturbance within the forest (Carlson 1995).

--**Rock Gorge**,* in the Chattooga National Wild and Scenic River Corridor (Oconee County). Three stands of Class B forest totaling 96 acres in a “deep rock-walled stretch of the Chattooga” (Gaddy 2000). The first stand is a 17-acre cove forest dominated by Eastern Hemlock and Tulip Tree with diameters ranging from 25-45 inches. Chestnut blight seems to be the only major disturbance within this stand. The second stand comprises 66 acres of primarily White Oak, Chestnut Oak, Eastern White Pine, and Eastern Hemlock. Post Oak aged at 225 years is found on the southwest-facing slope. Evidence of logging is found just at the edges of the stand. The third stand consists of 13 acres of subxeric oak-pine forest. No evidence of logging was found on the site (Carlson 1995).

--**Round Top,*** in the Chattooga National Wild and Scenic River Corridor (Oconee County). Two stands totaling 68 acres. The first stand is 8 acres of Class A xeric forest. The stand is primarily Pitch Pine with Scarlet Oak and Southern Red Oak. No evidence of logging was found on the site. The second stand comprises 60 acres of nearly pure Chestnut Oak exceeding 200 years. This Class B stand exhibited chestnut blight disturbance (Carlson 1995).

--**Big Stakey Mountain,*** Chatooga River watershed (Oconee County). Forty-five acres of Class B subxeric forest. Many areas of the forest are purely Chestnut Oak aged at 185-212 years. Some areas have Pitch Pine and Eastern White Pine as dominant canopy species. Selective logging of Yellow Pine has occurred in the past (Carlson 1995).

--Hickory Top,* Chatooga River watershed (Oconee County). Forty-three acres of Class B submesic forest. This stand is primarily Chestnut Oak with diameters of 36-44 inches. Selective logging has occurred within the stand (Carlson 1995).

--Lee Falls and Botanical Area (Oconee County).

--Station Cove. Within the Botanical Area, a site only 5 acres in size, but significant as one of the southernmost stands of Braun's mixed mesophytic forest. The dominants are American Beech, White Ash, White Basswood, and Yellow Buckeye. Hemlock is absent, because the ground is calcareous. Canopy trees are 100 to 200 years in age (Gaddy 1993, 2000).

--Lee Falls/Tamassee Falls.* A small area of old growth below the falls on Tamassee Creek. Tulip Tree and hemlock are major canopy species in the area. Rhododendron is common in the understory (Riddle 2003).

--Rich Mountain* (Oconee County). On the west face of the mountain is an "exemplary stand" of old-growth Northern Red Oak-Tulip Tree. The stand is on the headwaters of Barton Creek (Gaddy 2000).

Enoree District

-- Duncan Creek Bottomland* (Laurens County). One hundred and nine acres of possible old-growth bottomland. USFS lists the 109 acres in its possible old-growth inventory, but has not ground truthed the site to find out whether it meets USFS old-growth criteria (Roecker 2003).

--Broad River Scenic Area (Chester County). Possibly some bottomland old growth within a 58-acre bottomland hardwoods stand beside the river, and an adjacent 39-acre upland hardwoods stand. USFS reports 53 acres of possible old-growth bottomland (Roecker 2003). Meadows and Nowaki list the Broad River in Chester County as a site where "representative old-growth eastern riverfront forests may occur" (1996). According to the Heritage Trust, Steven Jones identified up to a couple of hundred acres of possible old growth at this site in the 1980s (Pittman 2001).

Long Cane District

--**Post Oak stand** (Saluda County). Thirteen acres of old-growth Post Oak. Some trees have been aged at up to 200 years (Shelfer 1990). USFS has proposed the site for a Botanical Area.

--**Long Cane Creek Bottomland*** (McCormick County). One hundred seventy-eight acres of old-growth bottomland included by USFS in its possible old-growth inventory (Roecker 2003).

Sandy Island Preserve ,* eastern South Carolina (Georgetown County)

Between 2500 and 3000 acres of old Longleaf Pine in a 9000-acre natural area. The land has never been plowed, and logging has been only by single tree selection. Some trees are in excess of two hundred years in age. The forest supports a dense collection of Red-cockaded Woodpeckers.

The land that is not in Longleaf Pine is forested wetlands, most of which originally were cypress-tupelo swamps. After construction of dikes, they gave way to rice fields. The rice culture collapsed in the late 1800s, and wetlands are now recovering.

Sandy Island is 12,000 acres in total. It is bounded by the Pee Dee River on the west, the Waccamaw River on the east and creeks on the north and south. Two small villages are located on the 3000 acres not included in the natural area.

In 1996 the South Carolina Department of Transportation (DOT) bought the 9000 acres, mostly for wetlands mitigation. The South Carolina Chapter of The Nature Conservancy contributed to the purchase price. The Conservancy manages the property. When DOT has destroyed enough wetlands elsewhere to use up all the mitigation credits that it received for the purchase, The Conservancy will own the property (Robinson 2001).

Beidler Sanctuary, southern South Carolina (Dorchester County)

Seventeen hundred virgin acres in a 5800-acre refuge, which constitutes a portion of a 60-mile-long swamp. The virgin area includes both mixed hardwoods and deep cypress-tupelo swamp. The hardwoods include Red

Maple, Overcup Oak, Water Oak, Swamp Chestnut Oak, Laurel Oak, Mockernut Hickory, and Water Hickory. The balance of the sanctuary was logged anywhere from 20 to 100 years ago. The sanctuary has no trails other than a board walk and a canoe trail on which visitors can take only guided trips. The American Alligator, the Dwarf Trillium, and the rare Swainson's Warbler are all found at the sanctuary. It is co-owned by The Nature Conservancy and Audubon Society (Dawson 1990, Nelson 1989).

Mountain Bridge Wilderness, in northwestern South Carolina (Greenville County)

Within the 10,883-acre state-designated Wilderness, close to 700 acres of old growth in two State Parks. Here the Blue Ridge escarpment ends in an abrupt 2000-foot drop to the foothills where the Piedmont begins. The area was logged in the 1920s, when available logging equipment did not permit the cutting of steep slopes.

--Caesar's Head State Park.* Around 500 acres of old growth within a park of approximately 7600 acres. The oak and hemlock-dominated forest on the ridge above Raven Cliff is unlogged. The steep north and south slopes below Raven Cliff, including the Dismals, support unlogged oak-hickory forest. Low on the slopes in the old growth, hemlock reappears near water. Large Pignut Hickories grow in an area with an open understory between Matthews Creek and Raven Cliff.

--Jones Gap State Park.* A couple of hundred acres of old growth on Little Pinnacle Mountain within the 3400-acre Park. The ridge line on Little Pinnacle has been logged, as it was more accessible than the ridge above Raven Cliffs. However, the steep slopes on the north and south sides of Little Pinnacle support apparently unlogged forest, with the same species as at Raven Cliff. The north side of the ridge connecting Little Pinnacle Mountain to Caesar's Head also has old growth (Riddle 2003, Anderson 2003, Lee 2003).

Tryon Watershed Property,* northwestern South Carolina (Greenville County)

Some 600 acres of forest with old-growth characteristics. The forest has been selectively logged in the past but never clearcut. The area supports eight natural communities, including cove hardwoods, Chestnut Oak, oak-hickory, hemlock, and spray cliff. It harbors *Coreopsis latifolia*, *Pychnanthemum montanum*, and the state's largest population of the federally endangered Reflexed Blue-eyed Grass (*Sisyrinchium dichotomum*). The Nature Conservancy holds a conservation easement on the property, which is owned by Tryon (Green 2001).

Snuggedy Swamp,* southern South Carolina (Colleton County)

Within the swamp, an old-growth loblolly-bay forest of several hundred acres. The old growth is on the Ashepoo River of the ACE (Ashepoo-Combahee-Edisto) Basin and is accessible only by boat. It is privately owned and without protection (McKevlin 1996; Pittman 2001, Prevost 2003).

Black River Swamp Heritage Preserve ,* eastern South Carolina (Georgetown County)

A 1276-acre preserve that includes 9 acres of old-growth Loblolly Pine hammocks. The dominant vegetation in the preserve is Baldcypress and Water Tupelo. The preserve is owned by the state but managed by The Nature Conservancy (TNC 2003).

Little Pee Dee River Heritage Preserves,* eastern South Carolina (Marion County)

A state-owned Heritage Preserve of 6538 acres, divided among five tracts. The preserve includes bottomland with Baldcypress and hardwoods, sand ridges, and uplands. Loggers cut it 100 years ago, but nobody today knows to what extent. Some parts are clearly in better shape than others; and the preserve may include uncut pockets (Greeter 1993).

Table Rock State Park,* northwestern South Carolina (Pickens County)

Well over 100 acres of old growth in a continuous tract on the top of Table Rock, The Stool (a smaller peak to the east of Table Rock), and the steep south-facing slopes at the top of the Carrick Creek watershed. A large portion of this old growth is within the 3083-acre Table Rock State Park, which is on the Blue Ridge Escarpment.

The trees on the relatively flat top of Table Rock are stunted—probably around 30 feet tall. Scarlet Oak, Chestnut Oak, Virginia Pine, Table Mountain Pine, and, depending on the site, either Pitch Pine or Shortleaf Pine are the most common trees on the top of the mountain. Fringetree and Eastern Red-cedar are common around some of the rock outcrops. The Stool apparently supports uncut mixed hardwoods. The upper slopes in the Carrick Creek drainage are surprisingly fertile. Here are Northern Red Oak, Tulip Tree, and Chestnut Oak up to three feet in

diameter. White Oak and Black Oak with an open understory grow on the Carrick Creek ridge tops, except for the drier areas where Shortleaf Pine dominates with a heath understory (Riddle 2003).

Coon Branch Natural Area,* Nantahala National Forest (Jackson County, NC) and northwestern South Carolina (Oconee County, SC)

Old-growth acidic cove forest comprising a 122-acre Natural Area on the west bank of the Whitewater River and in the adjacent Coon Branch Cove between the river's upper and lower falls. The Appalachian Society of American Foresters states that "very little logging has been done on the west bank of the river between the falls, although there is evidence that chestnut was removed from part of the area 45-55 years ago. The Coon Branch drainage appears undisturbed as the large trees there give evidence of ages between 300 and 400 years." Eastern Hemlock and Tulip Tree are the dominant trees. The understory is rhododendron. The upper falls drop 417 feet; and the lower, 300 feet in two stages. USFS owns the land between the upper falls and the North Carolina/South Carolina state line; Crescent Resources, the land between the state line and the lower falls (ApSAF 2002).

Emory Creek,* the Jocassee Tract, northwestern South Carolina (Pickens County)

At least 90 acres of old growth above approximately 2560 feet in the Emory Creek drainage on the south side of Hickorynut Mountain. The only direct human disruption appears to have been the construction and maintenance of the Foothills Trail, which crosses the upper slopes. Chestnut Oak and Scarlet Oak, with a dense understory of Mountain Laurel, dominate the ridge at the eastern edge of the watershed. The upper slopes consist of a series of very shallow coves where White Oak is prominent in a mix of species. Silverbell and Sourwood are in the understory. In the riparian corridor, Tulip Tree, scattered hemlocks, and scattered Sweet Birch grow; White Basswood is found at the lower edge of the stand.

To the west, the forest surrounding a tributary of Reedy Cove Creek may also be old growth (Riddle 2003).

Shealy's Pond,* central South Carolina (Lexington County)

An old-growth bay forest, along with an Atlantic White-cedar bog, in and beside a 62-acre Natural Heritage Preserve. The site, including the pond, is 100 acres. Part is publicly owned; part, private (Pittman 2001).

Guillard Lake Scenic and Research Natural Area, in Francis Marion National Forest, southeastern South Carolina (Berkeley County)

Approximately 60 acres of old-growth bottomland hardwoods on three sides of Guillard Lake in the 925-acre Scenic Area and, adjacent to it, a 23-acre stand of big pine, bottomland hardwood, Baldcypress, tupelo, and maple mostly within an 18-acre Research Natural Area. The Baldcypress have knees up to 8 feet tall. USFS does not know whether the stand is virgin but notes that the area was extensively farmed from settlement to the 1850s (Shelfer 1990).

Paris Mountain State Park,* northwestern South Carolina (Greenville County)

A total of over 50 acres of old growth and perhaps considerably more, in patches, on the steep east side of Paris Mountain. The 1275-acre park was formerly a source of water for the city of Greenville. The mountain is a monadnock of alternating layers of mica schist and gneiss. The bedrock is near the surface and the soil dry. Therefore Chestnut Oak and pines dominate. Within the old growth, Chestnut Oak, Pale Hickory, and, in some stands, Shortleaf Pine are common. Table Mountain Pine is also found, as, in riparian areas, is Tulip Tree (Riddle 2003).

Laurel Fork Heritage Preserve,* northwestern South Carolina (Pickens County)

Old-growth hemlock forest within a 1000-acre preserve in the Jocassee Gorges. Two headwater streams for Laurel Fork flow through the preserve. The old-growth hemlocks are along one stream; second-growth Tulip Trees, along the other. The hemlocks were left when the area was originally logged, because hemlock was not highly regarded as a source of lumber. The preserve is owned by the Wildlife Management section of the South Carolina Wildlife and Freshwater Fisheries Division, but managed by the Division's Wildlife Diversity section. The state purchased the thousand acres with help from the Richard K. Mellon Foundation. It is the first parcel that the state obtained in the Gorges (Stokes 2001).

Cathedral Bay Preserve, also known as Chitty Bay Preserve, southern South Carolina (Bamberg County)

Fifty-eight acres in two tracts, which The Nature Conservancy has described as including old-growth Pond Cypress (TNC 1966) and the South Carolina Wildlife and Marine Resources Department, the owner, characterizes as a "near-pristine example of a mature pond cypress community within one of the few undisturbed [Carolina] bays in its region" (SCWMRD [n.d.]).

Stevens Creek Natural Area, western South Carolina (McCormick County)

A mixed mesophytic community, believed to contain Pleistocene relic species. It is located on the side of a steep, north-facing bluff along the creek. Northern Red Oak, Pignut Hickory, Southern Sugar Maple, and Sugarberry dominate. Trees are 200 to 250 years old. The area includes disjunct species such as Baldcypress, which occurs beside the creek. The site is owned by the South Carolina Department of Natural Resources (Radford 1959, Barry 1980, Gaddy 1993, Soblo 1993, Robinson 2001).

Eastatoe Creek Heritage Preserve , the Jocassee Tract, northwestern South Carolina (Pickens County)

An old-growth hemlock-Tulip Tree forest, with an understory of Great and Carolina Rhododendron, within the 347-acre preserve in the upper Eastatoe Gorge. The trees are not unusually large for their respective species, as "the slopes of over 40 degrees inhibit the formation of rich soils and limit tree size" (Riddle 2001). The preserve is owned by the South Carolina Wildlife Management Section but is managed by the Wildlife Diversity Section (Bunch 2001). The flats in the lower part of the gorge support at least 22 tree species in a single acre but have been logged in the past (Riddle 2001).

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TENNESSEE

The southernmost disjunct populations of Northern White-cedar are found in Tennessee. The trees grow in pure or mixed stands in three habitats: on nearly vertical cliffs, on cobbly slopes located below cliffs and extending down to a river, and streamside (Clebsch 2001). Because the first two habitats tend to be inaccessible locations that provide severe growing conditions, causing trees to be small, the stands may never have been logged or grazed. However, not all disjunct populations are old growth. One site in Tennessee that has been studied includes charred stumps; and the tree diameters in another suggest that a portion of the site has been logged and grazed (Walker 1987). Stands in Tennessee that are likely to be old growth include one on the **Wolf River** (Pickett County): in a cove, Northern White-cedars "with deciduous trees and hemlocks on steep, unstable slopes" extending from a large ridge down to the scour line of the Wolf River (Walker 1987); **Powell River** (Clairborne County): among various sites along the river, a continuous population spread across a 100-meter section of north-facing limestone cliff and scattered individuals on less severe slopes on both sides (320 stems in total) (Young 1996); **Norris Lake reservoir** (Campbell County): various sites on steep, unstable slopes along bluffs above Norris "Lake" in Norris Dam State Park (Walker 1987); and **Watauga River** (Johnson County): populations on an "unstable, northeast-facing cliff of Pine Knob," on the ridge above, and in a series of dry coves nearby; but at least in part disturbed by "industry" (Larson et al. 2000, Larson 2000, Walker 1987). A southern disjunct site that is in an old-growth context is described under Falls Creek Falls State Park below.

Other small old-growth areas in Tennessee include **Wright Forest Natural Area*** (Johnson County): 30 acres of privately owned old-growth White Pine-hemlock forest in Shady Valley (Testerman 1997); **River Bluff Natural Area** (Anderson County): upland and cove hardwoods mixed mesophytic old growth within a 294-acre Natural Area owned by the Tennessee Valley Authority (TVA) (Bartlow 1992, Fraley 2003); **Colditz Cove State Natural Area** (Fentress County): some 20 to 30 acres of unlogged forest, dominated by White Pine, within a 70-acre Natural Area, owned by the state of Tennessee (Jenson 1993, TDEC 1993); **Hatchie River** (Haywood County): possible patches of old-growth Baldcypress and bottomland hardwoods along the river, totaling a few dozen acres (Shankman 1993, Smith 1993); **Land Between the Lakes** (Stewart County): 15 acres of old growth, including a 7.5 acre White Oak stand on a south slope, the whole crossed by a road and trails and managed by the US Forest Service (Doyle 1993, Fraley 2003); **Fiery Gizzard** (Grundy County): old hemlock and mesic species along a creek bed in the upper part of a narrow gorge, from which marketable species may have been removed 60 or 70 years ago (Ramseur 1993, Jenson 1993); **Greeter Falls** (Grundy County): a small pocket of old growth, including Chestnut Oak and Eastern Hemlock well over 300 years old (Hedgepath 1993); **Shelby Bottoms and Park)*** (Davidson County): less than 10 acres of bottomland hardwoods within an 800-acre park owned by Metropolitan [Nashsville] Board of Parks and Recreation (Nordman 2001).

The US Forest Service (USFS) is in the process of revising the Land and Resource Management Plan for Cherokee National Forest. In April 2003 it released the proposed revision and a Draft Environmental Impact Statement.

An old-growth inventory and catalog of the Blue Ridge Province is being prepared for 2004, under the sponsorship of the Southern Appalachian Forest Coalition (SAFC) and The Wilderness Society. Rob Messick is heading up the field work, for which he will receive much assistance from grassroots forest watch groups. The catalog will mainly cover Georgia (Chattahoochee National Forest) and Tennessee (Cherokee National Forest). It will also include corrections and additions to the North Carolina catalog (Nantahala-Pisgah National Forest), which was compiled by Messick and released in 2000 (Messick 2002).

Great Smoky Mountains National Park

For a description of old growth in the park as a whole, see the section of this report on North Carolina. Three readily accessible examples of the Park's old-growth forest in Tennessee follow:

--Albright Grove (Sevier County). An unlogged forest of Tulip Tree and hemlock, between Dunn Creek and Indian Camp Creek, on the Maddron Bald Trail.

--Porters Flat (Sevier County). A "rich lowland" with a cove hardwood forest. The Porters Creek Trail that leads to the flat runs for several miles through an "undisturbed" forest of oak, maple, basswood, and Tulip Tree.

--Ramsey Cascade (Sevier County). Near the waterfall called Ramsey Prong, old growth that includes a Silverbell tree 2.5 feet in diameter, a Sweet Birch 3.5 feet in diameter, a grove of Tulip Trees up to 5 feet in diameter, and Black Cherry 3 feet in diameter (Irwin 1993, Murlless and Stallings 1973).

CHEROKEE NATIONAL FOREST

In preparation for field work for the inventory and catalog of the Blue Ridge Province (see chapter introduction), Rob Messick put into a uniform and understandable form the existing information on old-growth in the National Forest, which had been gathered by a variety of field researchers including Kevin Caldwell, Dana Eglinton, Hugh Irwin, Ken Jones, Clarence Korstian, Paul Myers, Arthur Smith, Ted Snyder, Dean Whitworth, George Wuerthner, and Rob Messick himself. The following presentation of old growth in the Cherokee is his compilation, with the addition of a few supplemental descriptions from the first edition of *Old Growth in the East: A Survey*. The sites listed here have forest community descriptions for Class A or Class B old growth (or are likely to be Class A or Class B old growth) (Messick 2003).

Nolichucky District

Researchers have visited the 26 sites listed below (Caldwell and Myers were the researchers for all areas except the Bald Mountain Ridge Area, which Snyder studied.) The district also has 48 candidate sites.

--Green Mountain area (south of French Broad River, Cocke County)

----Laurel Hollow.* Submesic oak, dry oak, dry oak-pine, and xeric pine.

--Stone Mountain area (south)(south of French Broad River, Cocke County).

----Pigeon River frontage.* Dry oak-pine (with cliffs), xeric pine, and subxeric pine.

----Landin Cove.* Dry oak-pine, and xeric pine (with Shortleaf and Pitch Pines).

----McSween Branch (South Fork).* Submesic oak (with the highest herb diversity found in this section of Stone Mountain).

----McSween Branch.* Xeric pine (with Shortleaf Pine), and subxeric pine (with Pitch Pine).

----Pigeonroost Branch (north-facing slopes).* Dry oak.

----Upper Mill Creek.* Dry oak with cliffs, and dry oak with circum-neutral soils.

----Panther Mountain (west).* Dry oak-pine and xeric pine.

--Laurel Mountain area (south of French Broad River, Cocke County)

----Laurel Mountain.* Northern hardwoods (with lush herb layer) and high elevation Northern Red Oak.

----Trail Fork Big Creek (headwaters).* Acidic cove and slope (with many old-growth characteristics.

--Bluff Mountain area (south of French Broad River, Cocke County)

----Bluff Mountain (west).* Northern hardwood boulderfield, rich cove, and high elevation Northern Red Oak (on some upland slopes).

--Meadow Creek Mountain area (north of French Broad River, Cocke County)

----Upper Yellow Spring Branch (South Fork).* Dry oak.

----Meadow Creek Mountain.* Submesic oak (with large canopy trees in places), dry oak, and dry oak-pine (with frequent rock outcrops).

----Clifty (north slopes).* Dry oak (with cliffs and some boulderfields), dry oak-pine, and pine-oak heath. Near submesic conditions* are found in some of the oak forests here.

--Brush Creek Mountain Area (north of French Broad River, Cocke County)

----Brush Creek Mountain.* Submesic oak, dry oak, oak heath, and pine-oak heath.

----Upper Bryant Hollow.* Pine-oak heath (with cliffs).

----Upper Austin Branch.* Dry oak.

--Greene Mountain area (north of French Broad River, Greene County)

----Greene Mountain (Upper Back Creek).* Pine-oak heath (with cliffs).

----Greene Mountain (Upper Mud Creek).* Dry oak (with some Black Cherry).

----Greene Mountain (Upper Mud Creek).* Rich cove (with lush herb layer).

----Greene Mountain (Upper Mud Creek).* Northern hardwood, acidic cove and slope, and dry oak.

----Greene Mountain (Upper Camp Creek).* Rich cove, acidic cove (in some tight valley slopes), and dry oak (on ridge slopes).

----Greene Mountain (Upper Camp Creek).* Mesic oak, dry oak, and dry oak-pine (near ridge slopes).

----Reynolds Ridge (Upper Camp Creek).* Rich cove and dry oak.

----Reynolds Ridge (Upper Camp Creek).* Rich cove, acidic cove (infrequent), and dry oak (Messick 2003-Caldwell and Myers).

--Bald Mountain Ridge area (north of French Broad River, Cocke County)

----Upper Sarvis Cove (Bald Mountain Ridge Scenic Area).* Hemlock forest and acidic cove (Messick 2003—Snyder).

Ocoee District (Cohutta/Big Frog Conservation Area). In addition to Big Frog Wilderness, one site has been visited. Twenty-seven other locations are candidate sites. Wally Crane, district silviculturist, told us in 1993 that the heavy logging of the district took place between 1890 and 1920. Any stands that survived that period were generally considered to be old growth (Crane 1993).

--Big Frog Wilderness Area (south of Ocoee River). Northern hardwood (in upland coves), high elevation Northern Red Oak (on some gentle slopes above 3800', dry oak (on upland ridges), and dry oak-pine (White Pine, Virginia Pine, Chestnut Oak). According to Z. E. Murrell and B. E. Wofford, who relayed the results of a 1982 Forest Service Wilderness Study Report, the upper slopes of Big Frog Mountain were not logged, because the terrain was too rugged; but because of fire and chestnut blight the forest is similar to second-growth forest (1987).

--Brock Mountain area (north of Ocoee River, Polk County)

----Rogers Branch.* Hemlock forest (Crane 1993).

Hiwassee District (Cohutta/Big Frog Conservation Area, Poke County). One site has been visited. Twenty-seven other sites are candidates.

--Duckett Ridge area (north of Hiwassee River)

----Coker Creek (Coker Creek Scenic Area). Stands of old-growth Eastern Hemlock and White Pines (Wuerthner 1990).

Tellico District (Unicoi Mountains Conservation Area). Eight sites have been visited. Thirty-eight other sites are candidates.

Fred Locke, district silviculturist, told us in 1993 that in the Tellico District old growth is basically concentrated along the higher ridges near the Tennessee-North Carolina line, particularly in the Bald River Gorge and Citico Creek Wildernesses. It is mostly hardwoods: buckeye, ash, oak, hickory, sometimes Sugar Maple, and sometimes beech.

The loggers who cut the land before the Forest Service acquired it had primitive equipment. During the period when the area was extensively cut, logging companies put in railway lines that followed the mountain valleys. Spur railways went out from the main lines. However, the loggers did not get into all the smaller coves and hollows. In those that escaped fire, sizeable pockets of old growth may exist today (Locke 1993).

The Tellico District's Citico Creek Wilderness adjoins the Joyce Kilmer-Slickrock Wilderness, most of which is in North Carolina. Following a 1925 fire which burned about half of what is now the Citico Creek Wilderness, logging abruptly stopped in the upper elevations of that area. Stands of uncut forest are therefore left in the less accessible locations (HBG 1993).

--Upper Tellico River Area (south of Cherohola Skyway, Monroe County)

----Sugar Mountain.* High elevation Northern Red Oak. Ted Snyder characterized the site (Messick 2003-Snyder).

----Upper Rough Ridge Creek. Hemlock-northern hardwoods.

----Sycamore Creek. Submesic oak. Locke described the old growth in 1993 as a 75-acre stand. On the lower slopes hemlock occurs. The hardwoods include upland and cove species: Northern Red Oak, Tulip Tree, maple, ash, hickory, White Oak, Chestnut Oak. The stand, which mostly faces north, is at 2800 to 3200 feet. The Forest Service describes it as 165 years in age (Locke 1993).

----Service Tree Branch Area.* In a small north-facing cove, acidic cove (lower slopes), rich cove (midslopes). Paul Myers characterized this site (Messick 2003-Myers).

--Citico Creek Wilderness Area (North of Cherohola Skyway, Monroe County)

----Falls Branch Scenic Area (Citico Creek Wilderness). Northern hardwood. Within a 275-acre Scenic Area are approximately 175 "virgin" acres (Malter 1977) or 187 "relatively untouched" acres of old growth (HBG 1993). The area includes very big Sugar Maple, buckeye, basswood, and Black Cherry. Among the shrubs are Mountain Winterberry, Maple-leaved Viburnum, and Mountain Pepperbush. As of 1977 some slopes appeared to have been disturbed by hogs. "Several bear dens" were "in evidence" above the 80-foot falls (Malter 1977, Pittillo 1976).

----Bob Bald* (Joyce Kilmer Wilderness). Stunted Yellow Birch forest. Hugh Irwin characterized this site.

----Upper Indian Valley Branch* (Citico Creek Wilderness). Hemlock-northern hardwood. The site was described in 1993 as two hundred acres of "relatively untouched" hemlock-hardwoods between the headwaters of Indian Valley Branch and Glenn Gap (HBG 1993). Malter characterized the site as one of two areas of "virgin" forest in Citico Creek Wilderness (1977).

--Little Tennessee River area (north of Cherohola Skyway, Monroe County)

----Upper First Creek.* Dry oak (with old White Oak trees).

------Upper Goat Creek

------Upper Lowdown Creek (Messick 2003-Snyder).

Unaka District (Unaka/Roan Mountains and Bald Mountains Conservation Areas). Fifteen sites have been visited. Thirty-five sites are candidates.

--Sampson Mountain area (west of Erwin, Unicoi County)

----Sampson Mountain.* Acidic cove and slope, dry oak-pine, xeric pine, and pine-oak heath (Messick 2003-Caldwell-Myers).

--Embreeville Mountain area (west of Erwin, Washington County)

----Embreeville Mountain (northeast terminus).* Submesic oak (Messick 2003-Eglinton).

--Big Bald/Little Bald area (east of Erwin, Unicoi County)

----Upper East Fork of Higgins Creek.* Northern hardwood (with some crown die-back) and high-elevation Northern Red Oak (Messick 2003-Eglinton, Smith, and Whitworth).

----Upper Big Bald Creek.* Northern hardwood and northern hardwood with rocky conditions (dominated by Yellow Birch) (Messick 2003-Eglinton).

----Little Bald.* Northern hardwoods and northern hardwoods with rocky conditions (dominated by Yellow Birch) (Messick 2003-Eglinton).

--Nolichucky Gorge area (east of Erwin, Unicoi County)

----Devils Creek (AT shelter).* Acidic cove (Messick 2003-Eglinton). Three individuals have nominated the site as an unlogged watershed.

----Nolichucky Gorge frontage (northeast side).* Rich cove, acidic cove, mixed riverine with Sweetgum, dry oak (on upland southwest- facing slopes), and talus slopes (mesic and dry) (Messick 2003-Messick).

----Jones Branch.* Hemlock forest (with some talus slopes) and acidic cove (Messick 2003-Caldwell and Myers).

--Unaka Mountain area (east of Erwin, Unicoi County)

----Unaka Mountain. Spruce-fir forest, and xeric pine with Table Mountain Pine (Korstian-1937, Wuerthner 1990).

--Stone Mountain area (east of Erwin, Unicoi County)

----Stone Mountain (southwest half).* Xeric pine and pine-oak-heath (Messick 2003-Caldwell and Myers).

--Strawberry Mountain area (east of Erwin, Carter County)

----Little Rock Knob.* Northern hardwood and northern hardwood with rocky conditions (dominated by Yellow Birch).

----Strawberry Mountain.* Northern hardwood and high- elevation Northern Red Oak (Messick 2003-Eglinton).

--Roan Mountain area (east of Erwin, Carter County)

----Highlands of Roan. Northern hardwood (surrounding balds). *Wilderness Trails of Tennessee's Cherokee National Forest* describes dwarf beech, 250 years old but only 12 inches in diameter, at the edge of the balds; a Yellow Birch 385 years old; a "mature stand" of Table Mountain Pine; and dwarf Yellow Buckeye in one of the gaps (HBG 1993).

----Roan High Knob (Upper Cove Creek). Red Spruce forest (and likely spruce-northern hardwood). Robert Leverett noted several hundred acres of old growth on the northwest side of Roan High Bluff. Red Spruce is dominant. Numerous trees are crowned out, and appear to be over 100 years old (Messick 2003-Leverett 1990).

--Doe River area (east of Erwin, Carter County)

----Ripshin Ridge.* Northern hardwood and hemlock-northern hardwood (Messick 2003-Eglinton). Boulderfields and cliffs are present in this area.

Watauga District (Unaka/Roan Mountains and Iron Mountains/Mount Rogers Conservation Areas). Thirty-six sites have been visited. In one of them no old growth has yet been found and another is listed as an "old-growth recovery area." These two sites are not listed here. The other thirty-four are listed below. Fifty-nine sites are candidates.

--Stone Mountain (south end, Johnson County)

----Stone Mountain (southwest terminus).* Dry oak (with cliffs).

----Upper Pine Branch Bottom Branch.* Submesic oak.

----North Spur of Stone Mountain.* Dry oak.

----Morgan Branch.* Dry oak (with White Pine) (Messick 2003-Whitworth).

--Rogers Ridge area (Johnson County)

----Upper Whetstone Branch.* Northern hardwood (Messick 2003-Eglinton and Smith).

--Pond Mountain area (Carter County)

----Little Pond Mountain.* Submesic oak and dry oak (Messick 2003-Eglinton).

----Pond Mountain (Pond Mountain Wilderness). An old-growth stand of approximately 150 acres at 3500 to 4000 feet, on the steep side of a mountain. The forest is hemlock forest, hemlock-mixed mesophytic. Hemlock and White Oak dominate. Also present are American Basswood, Table Mountain Pine, Tulip Tree, and Sugar Maple (Range 1993). Wuerthner writes that the Watauga Scenic Area, which is within the Pond Mountain Wilderness, contains scattered old-growth hemlock-hardwoods sites (1990).

--Iron Mountain Shelter area (Iron Mountains, Carter County)

----Five small sites (near the main ridge).* Northern hardwood, high-elevation Northern Red Oak, mesic oak, and dry oak (with significant White Oak).

--Shady Gap Area (Iron Mountains, Johnson County)

----Four small sites (near the main ridge).* Rich cove, and high-elevation Northern Red Oak (with frequent codominant Sugar Maple) (Messick 2003-Eglinton).

--Maple Branch area (Iron Mountains, Johnson County)

----Upper Blevins Branch.* High elevation Northern Red Oak (Messick 2003-Eglinton and Whitworth).

----Upper Maple Branch* [Two areas have been delineated, but as of March 2003 the area will have to be revisited because the data forms were missing.] (Messick-2003).

--Holston High Point Area (northwest slopes) (Holston Mountain, Sullivan County)

----Upper Weaver Creek.* Rich cove (riparian), dry oak (in rocky area by stream), dry oak (on upland slopes), and dry oak-pine (on ridge slopes).

----Upper Berry Branch (a).* Northern hardwood (dry).

----Berry Branch (b).* Mesic oak (in a steep rocky area), and dry oak-pine (on upland slopes).

----Low Gap Branch (a).* Hemlock forest (on a small upland valley slope).

----Low Gap Branch (b).* Rich cove.

----Nameless Tributary of Right Prong of Hatcher Creek.* Rich cove (riparian), and dry oak (on upland slopes). Rocky conditions are present.

----Upper Hatcher Creek.* Rich cove (riparian).

----Upper Riddle Creek (a and b).* Submesic oak, dry oak-pine, and xeric pine (on ridge slopes).

----Short Spur Trail (a).* Rich cove (riparian).

----Short Spur Trail (b).* Submesic oak (Messick 2003-Eglinton).

--Flint Rock area (northwest slopes) (Holston Mountain, Sullivan County)

----Upper Little Creek.* Rich cove, and dry oak (on ridge slopes).

----Upper Big Creek.* Rich cove (with a few Eastern Hemlock in the mix).

----Flint Rock.* Rich cove (in riparian areas, some of them rocky), mesic oak, dry oak, and dry oak-pine (on ridge slopes).

----Nameless tributary of South Holston Lake.* Submesic oak (Messick 2003-Eglinton).

----Upland Shelf near Josiah Creek.* Submesic oak (on an exceptional shelf with deep soils, open understory conditions, and more full understory conditions) (Messick 2003-Eglinton and Whitworth).

--Stony Creek Scenic Area (Holston Mountain, Carter County)

----Bakers Ridge Creek (Stony Creek Scenic Area).* Submesic oak (with an unusual occurrence of Carolina Hemlock) (Messick 2003-Eglinton)

--Rich Knob area (Holston Mountain, Sullivan County)

----Rich Knob.* (Messick 2003-Whitworth)

----Snake Spur.* Mesic oak (Messick 2003-Eglinton)

--Pine Mountain area (Holston Mountain, Sullivan County)

----Delaney Mountain (northwest slopes). Submesic oak with large canopy trees, dry oak, and dry oak-pine (on ridge slopes) (Eglinton). The old growth "very probably" exceeds 100 acres in size. According to Forest Service records, 99 acres in 4 stands were more than 100 years old and 31 of these acres were 132 years of age in 1993. Probably at least part of the adjoining forest is also old growth, since access to these stands was as poor as to the 99 acres. The forest has "many very large trees" (Irwin 1993).

--Holston Mountain (north end) (Sullivan and Johnson Counties)

----Upper Ramsey Branch.* Submesic oak

----Upper East Fork of Ramsey Branch.* Mesic oak

----Nameless Tributary of Beaverdam Creek.* Dry oak (Messick 2003-Eglinton).

Franklin State Forest (Marion County)

A 6941-acre forest with two areas of possible old growth.

--Upper Sweden Cove. A 1450-acre compartment, a portion of which has been only minimally disturbed. Hedgepath stated that there are at least several hundred and probably a thousand acres of old-growth hardwood forest in an extremely rugged gorge. Species vary with location. Chestnut Oak occurs on the upper slopes; much American Beech grows near the stream at the bottom. The gorge has no hemlock. The only known logging was the removal of dead American Chestnut (1993). More recently Strohmeier noted that the only logging in much of the cove has been selective (2003). Todd states that the forest as a whole was farmed and logged but that in the upper reaches, on the rocky face of the escarpment, there may be old Tulip Tree, hickories, cherry, walnut (2003).

--Crooked Tree Hollow.* Hardwood forest with minimal disturbance on much of the 890 acres owned by the state's Division of Forestry. As with Upper Sweden Cove, timber was sold in a power-line right of way. The state does not own the bottom of the hollow (Strohmeier 2003).

Prentice Cooper State Forest* (Marion and Hamilton Counties)

Likely old growth of uncertain extent in the bottom of the big gulfs. Suck Creek and Mullens Creek are two specific possibilities (Lane 2003).

Savage Gulf State Natural Area, within the South Cumberland Recreation Area, south-central Tennessee (Grundy County).

Two distinct types of old growth within the 11,500-acre Natural Area on the Cumberland Plateau. Commercial pine plantations surround much of the north and east and part of the south sides of the Natural Area.

--In the uplands in the northeastern part of the Natural Area, 1976-2470 contiguous acres (800-1000 ha) of mixed pine-hardwood old growth. The forest probably originated after a catastrophic fire early in the 18th century; parts have been selectively logged. Canopy dominants are Shortleaf Pine, Virginia Pine, and red and white oaks. Hardwoods dominate the midstory. Ericaceous shrubs dominate the shrub understory. Based on rings of trees cut to clear hiking trails, Shortleaf Pines are 230-270 years old. According to Haney and Lydic, who discovered the old growth, the age and the diameter size frequency distribution of the dominant canopy trees at Savage Gulf agree with USFS Guidance for old growth in the southern region; but Savage Gulf has lower snag density and fewer canopy

openings than USFS believes characterize old-growth oak-pine. Haney and Lydic theorize that damage caused by the southern pine beetle led to USFS's inadvertently inflating criteria for those characteristics (Haney and Lydic 1999, USFS 1997).

--In a gorge, a 750-acre virgin forest* of hemlocks and hardwoods in a climax association. The forest is within a long, narrow "gulf," 800 feet deep, formed by 3 downward-rushing creeks (Marcus 1988, West Tennessee 1988). The Gulf is off limits to recreational use.

Meeman-Shelby Forest State Park,* southwestern Tennessee (Shelby County)

Within the 13,000-acre park, 6000 acres of bottomland that have been little logged and that have, scattered throughout patches, some 10-40 acres in extent, that have never been logged. However, no scientific study of the area to determine what is old growth has been done. The land on which the park stands was long ago part of the Mississippi River. Then it became an oxbow and then a delta. Trees are mostly cypress, cottonwood, and Hackberry, also Pecan, White Oak, and Honey Locust. In the very wet, perennial swamp, the treees are mostly cypress, willow, and tupelo, with a lot of Buttonbush. As a state park, the entire 13,000 acres are protected from logging (Nordman, 2001; Smalley 2001, 2003).

Reelfoot Lake, northwest corner of Tennessee (Obion County)

Baldcypress 200 to 800 years old in a lake of approximately 20,000 acres, created by the 1811-1812 New Madrid earthquake. The earthquake appears to have impounded the Reelfoot River, which had flowed into the Mississippi River. The shaking and flooding of the ground killed most hardwood trees in the river basin, but hundreds of Baldcypress survived and today outline the locations of former stream channels. The University of Arkansas's Tree Ring Laboratory cored sample trees and found that their rings reflect an increase in radial growth between 1812 and 1819 and a permanent decrease in wood density after 1811, apparently due to the flooding. Furthermore, the researchers discovered broken wood in the pre-1812 portion of the cores, apparently due to the ground having shaken (Cleaveland 1993, Stahle et al. 1992).

The bottomlands along the lake are probably second growth, H. R. DeSelm reports, but they are nonetheless "nice" (2001).

The state of Tennessee owns the lake, about 25,000 acres, and has made it a State Natural Area. The state leases 11,000 acres to the US Fish and Wildlife Service for the Reelfoot National Wildlife Refuge. A 300-acre Reelfoot State Park is along the lake shore. The balance of the acreage is in Reelfoot Lake Wildlife Management Area. The Tennessee Wildlife Resources Agency is the lead agency for the Natural Area. (TDEC 1993, Pardue 2003).

Fall Creek Falls State Park, central Tennessee (Van Buren County)

Within the 17,000-acre park, old-growth forest, part never logged, in a complex of gorges at the head of Cane Creek. Donald Caplenor wrote that no logging or burning occurred in Fall Creek Gulf, Cane Creek Gulf between the mouth of Fall Creek and Cane Creek Falls, or upper Johnny Branch Gulf. In the upper half of Piney Creek Gulf, few trees other than Tulip Tree were removed (1965). Files of the Tennessee Department of Conservation give a tentative estimate of 20 to 30 acres for the uncut forest (TDEC 1993), but Randy Hedgepath, Naturalist at South Cumberland Park, says that the upper Cane Creek complex contains some 200 acres of uncut forest and selectively logged old growth. The trees may look young, he says, but they are small because of severe conditions (1993).

The basic forest type in the Cane Creek system is mixed mesophytic; the uncut portions of the gorges support hemlock and hemlock-Yellow Birch communities. Great Rhododendron is the most important shrub in these communities. In the 1920s, where major harvesting occurred, loggers apparently removed large Tulip Tree, oaks, chestnut, basswood, and hickory; but left all maple, beech, birch, and walnut (Caplenor 1965).

A disjunct population of 62 Northern White-cedars is found along the overhanging, north-facing sandstone cliff walls of Cane Creek Falls. They "grow from the edge of the main waterfall, eastward around the bowl-shaped cliff face . . . , and cease to occur at an abrupt transition with the adjacent forest." By estimating the age of a lateral branch from a stem, Young estimated that an individual tree was over 400 years old and concluded that the population was probably established 200 years before European settlement (Young 1996).

The Tennessee Department of Environment and Conservation owns the park, and the Division of Parks manages it.

Owl Creek Bottoms,* in Shiloh National Battlefield Military Park, southwestern Tennessee (Hardin County)

Eighty acres of never-logged bottomland hardwoods within the 4000 acre park. The additional 120 acres of bottomland "had seen some clearing" before 1894 when the park was established. Dominant trees in the bottomland are red oak, hickory, and Sweetgum. The bottomland is on Owl Creek River Channel, two miles west of the Tennessee River. The uplands in the park were logged by farmers, but the area was never commercially logged (Nordman 2001, Allen 2003).

Big Ridge Natural Area, south-central Tennessee (Hamilton County).

A 200-acre upland and mixed hardwoods forest, of which at least 60 acres are more than 100 years old. The balance of the forest is 60 to 80 years old. Adjacent land serves as a greenbelt and an environmental education farm for the city of Chattanooga, and for a housing development. The Tennessee Valley Authority owns the site (Bartlow 1992).

Shakerag Hollow, south-central Tennessee (Franklin County)

A couple of hundred acres of old-growth mixed-mesophytic hardwoods. A few trees have been removed. A trail runs through the area; and a coal operation used to take place in the hollow, but it caused little disruption. The University of the South owns the hollow (Hedgepath 1993).

Overton Park, Memphis (Shelby County)

A 175-acre uncut forest, within a 342-acre park, owned by the city of Memphis and managed by the Memphis Parks Commission. At the center of the forest is a mature climax oak-hickory-Tulip Tree stand with trees approximately 200 years old. Around the core are trees perhaps 50 years younger, which are at or close to reaching the final succession stage. As they age, they are becoming part of the core. The forest supports 50 species of trees (Marcus 1988, West Tennessee 1988). Exotic species are a problem (Caldwell 2002).

Dick Cove State Natural Area (Thumping Dick Cove), south-central Tennessee (Franklin County)

An old-growth, mixed mesophytic forest, 100 (McGee 1984), 150 (Ramseur 1993), or 200 acres in size in a 250-acre Natural Area (TDEC 1993). A few trees may have been cut before 1900 (McGee 1984), and the forest may have been selectively logged about 1901 (Schmalzer 1978). Walnut and Tulip Tree may have been taken out about a hundred years ago (Ramseur 1993). Between 1974 and 1982, 26% of the hickory and 18% of the White Oak and Northern Red Oak over 17 inches dbh (diameter at breast height) died, apparently because of drought, blowdown, insect infestation, and age. Ages of the trees that died ranged from 90 to 375 years (McGee 1984). The forest continues to experience heavy mortality, and succession is changing the composition, as Sugar Maple replaces Red Oak (Ramseur 1993). Little oak regeneration is taking place, and the majority of the understory is Sugar Maple (Evans 2001). The University of the South owns the Natural Area, which is on the western slope of the Cumberland Plateau.

Piney Falls State Natural Area, central Tennessee (Rhea County)

Within a 440-acre natural Area, an estimated 55 acres of uncut forest. The old growth is between an upper and a lower waterfall, where the trees are very difficult to reach. White Pine dominates. The site also has large hemlocks and a hardwood understory (Jenson 1993, TDEC 1993). Reggie Reeves describes the forest in the gorge as "typical mixed mesophytic" on the upper slopes and "hemlock-white pine mixed mesophytic on the lower slopes." Piney Falls is jointly managed by Cumberland Mountain State Park and the Tennessee State Natural Areas Program (Reeves 2001).

Stiner's Woods Natural Area, eastern Tennessee (Union County)

A 57-acre site comprised of old-growth mixed mesophytic forest dominated by beech (Bartlow 1992, Fraley 2003). DeSelm agrees that the slope is probably old growth (2001). The site is owned and managed by the Tennessee Valley Authority. The Tennessee Outdoor Recreation Plan says that the area was established in 1974 to protect 15 acres of virgin beech grove. The forest around the tract grew up after logging and farming (TVA 1986).

Hatchie River, western Tennessee (Haywood County)

Possible patches of old-growth Baldcypress and bottomland hardwoods along the river, totaling a few dozen acres, according to David Shankman and Larry Smith. The Chickasaw National Wildlife Refuge has been somewhat disrupted by logging, but cored trees are "several centuries" old (1993, 1993). Clyde Stewart, District

Forester, does not believe that the Chickasaw Refuge has any old growth (1993); neither does Leif Karnuph of the Refuge (2003). Kim Carpenter of The Nature Conservancy alluded to old growth along the Hatchie River, presumably outside the Refuge (1993). H. R. DeSelm reports that the best bottomland in western Tennessee, except for Reelfoot Lake, is found along the Hatchie. He does not know the logging history, but speculates that a logging limit may have meant that only trees over a certain size were taken (2001).

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VIRGINIA

In 1989, in response to a question about a specific ridge in the George Washington National Forest, Robert Mueller of Virginians for Wilderness wrote: "This is a typical xeric oak-chestnut type ridge forest. . . . It's sometimes difficult to tell if this type of forest is primary or secondary, unless the tree ages are known. The oaks . . . generally are stunted, thick-trunked and contorted and, if they escaped charcoal burning, frequently would have been rejected for timber use. I believe that there are probably a lot of scattered tracts of such inconspicuous, almost primary forest on exposed ridges throughout the Appalachians. They probably escaped the logging that destroyed the conspicuously large trees and more accessible stands along streams and in coves and on gentle slopes." At the time, his words seemed quite radical, at least to environmentalists who were not also scientists. Today the existence of extensive areas of uncut forest in the Appalachians is more commonly recognized. Even the tentative old-growth inventory of the George Washington National Forest put out by the US Forest Service (see below) bore out Mueller's speculation.

Tom Rawinski, speaking of the xeric pine and pine-oak forest types noted in the inventory, says that Virginia has "thousands and thousands of acres" of forest with Pitch Pine, Chestnut Oak, Table Mountain Pine, and Bear Oak that may have experienced little or no logging. This forest is found on ridge crests and on the upper, convex slopes of mountains, which means most frequently at elevations above 2000 feet. The forests are fire-maintained. If fire were removed, in many cases the pine would evanesce. Hence, he points out, they are not old growth in the classic sense of the term, although they may be original forest (1933).

Steven Stephenson notes that ridges in the Central Appalachians, below those that support primarily Chestnut Oak and pine, may bear old-growth Northern Red Oak and White Oak neglected by loggers because of the trees' poor growth forms. He is certain that patches of uncut Eastern Hemlock and Northern White-cedar survive in rocky ravines and inaccessible sites on steep slopes (1993).

Doug Coleman told us that inaccessible north-facing slopes support many very small plots of old growth, including shale barren communities that may be less than an acre in size. He also said that much land that has never been ploughed is scattered through the Appalachian forests. It can be identified through the species in the herbaceous layer, as the life histories of plants indicate whether a forest floor has been disturbed (1993).

Four of Virginia's coastal islands, owned by The Nature Conservancy, have forest that has never been cut, but the islands are constantly changing their forms and the vegetation is naturally young. Parramore Island has a ridge on which grow Loblolly Pine with Eastern Red-cedar, American Holly, Black Cherry, and Sassafras. (Pine bark beetles are killing the Loblolly Pine, but for each old tree that falls many young trees appear. Thus an even-aged pine forest will give way to an uneven-aged pine forest.) On the north end of Hog Island is a ridge over a hundred years old, on which is a myrtle thicket 15 feet tall and trees sticking out 15 feet above the myrtle. Maritime forest with Yaupon, Black Cherry, American Holly, and Live Oak among other species grows on recurved ridges on the south end of Smith Island; and Revels Island has a Holocene dune ridge with pine, cedar, and a small amount of Yaupon. The vegetation on Smith Island and Revels Island is 50 or 60 years old (Truitt 1993).

Small disjunct populations of Northern White-cedar occur in Virginia. Three sites that support Northern White-cedar communities that may be entirely or partly old growth are **New River** (Giles County): limestone rock, no signs of disturbance (Larson et al 2000); **James River** (Buckingham County): a north-facing rock outcrop with steep slopes (Walker 1987, Young 1996); and **Natural Tunnel State Park** (Scott County): steep, exposed cliffs around both sides of a natural tunnel, the cliff top portion logged (Larson et al. 2000, Young 1996).

Other specific old-growth sites in Virginia in addition to those described below include **Sweetbriar College White Oak Woods** (Amherst County): on a flat ridge owned by the college, approximately 10 acres of White Oak-mixed hardwoods-mixed herb community in which most of the dominant trees have dbhs (diameters at breast height) of 30 to 36 inches (Rawinski 1993, Coleman 1993)**; Pond Drain** (Giles County): old-growth forest dominated by Eastern Hemlock, large American Beech, and Yellow Birch on the floor of a ravine through which runs the stream that drains Mountain Lake (Stephenson 1993); **Great Falls** [National] Park (25 or more acres of old-growth mixed oak forest (Abrams and Copenheaver 1999)

GEORGE WASHINGTON NATIONAL FOREST

The Final Environmental Impact Statement for the Revised Land and Resource Management Plan published by the George Washington National Forest managers in January 1993 contains a Tentative Old Growth Inventory according to which the one million acre-Forest has 179,677 acres of old growth, divided as follows:

northern hardwoods (Sugar Maple-American Beech-Yellow Birch): 349 acres (180 years or older);

conifer-northern hardwoods subdivided as follows--hemlock-northern hardwoods: 1960 acres (180 years or older); White Pine-northern hardwoods: 1968 acres (180 years or older); spruce-northern hardwoods; 375 acres (180 years or older);

mixed mesophytic (cove hardwood-White Pine-hemlock; Tulip Tree; Tulip Tree-White Oak-Northern Red Oak): 3425 acres (180 years or older);

dry-mesic oak (Chestnut Oak; White Oak-Northern Red Oak-hickory; White Oak; Northern Red Oak; Scarlet Oak; Chestnut Oak-Scarlet Oak): 87,889 acres (130 years or older);

dry and xeric oak woodlands and savannas (Post Oak-Black Oak): 575 acres;

xeric pine and pine-oak forests and woodlands (Shortleaf Pine-oak; Pitch Pine-oak; Virginia Pine-oak; Table Mountain Pine-hardwood; Shortleaf Pine; Virginia Pine; Pitch Pine; Table Mountain Pine; Bear Oak-scrub oaks-Yellow Pine; scrub oak): 78,178 acres (80 years or older);

dry and dry-mesic oak-pine forests (upland hardwoods-White Pine; Chestnut Oak-Scarlet Oak-yellow pine; White Oak-Black Oak-Yellow Pine; Northern Red Oak-hickory-Yellow Pine): 4441 acres (130 years or older);

eastern riverfront forests (River Birch-sycamore; cottonwood): 206 acres (80 years or older).

The Virginia Natural Heritage Inventory and the staff of USFS itself have since discovered in the field extensive old growth. Nevertheless, USFS has allowed logging of certain old growth despite appeals and suits from environmentalists. The Hiner Hollow Timber Sale, for example, allowed the logging of two 20-25-acre streamside units of dry-mesic oak forest believed to be old growth, and the Hematite Sale cut into the edge of the Peters Mountain area described below (Krichbaum 1997). More recently the Hoover Creek Timber Sale resulted in the logging of 100 or more acres of old growth in Allegheny County (Neas 2001, Messick 2002).

Specific old-growth sites in the National Forest include:

--**Ramsey's Draft Wilderness** (Augusta County). Unlogged forest of uncertain extent within a 6720-acre Wilderness Area. According to the Audubon Society Field Guide to the Natural Places of the Mid-Atlantic States, over 6000 acres at Ramsey's Draft "were never logged" (Lawrence and Gross 1984). The Forest Service characterizes 608 acres in the Wilderness, divided among 9 stands, as having a birth date of 1790 or earlier (Sitton 1989). Rawinski reports that Ramsey's Draft Natural Area is 1700 acres in size, but that "over 6000 acres" may be a more accurate figure for the extent of the old growth (1993). Dan Miles notes that as of 1998, many of the largest trees (dbh over 24") were "fire-scarred survivors surrounded by younger unscarred trees." He speculates that the forest was not logged, because during the height of logging, which occurred around 1900, the area had few trees of marketable size as a result of fire (Miles 1998).

--**Peters Mountain Study Area,*** James River District (Alleghany County). Two large stands of old growth on rugged areas of the Peters Mountain ridges. (The two stands are described separately as Frozen Knob and Peters Mountain North in Wilson 2000a). The first stand covers about 3600 acres (1455 ha) on the northern ridge. It encompasses 2800 acres (1130 ha) of old, "generally oak-dominated forest" and 800 acres (325 ha) of "younger, pyrogenic forests that have regenerated following intense disturbance by fires." Except for one selectively cut area and five relatively small clearcuts, it has never been logged. The second stand covers about 1100 acres (445 ha) "of the more remote middle to upper slopes and crest" of the southern ridge. This stand is composed of old, oak-dominated forest, which has not been logged.

The lack of logging is indicated by the absence of stumps, the presence of thousands of boles of chestnut trees killed by the chestnut blight, and the size and age of the canopy trees. The oldest trees cored were a Northern Red Oak about 300 years old, a 289-year-old Chestnut Oak, and a White Oak about 280 years old. Size to age ratios vary with topographic position. The large number of dead chestnut bolls makes the site valuable for the study of the distribution and abundance of the species, among other subjects (Fleming 2002).

In 1996 Steven Krichbaum of Staunton, Virginia, filed a suit to stop the Hematite Timber Sale, which cut into the edge of the old growth on Peters Mountain. The suit did not prevent the logging unfortunately.

The old growth still has no formal protection. A large portion of it is, however, on lands declared to be unsuitable for timber production. Furthermore, because USFS logs within any specific area on the George Washington only once every ten or more years, it will not revisit the area for purposes of logging for ten years after the Hematite sale. By that time USFS expects to be well into revision of the management plan for the George Washington. The agency will consider setting aside the old growth in the revised plan, Steve Croy, USFS biologist reports (2003).

In a report on the site, the Virginia Natural Heritage Program states "unequivocally that the outstanding size and internal community type diversity of the Peters Mountain old growth warrants its exclusion from the timber base and justifies formal protection . . . . (Fleming 2002).

--Shenandoah Mountain Crest Special Biological Area,* Dry River District (Rockingham County). Within a 43,000-acre Biological Area, climax hardwood forest of unspecified extent. Northern Red Oak and White Oak are abundant in the overstory. The forest, at 1146 meters (>3500 feet) elevation, has much woody debris and no signs of logging. Terry Slater of USFS states that much of the area is old growth (2003). Mitchell et al. raise the question of whether the area is "virgin" (Mitchell et al. 1997).

--Mount Pleasant National Scenic Area,* Glenwood/Pedlar Districts (Amherst County). Varied old-growth communities within a 7580-acre area. An old-growth grove with Northern Red Oak and White Ash, over 4 feet dbh, occupies the steep valley of Indian Creek on the east face of Mount Pleasant. Another, larger grove, possibly over 1000 acres, lies alongside Little Cove Creek and extends upslope to the summit of Bald Knob. Oak-hickory forest, typical of ridges and slopes over 3500 feet, appareтnly unlogged, extends over the tops of Pompey Mountain, Bald Knob, and some of Mount Pleasant and Cole (Cold) Mountains (Miles 1998).

--**Skidmore Special Management Area,*** Dry River District (Rockingham County). A 1300-acre area with extensive old-growth hemlock-northern hardwood forest. The old growth includes areas of pure hemlock. However, the hemlock is dead or dying because of the Hemlock Woolly Adelgid, an exotic species (Slater 2003). Miles estimates that the unlogged forest covers more than 1000 acres (1998). Virginia Natural Heritage describes the 2337-acre Skidmore area in general as containing "one of the largest tracts of old growth hemlock-northern hardwood forest in Virginia" and urges that it receive Research Natural Area status (VNHP [nd]).

--Little Laurel Run Research Natural Area, Dry River District (Rockingham County). At least 1000 acres of unlogged forest in a 2000-acre Research Natural Area. A lot of the area has been burned so the trees do not look old; but the hollows the fire did not reach have big, impressive trees (Rawinski 1993).

--Little River Roadless Area,* Dry River District (Rockingham County). Substantial old growth within a 27,248-acre area proposed as Wilderness. The Roadless Area encompasses the Little River watershed, Skidmore Forks, Stony Run, and Wolf Run among other named areas. The old growth is mostly hardwoods and, as would be expected, is on the most inaccessible sites, for example at the head of the Little River. Oaks, hickories, and maples grow on the moister sites. Oaks and pines are on the poorer sites, particularly ridge tops, and southern and western exposures. The Dry River District has many sites up to 50 acres outside the Roadless Area and the other areas named above (Slater 2003).

--Rich Hole Wilderness, James River District (Rockbridge County). Within the Wilderness, hundreds of acres of old growth that follow a stream for a couple miles through very rough terrain. White Ash and Northern Red Oak have dbhs of 3 feet to 4 feet. Hemlock are almost as impressive. Sugar Maple are present though not big (Mueller 1993).

JEFFERSON NATIONAL FOREST

For the revision of the forest's Land and Resource Management Plan, underway in 2003, the staff of Jefferson National Forest compiled a Preliminary Inventory of Possible Old Growth. The Preliminary Inventory was based on the guidance on old growth provided by USFS's Region 8 Old Growth Team (USDA 1997). The inventory drew on three sources of information: USFS statistics in the form of the Continuous Inventory of Stand Conditions (CISC) database, the identification of areas withdrawn congressionally or administratively from timber production, and inventories conducted for the purpose of identifying old growth. Eleven Wilderness Areas have been designated on the Jefferson. According to the Preliminary Inventory, most of them "are not existing old growth," but they do qualify as future old growth. The inventories to identify current old growth included a review of aerial photography from the 1930s, Virginia Division of Natural Heritage inventories, and "local knowledge and citizen

input." These inventories do not constitute a thorough field checking of the forest. Much field work remains to be done. The report lists separately the acreage garnered by each of the three approaches. It also combines the results of the three approaches to give total figures for the forest. Sites identified by two or three types of sources are counted only once in the totals, but these totals include much future old growth as well as actual old growth.

The figures for the forest as a whole based on inventories conducted specifically to identify old growth are as follows: conifer-northern hardwood, 563 acres; dry-mesic oak, 27,769 acres; dry and dry-mesic oak-pine, 4808 acres; mixed and western mesophytic, 3647 acres; northern hardwood, 1969 acres; xeric pine and pine-oak, 903 acres; montane spruce and spruce-fir, 23 acres; for a total of 39,685 acres. The total for the forest as a whole based on the combination of the three sources is 107,856 acres. That figure includes all the land in Wilderness Areas. The totals per district for old growth discovered through inventories to locate old growth are Glenwood, 2432 acres; Wythe, 13,998 acres; Clinch, 2280 acres; Newcastle, 7001 acres; and Blacksburg, 106 acres. The Mount Rogers Recreation Area, which is part of the Jefferson National Forest, has 6868 acres (Jefferson National Forest [nd]).

The Draft Revised Land and Resource Management Plan includes allocations for future and for existing old growth. The figures for existing old growth are in each case but one (dry-mesic oak) higher than those in the inventory. Two categories in the allocations were not included in the inventory figures (river floodplain and eastern riverfront; and dry and xeric oak forest, woodland and savanna). The allocations are northern hardwood, 2000 acres; conifer-northern hardwood 1300 acres; mixed mesophytic 4000 acres; river floodplain and eastern riverfront 13 acres; dry-mesic oak 22,400 acres; dry and xeric oak forest, woodland and savanna 10,400 acres; xeric pine and pine-oak forest and woodland 1300 acres; dry and dry-mesic oak-pine 8800 acres; montane and allied spruce and spruce-fir 120 acres (USDA 2003).

--Pick Breeches and Flannery Ridges,* Clinch District (Scott County). Nine hundred contiguous acres of old growth on portions of Flannery Ridge, Pick Breeches Ridge, and Laurel Fork Gorge, which links the ridges. The stand is signficant for its size and for the fact that much of it is on gentle to moderately sloping terrain. Steep rocky slopes on three sides of the gentle terrain seem to have protected the trees in that area.

The majority of the old growth is Chestnut Oak forest on mesic, infertile land. Old-age associates of the Chestnut Oak are White Oak, Black Gum, and Red Maple. Younger trees in the canopy include Black Oak, Scarlet Oak, and Fraser's Magnolia. Dead chestnut trees appear to have been removed from Pick Breeches Ridge, but not from Flannery Ridge. As is typical for mesic, infertile land, the shrub layer is dominated by heath and the herbaceous layer is sparse.

Laurel Fork Gorge supports acidic cove forest dominated by Eastern Hemlock, many individuals over 100 feet tall. Other canopy trees are Yellow Birch, Tulip Tree, Fraser's Magnolia, Red Maple, and several oaks. The understory is dominated by rhododendron with Mountain Pepper-Bush (*Clethra acuminata*), and alternate-leaf dogwood (*Cornus alterniflora*). The herb layer is either nonexistent or dominated by mosses and ferns.

Montane oak-hickory forest is found on middle and lower slopes on the south side of Pick Breeches Ridge. The dominant trees on talus are Chestnut Oak, Northern Red Oak, and Tulip Tree. On a small area with more fertile soil, Red Oak, Sweet Pignut Hickory (*Carya ovalis*), and Chestnut Oak are dominant.

The site is not protected. Virginia Natural Heritage recommends an immediate prohibition on mining and road building within the significant communities and consideration of the site as a Special Interest Area (Wilson 2000b).

--Pickem Mountain,* Clinch District (Wise County). Old-growth mixed mesophytic forest and Chestnut Oak-Pitch Pine forest, possibly 700 acres in extent. The mixed mesophytic forest is on the north-facing slopes of Pickem Mountain. Dominant trees are Tulip Tree, Chestnut Oak, and Northern Red Oak, with the larger individuals 3 to 4 feet in diameter. The upper slope shows no signs of logging. The lower slopes had not been studied at the time of the report that is our source. The Chestnut Oak-Pitch Pine forest occupies the mountain's drier ridge crests, south-facing slopes, and knobby highlands. As would be expected, the canopy oaks here are not as large or straight as those in the mixed mesophytic forest. A relatively recent logging road crosses this forest; but, off the road, researchers found no signs of logging. Virginia Natural Heritage recommended further study of the site and its designation as a Special Interest Area (Virginia 1995).

--Roaring Branch, Clinch District (Wise County). Old-growth acidic cove forest and Chestnut Oak forest within an 1167-acre (472-ha) site, the watershed of Roaring Branch between State Route 23 and High Butte.

The acidic forest, a "spectacular" example of Lucy Braun's "hemlock-mixed mesophytic forest," occupies a steep-sided ravine near the mouth of the stream. Eastern Hemlock and Yellow Birch dominate adjacent to the stream; Tulip Tree, on the slopes. Many trees are 70 to 100 cm dbh and 200 to 300 years old. Great Rhododendron forms the

shrub layer; Intermediate Wood-fern (*Dryopteris intermedia*) dominates the mossy ground layer. Two milllipedes new to science were found in the forest.

An almost four-mile-long strip of old-growth Chestnut Oak forest, dominated by White Oak and Chestnut Oak is found in the middle and upper reaches of the drainage. Large trees are less dense than might be expected either because of fires or the former importance of American Chestnut in the stand.

Virginia Natural Heritage, which describes this site, does not estimate the acreage of the old growth that they identified and did not have time to explore the steep side-slopes of the watershed, where there may be additional old growth. They set the boundary for the site at the drainage divides for the valley in order to best protect the identified old growth and the side slopes.

All except 30 acres of the site are owned by USFS. USFS's land is not protected. Natural Heritage recommends that the agency designate the site a Special Interest Area (Wilson 2000b).

--Cliff Mountain, Clinch District (Lee and Scott Counties). A 2763-acre (1082-ha) site with at least 505 acres of old growth on low cliffs and steep slopes on the northwest face of Powell Mountain and the southwest face of Cliff Mountain. Two complexes of old-growth forest, 275 acres and 230 acres respectively, support montane oak-hickory forest and four occurrences of rich cove/mesic slope forest of the Wood Nettle-Blue Cohosh type. Numerous trees in the slope forest are up to 4.5 feet in diameter, and age classes of 179-190 years and 200-300 years are typical. Virginia Natural Heritage remarks that "the old growth rich hardwood forests at this site are probably the finest examples of this type anywhere in Virginia."

Another community on the site is an "outstanding example of a Xeric Calcareous Cliff woodland." Natural Heritage does not describe this community as old growth, but since it is on the southwest-facing exposures of Cliff Mountain and since much of the site is "essentially inaccessible," it seems likely that this woodland is primary.

The boundaries of the site include "substantial areas that have not been explored due to logistical constraints and the ruggedness of the area. This unexplored area is likely to contain additional natural heritage resources."

Roughly two-thirds of the site (1594 acres) belongs to USFS; the other third is in private hands. National Heritage recommends the USFS land for designation as a Special Interest Area (Wilson 2000b).

--Indian Grave Gap,* Clinch District (Wise County). A 373-acre site at the headwaters of Phillips Creek and Laurel Fork, with 4 old-growth communities and a significant wetland community. The site is partially bounded by the ridgeline of Pine Mountain.

Chestnut Oak forest, with no signs of chestnut salvaging or other logging, covers approximately 150 acres. Most of this forest is dominated by old Chestnut Oak and White Oak and has a relatively open understory. It is found on moderate to gentle slopes and rounded crests. The density of large, old trees is high. On average about 20 trees with diameters at breast height of 30 to 40 inches occur per acre, and 28 such trees per acre are frequently found. Small portions of the Chestnut Oak forest are dominated by Chestnut Oak over a dense understory of Great Rhododendron or Mountain Laurel. Shortleaf Pine and Pitch Pine also grow in these small areas, which are found on steep slopes.

Pine-oak/heath woodland with tall Shortleaf Pine and Pitch Pine covers approximately 42 acres on a ridge crest and steep slopes. The understory is dense, and pine is not being recruited, which may indicate need for prescribed fire.

Montane oak-hickory forest occurs as inclusions of 11 and 10 acres respectively in the Chestnut Oak forest. This forest type may have suffered selective high grading.

The site is unprotected and should be considered for designation as a Special Interest Area, Virginia Natural Heritage states. Furthermore, the fire and vegetation history needs study (Wilson 2000b).

--Dark Hollow,* Clinch District (Wise County). A 109-acre site composed of a ravine with "a relatively pristine, impressive old growth hemlock" stand and a 200-foot buffer. The older hemlocks are 200 to 300 years old and often 3-4 feet in diameter. Growing with them are equally large Tulip Tree and Northern Red Oak. The site shows no signs of logging, but is unprotected (Wilson 2000b).

--Tributary East of Laurel Fork,* Clinch District (Wise County). Five old-growth communities along the second un-named tributary flowing into Pound Reservoir to the east of Laurel Fork. Acidic cove forest is located near the mouth of the tributary and extends along it to 2000 feet and above. Dry oak forest is found near 1950 feet on a south-west facing slope, between two shallow valleys. Dry oak-pine grows near 2000 feet, also on a southwest-facing slope. Shortleaf Pine, Pitch Pine, Chestnut Oak, Black Oak, Tulip Tree, Red Maple, Fraser Magnolia, and Witchhazel are found in this type. Acidic cove forest is found above 1960 feet in a rocky ravine. Mixed mesophytic

forest is located on an east-facing slope near 2300 feet. In 1997 no roadbeds, trails, or signs of logging were found in any of the communities except the acidic cove forest near the mouth of the tributary, where there is an abandoned homestead and a campsite. Steve Brooks and Rob Messick, who discovered the site, have not specified the old-growth acreage (Brooks and Messick 1997).

--Good Spur Ridge,* Clinch District (Scott County). Seventy-five acres of confirmed and suspected old growth on a steep west- and southwest-flank of Good Spur Ridge. There are no signs of logging. Chestnut Oak, including trees more than 200 years old, dominates the canopy. Associated trees are Red Maple, Black Gum, Pitch Pine, and Sourwood. Chestnut Oak is found in the understory and the herb layer. The shrub layer is ericaceous (Virginia NHP [nd]).

--Thunder Ridge Wilderness,* Glenwood District (Bedford County). At least two old-growth oak stands of 15 acres each. The two stands, only about 2 miles apart, are at an elevation of 3400-3600 feet. One stand, dominated by Northern Red Oak, is "on a flat to gently rolling, exposed ridgetop." The other, dominated by Chestnut Oak, is "on a steep talus sideslope." Researchers have contrasted their history and successional status (Abrams et al. 1997).

-- **Salt Pond Mountain,** in Mountain Lake Wilderness (Giles County). Virgin Eastern Hemlock-Red Spruce forest at the bottom of a ravine. Other trees present include Yellow Birch and Sweet Birch. Great Rhododendron is the most important shrub. The shrub layer and the herb layer have few species (Stephenson 1993, Adams and Stephenson 1989). Mueller points out that the site supports both the southern species Galax and the northern species Canada Mayflower. He estimates the old growth as being around 10 acres in size and at an elevation of approximately 3600 feet, and he suspects the Jefferson National Forest has other such uncut ravines (1993).

Mount Rogers National Recreation Area (Jefferson National Forest) and Grayson Highlands State Park, southwestern Virginia

Thousands of acres of subalpine Red Spruce and Fraser Fir that are apparently unlogged, plus some small areas of lower elevation old growth (Tyrrell 1998). Rheinhardt and Ware studied 49,400 acres (20,000 ha) in the Virginia Balsams, which encompass Mount Rogers, Mount Whitetop, and their "associated ridges and smaller peaks" and lie within the 140,000-acre Mount Rogers National Recreation Area and 4822-acre Grayson Highland State Park. They wrote that most undisrupted forests are found above 1150 m in elevation and that "about 70% [of the 49,400 acres, ie about 35,000 acres]is covered by old growth forests" (1984). USFS's Preliminary Inventory of Possible Old Growth lists for the Mount Rogers Recreation Area, 2228 acres based on CISC data, 12,147 acres based on designated protected areas, and 6868 acres based on old-growth inventories. Combining them, the Preliminary Inventory gives a total from all sources of 19,309 acres of old growth (Jefferson [nd]). Half of the National Recreation Area is in the timber base, according to the 1990 management plan (Parsons 1999). Specific examples of old-growth sites include:

--Mount Rogers (Grayson County}. Subalpine Red Spruce-Fraser Fir, probably uncut, on the summit and north slopes of Mount Rogers (Reinhardt and Ware 1984). A map by Pyle and Schafale presenting the disturbance history of the mountain's spruce-fir zone shows a substantial uncut and unburned area (1988). Mount Rogers is protected, because it is within the Lewis Fork Wilderness (Parsons 1999).

--Whitetop Mountain (Washington, Smyth, and Grayson Counties). Red Spruce, probably uncut, on the north slope and summit (Rheinhardt and Ware, 1984). Whitetop Mountain does not support Balsam Fir. The lack of fir could be the result of past temperature changes or of anthropogenic disruption (Rheinhardt 1984). Pyle and Schafale show an uncut and unburned area (1988); and Ware believes that the stand is unlogged (1993). However, Adams and Stephenson do not include Whitetop Mountain in their list of uncut Red Spruce stands in the mid-Appalachians (1989). According to Virginia's Treasures, the 5919-acre Whitetop Mountain area includes 1323 acres "of possible old growth" (Parsons 1999).

--Horse Heaven* (Wythe County). A dry, lower-elevation area of oak, hickory, and pine with 534 acres of possible old growth. The Horse Heaven area as a whole covers 4744 acres (Parsons 1999). This site and the following site are only examples of various possible old-growth areas of less than a thousand acres.

--Raccoon Branch* (Smyth County). A 4384-acre area with 321 acres of possible old growth. USFS identified Raccoon Branch as a roadless area (Parsons 1999).

Warm Springs Mountain,* western Virginia (Bath County)

At least 425 acres of old growth within a 9000-acre tract on and around the mountain. Old-growth oak hickory forest occupies about 300 acres. The trees, mostly oaks with a scattering of hickory, have dbh's up to 2-3

feet, and the majority are well above 120 years in age. A montane pine barren that has not been grazed by livestock and may not have been logged is in 3 patches that total at least 125 acres. The area is high, dry, and acidic; the trees are mostly Pitch Pine. Researchers do no know what the barren actually looked like 300 years ago. Therefore, they do not know if it has changed. The Nature Conservancy has purchased the 9000 acres (Ludwig 2003).

Bottomland on the Meherrin, Nottoway, and Blackwater Rivers, in southeastern Virginia

Old-growth bottomland hardwoods of unknown extent, mostly dominated by Baldcypress and tupelo. Chris Ludwig of the Virginia Division of Natural Heritage thinks the old growth probably totals hundreds of acres. Much of the forested bottomland is owned by lumber companies and by private individuals. Therefore, access is difficult; and no aerial survey has been carried out (1993, 2003). Gary Williamson, who floated the river swamps with John Dennis looking for old growth and rare species, says that the Blackwater has more pristine acreage than the other rivers. Along this river he found corridors of uncut, unspoiled cypress-tupelo several miles in length (1993). Two areas on the Blackwater with old growth are now in Blackwater River Preserve and Dendron Swamp Natural Area Preserve (see below). The Nottoway River in Isle of Wight County has 2 or 3 areas of old growth. Of the 3 rivers, the Meherrin has been the most heavily logged, but Fountain's Creek, a small tributary of the Meherrin, has a couple of old sites (Williamson 1993).

Caledon State Natural Area, east-central Virginia (King George County)

Old-growth forest within a 2600-acre, state-owned Natural Area. Opinions as to the extent of old growth differ. John Zawatsky, Park Manager, reports that the only remnants of original forest are scattered individual trees and patches of trees in ravines (1993). Tom Rawinski of the Virginia Division of Natural Heritage says that, although trees may have been cut in the early 1700s, the tract has 300 or so acres of oak and beech climax forest that are generally considered to be old growth (1993). Stewart Ware, professor at William and Mary, agrees that the upland forest includes old growth, perhaps a couple of hundred acres. He notes that very old trees, which appear to have lived 250 years or longer, have broad canopies as if they were grown in the open, and that there are gaps between the trees. He speculates that pigs or other livestock heavily grazed the area and ate the seedlings. After a while, he suggests, the animals were removed, and a new generation of trees began to establish itself. He also notes that many of the older oak are dying, while beech is reproducing profusely (1993). In addition to the upland old growth, the Natural Area, which is bounded by the Potomac River, includes a marsh and a climax White Oak swamp. Parts of the area are closed to the public at certain times of the year to protect wildlife (Duffy 1993).

North Landing River Preserve , City of Chesapeake, southeastern Virginia

An estimated 200 or more uncut acres, mostly Pond Pine, with some Atlantic White-cedar, within a 6000-acre area co-owned by the Virginia Division of Natural Heritage, Natural Areas Subsection, and The Nature Conservancy. The land is woodland and scrubland grading into Pond Pine pocosin. The trees in the uncut pocosin are as far apart as in a savanna (Ludwig 1993, 2003). The community is fire dependent and last experienced fire in the 1980s.

The Nature Conservancy also owns on North Landing River an 1100-acre preserve called Gum Swamp, with several dozen scattered ancient cypress (Van Eerden 2002).

James Madison Estate , Montpelier, central Virginia (Orange County)

A 200-acre National Natural Landmark of essentially undisturbed forest surrounded by 400 acres of forest that includes scattered old-growth remnants. The forest is on the northern side of a small foothill, cut by ravines, in the Blue Ridge. White Oak and Northern Red Oak are dominant on the upper slopes; Tulip Tree, hickory, and oak on the lower slopes and in the ravines. The site includes trees over 300 years old. A very few Tulip Tree have a 6 foot dbh; more abundant are Tulip Tree and oak 3 to 4 feet in diameter. On the uppermost, driest slopes, some American Chestnut died, and 60 or 70 years later a few of them were cut; but the 200 acres bear no other evidence of harvesting.

The forest is owned by the National Trust for Historic Preservation and is open to the public as one of the features of visits to the estate as a whole. Researchers wanting to see only the forest can call 703-672-2728 for permission to go directly there (Fleming 1993, Tice, 1993).

Shenandoah National Park , northern Virginia (Madison County)

One hundred or more acres of old growth, mostly in hollows. Researchers for the Virginia Natural Heritage Program, which inventoried the park, reported the following old-growth sites and acreages: **Limberlost** (in White

Oak Canyon): 25 acres; **Ivy Creek**: 15 acres; **Mount Marshall**: 5 acres; **Pocosin Hollow and Entry Run**: 5 acres; **Stony Man** (a 0.4 mile band): no estimate made; **Upper Staunton River**, an area with huge Tulip Trees: 15 acres; Laurel Prong, a small area: no estimate made (Winstead 1993). Robert Leverett would add 25 acres to **White Oak Canyon**--an area of small but old hardwoods down in the gorge--for a total of 50 acres at that site (Leverett 1993). Dominant trees in White Oak Canyon are hemlock and White Oak. Core samples from trees in the Limberlost as a whole show that hemlocks date back to the 1600s and White Oak to 1587 (Adams 1990).

Short Hill,* northern Virginia (Loudoun County)

Old growth of undetermined extent, possibly totaling well over 100 acres, in scattered pockets across the mountain. Species include Sugar Maple, Northern Red Oak, White Ash, White Oak, Black Birch, Yellow Birch, plus a little Hackberry and Sassafras. Part of the old growth is owned by Harpers Ferry National Historic Park and part by private parties (Sweeney 2002).

Bottom Creek Gorge, southwestern Virginia (Montgomery County)

A 90-acre tract, approximately half of which, by a waterfall, is thought to be virgin old-growth hemlock. The tract is owned by The Nature Conservancy (St. Clair 1993).

Blackwater Preserve,* southeastern Virginia (Southamptom County)

Seventy acres of Baldcypress-Water Tupelo extending for a mile on the west bank of the Blackwater River. The site has been only selectively logged. Chris Ludwig describes it as having 30 or 40 acres of old growth (2003). Cypress are up to 800 or more years old. Up and down the river are tracts of younger cypress-tupelo and occasional patches of older trees. Therefore prospects for retaining flooding processes are good. Away from the river the terrain is less natural with old field pine and pine plantations. The Nature Conservancy owns the preserve (Van Eerden 2002).

Dendron Swamp Natural Area Preserve,* southeastern Virginia (Sussex County)

A 179-acre preserve with cypress-tupelo swamp on the Blackwater River. A fact sheet from the Department of Conservation and Recreation describes the preserve as "old growth" (DCR 2002). Brian Van Eerden speaks of it as possibly having pockets of old growth (2002). Parts along the river are old growth, but how much is old growth is open to debate, Chris Ludwig summarizes (2003). The Natural Area includes the 19-acre Charles C. Steirly Natural Area, donated to the Department of Conservation and Recreation to protect a nesting site for the Great Blue Heron (DCR 2002).

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Ohio Valley

INDIANA

The US Forest Service (USFS) released a Notice of Intent to revise the management plan for Hoosier National Forest in November of 2000. The agency is now gathering data and working on alternatives. It hopes to produce a draft management plan in 2003. The planning staff does not regard old growth as an issue. The current forest management plan sets aside 96,000 acres as "potential old growth." The set aside is not permanent, but will last as long as a forest plan providing for it is in effect. The staff is planning to maintain the 96,000-acre allocation in the revised plan. According to forest planner Regis Terny, actual old growth on the Hoosier is limited to Pioneer Mothers Memorial Forest Research Natural Area and perhaps one or two other relatively small sites (Terny 2002; see below).

In welcome contrast to the US Forest Service, the Indiana Department of Natural Resources (IDNR) actively protects old growth. The various divisions of the department own numerous preserves with old growth, and the department's Division of Nature Preserves administers a state-wide system of permanently protected natural areas. A private individual may dedicate land as a Nature Preserve, but most Nature Preserves are owned by organizations or by state agencies.

In addition to the sites described below, old-growth tracts in Indiana include **Eunice Hamilton Bryan Nature Preserve** (Clinton County): 29 acres of old-growth forest, including White Oak four feet in diameter (IDNR); **Shrader-Weaver Nature Preserve** (Fayette County): a 28-acre stand of upland hardwoods from which only dead wood and a few Tulip Trees were apparently removed; **Bendix Woods** Nature Preserve: 27 acres of old growth dominated by American Beech and Sugar Maple, without signs of cutting (Saint Joseph County); **Laughery Bluff Nature Preserve** (Ripley County): within an 81-acre preserve in Versailles State Park, 20 or more acres of old-growth bluff top forest dominated by maple and beech; **Dogwood Nature Preserve**:* 20 acres of old-growth hardwoods, also within Versailles State Park (IDF); **Wells Woods Nature Preserve** (Jennings County): 20 acres of old growth, with American Beech, Sweetgum, Red Maple, Black Gum, White Oak, and Swamp Chestnut Oak, on "white clay flats" (level ground of Cobbsfork silt loam) (Spetich 1993, Huffman 1992, IDNR 1991);
Guthrie Woods (Jennings County): a 61-acre bluegrass Till Plain flatwoods, owned by The Nature Conservancy, within which are 20 acres of old growth (Huffman, 1992); **Scout Ridge Nature Preserve*** (Monroe County): 15 acres of largely beech-maple old growth, a portion struck by a tornado, within Morgan-Monroe State Forest (IDNR 2002; Huffman 2001) . All of the sites in this paragraph, except Bendix Woods Nature Preserve, are owned by IDNR. Bendix Woods is owned by the St. Joseph County Park and Recreation Board.

We did not include one preserve containing one hundred or more acres of old growth, at the request of IDNR, which fears that visitors would irreparably damage the site.

HOOSIER NATIONAL FOREST, in south-central Indiana

Dry Upland Forest. Perhaps as much as 10,000 acres that have apparently been subject only to some selective cutting for personal use prior to acquisition by the USFS, according to the agency's Steve Olson. Occasional stumps 50 to 80 years old testify to the personal cutting; but the trees grow too slowly and too out of proportion to be of obvious commercial value. Cross sections and increment borings have shown that many of the largest trees are more than 200 years old ([1993], 1993, and 2002).

Hank Huffman of IDNR believes that "as much as 10,000 acres" is overly generous but that there is more old growth, of one type or another, on the Hoosier than is recognized by the many people who limit the old growth to Pioneer Mothers Memorial Forest.

Until this century, the dry upland forest was subject to fire, which apparently occurred every five to ten years. Fire suppression began to make an impact in the thirties, and resulted in a thick understory of Sugar Maple and shrubs, and heavy leaf litter. Now the Forest Service is using prescribed burning.

Dry upland forest communities are found most often on the tops of ridges and high on slopes that face south or west. Depending on soil conditions in adjacent areas, they grade into barrens or dry-mesic upland forest. The dry forest is of two basic types, as a result of differences in soils.

Dry woods on moderately acidic soils with little exposed bedrock may be dominated by any of several canopy trees or combinations of trees, especially oaks. Black Oak, White Oak, Black Gum, and Pignut Hickory are common. Post Oak is often the dominant. Prominent in the understory are Red Maple, Shadbush, Flowering Dogwood, and Eastern Hophornbeam. Most common among the sparse shrubs are Lowbush Blueberry and Deerberry. Common Greenbrier often forms dense mats. Among the herbaceous species are Two-Flowered Cynthia, Woodland Sunflower, and Small Skullcap. Bushy Panic-grass is an abundant graminoid; and Ebony Spleenwort, the most common fern. Gray-shield Lichen covers large areas of tree trunks. Other lichens and also mosses are widespread on soil and rock. Some lichens may favor, or even be restricted to, old trees, research elsewhere suggests; and future research on mosses could shoe similar correlations with old forests.

In dry forest on calcareous sites, Chinquapin Oak is often prominent in the canopy, where it is accompanied by Black Oak, White Oak, and Pignut Hickory. In the understory are dogwood and Eastern Hophornbeam. Shrubs include Deerberry and Pasture Rose. Various species of greenbrier are abundant; and Poverty Oats and Bushy Panic-Grass, common. Calciphilic herbaceous species such as American Columbo and Sicklepod may be present. Again the most common fern is Ebony Spleenwort. Extensive areas of bryophytes and lichens may be found on tree bark, soil, and rock.

Barrens. Approximately 400 acres in the southern part of the Forest, mostly facing south or west. Two of the areas are sizeable. The barrens may have had a little cutting for such personal purposes as cleaning up a fence line or obtaining firewood. The age of trees and the history of fire, fire suppression, and prescribed burning is roughly the same as for dry upland forest, though trees in barrens tend to be smaller. Canopy closure ranges up to 75%. As in the dry upland forest, trees are "all branches," with conspicuous trunk taper; shrubbery ranges from absent to thick. Barrens grade into dry forest. There are two types of barrens, based on the soil and rock on which they lie.

Sandstone barrens are on thin, strongly acidic soil. Chestnut Oak or Black Oak and White Oak are the dominant trees. Post Oak is common, and Blackjack Oak also appears. In the understory, Red Maple, Flowering Dogwood, and Eastern Hophornbeam are most frequent. The most common shrubs are Coralberry, Lowbush Blueberry, and Black Huckleberry. Common Greenbrier is abundant. Grasses include Little Bluestem, Poverty Oats, and Loose-flowered Panic-grass. Prairie forbs mix with those of dry forests. Lichens grow on trees and exposed rock, and mosses cover the soil.

Barrens on limestone and calcareous shales occur in association with dry upland forest or sandstone barrens. In the limestone barrens, the lack of moisture, caused by rapid runoff, restricts tree growth. Stunted Post Oak and Blackjack Oak form an open canopy, sometimes as low as 20%. Flowering Dogwood, Redbud, and to a lesser extent Carolina Buckthorn compose an understory that is often little taller than the shrubs. The herbaceous layer, including Little Bluestem, Big Bluestem, and Indian-grass, forms a complete ground cover. A great variety of prairie forbs is present. Lichens grow on trees and exposed rock (Olson, [1993], 1993, and 1999).

--**Boone Creek Special Area*** (Perry County). A 700-acre area with unlogged barrens and dry upland forest of uncertain extent. USFS created the Special Area in November 2000. Richard Guyette and representatives of USFS's North Central Research Station have determined the age of a sampling of Post Oak on some 350 acres. The oldest fire scar that they found dates from 1661 (Olson 2002).

--**Pioneer Mothers Memorial Forest Research Natural Area** (Orange County). Within an 88-acre RNA, an old-growth beech-maple forest of uncertain extent. According to USFS, the entire 88 acres have never been logged although they have been grazed (Weigel 2002). Spetich, after a month-long inventory, believes that the RNA is composed of a 37-acre old-growth core, a former pasture, agricultural areas on which trees were planted in 1940, and other land that has experienced significant disturbance (Spetich 1999). The forest was owned from 1818-1940 by the Cox family, who protected it. To settle an estate, 203 acres including the 88 acres, were sold to a lumber company, from which the US Forest Service bought them, after local groups, including the Indiana Pioneer Mothers Association, raised half the purchase price (Lindsey et al. 1969, Hoosier 1990).

Big Walnut Nature Preserve , in west-central Indiana (Putnam County)

On both sides of Big Walnut Creek, a 682-acre preserve that includes forested floodplain, ravine, and upland. "Portions contain fine stands of old growth trees" (IDNR 1991). One of these stands, an upland beech forest, harbors a Great Blue Heron rookery first occupied around 1914. Hank Huffman of IDNR estimates the old growth as more than 200 acres (1992). Dominant tree species are beech, White Oak, Sassafras, and Black Oak. However, cool, north-facing slopes provide habitat for relict communities of hemlock and Canada Yew. Shinleaf, Spotted Wintergreen, and Snow Trillium are among the rare flora present. The Indiana Department of Natural Resources and The Nature Conservancy own the site. The Nature Conservancy is working on a long-term plan to buffer the site, by acquiring conservation easements on surrounding fields and planting them with trees. As of mid-2002, IDNR and TNC owned or had easements on a total of 2700 acres, and had planted seedlings on more than 180 acres. A one-mile loop trail was to be completed by summer 2002 (Huffman 1992, IDNR 1991, Lindsey et al. 1969, Jacquart 2002).

Pine Hills Nature Preserve, in Shades State Park in west-central Indiana (Montgomery County)

Within a 480-acre preserve, old growth composed mainly of White Pine, Eastern Hemlock, and Canada Yew in ravine areas. Huffman estimates that the preserve contains more than 200 acres of old growth (1992). Spetich reports that the preserve's hemlock is "essentially undisturbed," but that a saw mill, set up in the 1850s at Pine Bluff, impacted "most of the large hardwoods" (1993). Possible deer over-browsing is the only threat (Helmick 2002).

Rocky Hollow--Falls Canyon Nature Preserve , in Turkey Run State Park between Indianapolis and the western border of Indiana (Parke County)

Old growth within a 1609-acre Nature Preserve. The forested upland is covered by mesophytic forest; terraces along Sugar Creek, are covered by alluvial forest (IDNR 1991). Huffman estimates the old growth to be more than 145 acres in extent (1992). Spetich writes that six acres of upland forest are undisturbed, but that most other hardwood areas suffered some cutting in the late ninteenth century and the beginning of the twentieth. A walnut stand near Sugar Creek may be undisturbed (1993).

Henry Kramer Original Woods Nature Preserve , in extreme southern Indiana (Spencer County).

On Ginat and Weinbach silt loam, which drain poorly, a 200-acre forest (Huffman 1992) harboring bottomland oaks: Southern Red Oak, Pin Oak, Shumard Oak, and Swamp Chestnut Oak. Sweetgum, Silver Maple, and Hackberry are also prominent. As of 1969, wood had been cut only "for use in farm buildings" (Lindsey et al. 1969). The DNR Nature Preserves owns the woods, which it received from The Nature Conservancy. The Conservancy holds a reverter on the deed: if the state does not live up to the terms of the transfer, the land will return to The Conservancy. Farm land surrounds the preserve (Abrell 2002)

Wesselman Park Woods Nature Preserve , in the middle of Evansville in the southwestern corner of the state (Vandenburgh County).

A 220-acre site of old growth lowland forest showing southern influences. Sweetgum and Tulip Poplar dominate the canopy, and Sugarberry, Southern Red Oak, and Cherrybark Oak are also present. The area occupied by the bases of the trees, 187 square feet/acre,is the highest known in Indiana. Only one stump is visible; grazing may have occured "in the distant past, but there is only anecdotal evidence for that," according to Bob Dispenza of the center (Dispenza 1990). A canal and two railway lines that skirt the site have long since been abandoned and are overgrown. Several trails cross the site, which is owned by the city of Evansville The city is having to bait and shoot deer in order to stop deer from eliminating entire species of plants (IDNR 1991, Hoffman 2002).

Ginn Woods ,* east-central Indiana (Delaware County)

Within a 161-acre woodland, 151 acres of old-growth deciduous forest with varying land-use histories. Ball State University acquired the site in three transactions. It bought 111 acres from the Ginn family in 1971. The family reported that the northern 62 acres had not been burned, logged, or grazed since they acquired the land in 1832. The southern 49 acres had had some wood removed for construction of a house in 1924; and a few White Oak cut by a stave mill company. The university bought an additional 40 acres, Nixon Woods, in 1974. Nixon Woods may have been grazed in the past but shows no signs of logging. A final 10-acre tract purchased by the university was once fields.

Sugar Maple dominates the overstory and understory of all but the most moist areas. American Beech and American Basswood are next in prominence. Other overstory species present include American Elm, Slippery Elm, Northern Red Oak, and Hackberry. Researchers have identified 384 species of vascular plants, including 72 woody plants. Trees are not as large as in many Indiana old-growth forests, as dbhs (diameters at breast height) of more than 35 inches (90 cm) are uncommon. The reason may be a seasonally high water table, and a soil structure that prevents roots from penetrating deeply. Windfalls have been the primary disturbance.

Ball State's Department of Botany manages the forest "as a research natural area" (Badger et al. 1999, Ruch et al. 1999).

Manlove Woods , in eastern Indiana, northwest of Connersville (Fayette County)

A 90-acre, privately owned, forest of beech, Tulip Tree, Sugar Maple, and Black Cherry. Spicebush and Elderberry are prominent shrubs. For many years the maple were tapped for syrup, and the remains of an old wooden sugar house can be seen. As of 1969 only four large stumps were present, probably belonging to trees that died of old age (Lindsey et al. 1969).

Officer's Woods , in southeastern Indiana (Jefferson County)

The northeast and southeast portions of the Officer farm, comprising 85 acres of old-growth woods (Huffman 1992). "About 25 acres of the northern woods appear to have been undisturbed since before white settlement." As of 1969, beech and Sugar Maple, followed by Black Gum, dominated this segment. In the southern woods, which are less well drained, beech was dominant. Between the north and south, successional trees grow on formerly cleared land. The farm is privately owned (Lindsey et al. 1969, Head 1992, NPS 2003, NPS Park net www.nps.gov).

Hemmer Woods Nature Preserve , in southwestern Indiana (Gibson County)

Two areas of old growth, the larger of which lies entirely within Hemmer Woods Nature Preserve. IDNR owns the 73-acre preserve, which is composed of an old-growth upland oak-hickory forest and a smaller lowland mixed hardwoods forest. IDNR also owns a sliver, some 30 feet wide, of a 20-acre bottomland old-growth forest, which is separated from the larger tract by a dredged ditch. The balance of the 20 acres is in private hands. Brian Abrell reports that, according to the Hemmer family, about 5 acres in a corner of the upland site were logged selectively, but that the remainder of the two tracts was not logged (2002). Martin Spetich considers 65 acres (26.3 ha) of upland to have no "obvious significant disturbance" (Spetich et al. 1997, Spetich 1999). Lindsey et al. wrote in 1969 that the lowland tract had experienced only the removal of individual trees that died of natural causes (Lindsey et al. 1969). The composition of the lowlands strongly reflects the woods' southern position. The species include Sweetgum, River Birch, American Sycamore, Sassafras, and Tulip Tree. Lindsey et al. noted that the privately owned lowland "may well be the only floodplain stand remaining in the state that has very large specimens of tulip poplar." The large specimens are still present.

The nature preserve has a small second-growth forest on its eastern side. Otherwise roads and fields abut it. Although the preserve is a National Natural Landmark, the old growth is threatened in the long term. Coal companies own the land surrounding the old growth, including much of the eastern buffer. Strip mining has already occurred in the area. The greatest fear of IDNR is that the site will be dewatered because strip mines use large quantities of water and mines may draw on drainages connected to the site. IDNR is also concerned that the coal companies will import exotic species for revegetation (Abrell 1998 and 2002).

Donaldson's Woods Nature Preserve , in Spring Mill State Park in south-central Indiana (Lawrence County)

A 67-acre woods "classified as a western mesophytic forest type because it is intermediate between beech-maple and oak-hickory types. However, studies indicate that beech and maple are assuming greater importance. An unusual feature of the woods is the high percentage of white oaks" (IDNR 1991). A few stumps from the occasional cutting of dead or wind-thrown trees, and traces of a wagon road could be seen in 1969 (Lindsey et al.1969). Spetich, who examined all known old-growth areas in Indiana, believes that Donaldson's Woods is probably the least disturbed (1993).

Indiana Veterans' Home Woods Nature Preserve , in west-central Indiana (Tippecanoe County)

A 61-acre nature preserve with 50 acres of old-growth forest (Huffman 1992) on the southern part of the Veterans' Home property. A dry-mesic upland forest is "dominated by white, red and black oaks, sugar maple and bitternut hickory." The upland forest was probably grazed by livestock through the mid-1900s. A ravine forest and a buttonbush swamp are also present. A steep ravine bordering the site and the lack of trails make the site difficult to enter. The Indiana State Board of Health owns the area (IDNR 1991, Head 1992, Huffman 1992, Spetich 1993).

Davis Research Forest, in east-central Indiana (Randolph County)

A 51-acre (20.6-ha) old-growth tract dominated by oaks and hickories, accompanied by species typical of mesic to wet-mesic sites. Maples and ashes dominate the subcanopy. The living biomass of dominant early to mid-seral species is decreasing, while that of late-seral species is increasing.

The area was grazed by livestock prior to 1917 when the private owner donated it to Purdue University. In the 1940s and 1950s, fifty trees that were storm damaged, dead, or dying were removed; in the 1960s three to four Black Walnuts were stolen. As of 1998, Dutch elm disease and phloem necrosis had altered and were continuing to alter the structural status of American Elm and Slippery Elm (Lindsey et al. 1969; Spetich and Parker 1998).

Meltzer Woods , southeast of Indianapolis (Shelby County)

Forty-eight acres encompassing two distinct types of soil. On the well drained, slightly higher area (Crosby soil) are beech, Sugar Maple, Tulip Tree, and White Ash. The poorly drained area (Brookston soil) has Shumard Oak, beech, White Ash, and Bur Oak. The woods have been lightly, selectively logged. They are privately owned (Huffman 1992, Lindsey et al. 1969).

Calvert and Porter Woods (formerly Beckville Woods), in west-central Indiana (Montgomery County)

A 40-acre old-growth forest noted for the size of its trees. The major portion of the forest is mesic, upland beech-maple. Some canopy trees here are 60 inches dbh; many are over 36 inches dbh. The central part, which is usually ponded in the spring and late fall, is wet-mesic forest, with Red Maple, Pin Oak, and Red Elm. Spicebush is promiment in the understory. The forest, does not meet the strictest criteria for old growth, as it has been lightly and selectively logged (Lindsey et al. 1969). It belongs to the IDNR.

Kieweg Woods* (Vigo County)

A 43-acre (17.4-ha) old-growth beech-maple forest owned and managed by Indiana State University (Spetich et al. 1997, Spetich 1999]).

Bell-Croft Woods Nature Preserve* (Jay County)

A 40-acre mixed old-growth stand with Red, White, Bur, and Pin Oaks, beech, Sugar Maple, Slippery Elm, Black Cherry, Shagbark Hickory, basswood, and cottonwood. The woods has been minimally disturbed relative to the landscape. It is owned and managed by IDNR (Huffman 2001, Natural Area).

Woollen's Gardens Nature Preserve , in central Indiana (Marion County)

Thirty-eight acres of old-growth mesic upland forest, owned by the Indianapolis Parks and Recreation Department. In 1909, when William Woolen gave the tract to Indianapolis, it was in a rural area; but the city has developed around it (IDNR 1991, Huffman 1992, Spetich 1993).

Gilbert and Alma Neutrap Lubbe Nature Preserve (Dearborn County).

An upland and a ravine system with 35 acres of old growth dominated by beech, maple, and ash. The area is known to have had some cutting before it became a Nature Preserve (IDNR 1991, Huffman 1992, Spetich 1993). Since, thieves have since stolen at least one Black Walnut . The preserve, which is in the midst of cornfields, is owned by IDNR (Helmick 2002).

Tribbett Woods , in southeast Indiana (Jennings County)

A 34-acre "near virgin" bluegrass Till Plain flatwoods with beech and oak, some 150 feet high. A State Nature Preserve, it is owned and managed by the Nature Conservancy. Agricultural fields surround it (Sparks 1990, Maron 1993, Shuey 2001).

Charles McClue Nature Preserve , in the northeast corner of Indiana (Steuben County)

A 30-acre old-growth forest within the 80-acre nature preserve. Big Tulip Trees, and Red and White Oak form the canopy, Flowering Dogwood is among the trees in the understory. Young trees, and fields in the process of becoming woods occupy the balance of the preserve. Steuben County owns the preserve (Huffman 1992).

Hoot Woods (Owen County)

An 82-acre beech-maple forest, some 30 acres of which are old growth (Huffman 1992). The site includes huge beech, oak, Tulip Poplar, maple, and ash. Signs of past cutting are present. The Nature Conservancy holds a conservation easement, but the tract is still privately owned. Visits are by permission only through The Nature Conservancy's Indiana office (Sparks 1990, Shuey 2001).

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KENTUCKY

In *Trees and Shrubs of Kentucky*, Mary E. Wharton and Roger W. Barbour noted that "Many of the virgin mixed mesophytic forests [in Kentucky that Lucy Braun] analyzed and photographed were cut even before her work was published, and now, of those she studied, only a few small fragments remain that even resemble primary forest. Today no absolutely untouched virgin forests are left in the state" (Wharton and Barbour 1972). Strictly interpreted, their analysis is correct. No absolutely untouched forests remain. However, in 1991 the Kentucky Nature Preserves Commission identified an extensive, little disturbed forest of which scientists previously had no knowledge. The state natural areas inventory that led to this discovery is continuing in 2002, but, because of the results of aerial surveys, researchers do not expect to find any additional large tracts of old growth (Evans 1993, Hines 2002).

The US Forest Service (USFS) is in 2002 revising the management plan for Daniel Boone National Forest and hopes to have a draft revision out in October, 2002. In preparation for the revision, USFS compiled a "Preliminary Inventory of Possible Old Growth Forests" for the Daniel Boone. The preliminary inventory does not identify any stands "as existing old-growth through past inventories or land management decisions." Instead it lists a total of 669,166 acres of "possible old growth" and "future old growth," based on examination of records of the most recent, past field work. The 669,166 acres include existing and proposed Research Natural Areas and other special areas (Knowles 2002). Actually, according to USFS's own records, the existing and proposed Research Natural Areas include existing old growth. Furthermore, a cooperative inventory of the Forest in 1987-1993, focusing on native biodiversity and coordinated by Julian Campbell of The Nature Conservancy, identified various areas of old growth. Most were clusters of patches or sites of less than forty acres in extent. In presenting the Daniel Boone National Forest below, we include the proposed and existing Research Natural Areas and several other sites in the forest reported as actual old growth.

In Kentucky Wildlife Management Areas logging can take place only by a decision of the Fish and Wildlife Commission. Through mid-2002, the Fish and Wildlife Commission has not allowed logging in any of the Wildlife Management Areas. Through tradition, these areas have thus enjoyed informal protection (Walker 2002).

In addition to the 40-or-more-acre tracts across the state that are described individually below, old-growth areas already familiar to scientists include: **Boone County Cliffs**, 30 acres of old-growth maple-basswood-beech, within a 74-acre State Nature Preserve, owned by The Nature Conservancy (Boone County); **Floyd Woods**, 20 acres of bottomland hardwood in private hands but registered with the Nature Preserves Commission (McClean County); **Bayou Creek Ridge** in the Western Kentucky Wildlife Management Area, approximately 20 acres of mesic bottomland ridge, owned by the Tennessee Valley Authority but managed by the Kentucky Department of Fish and Wildlife Resources (Ballard County); **Murphy's Pond**, a 40-acre pond with 15 or more acres of possibly virgin Baldcypress, owned by Murray State University (Hickman County) (Goodwin and Niering 1975, Evans 1993). A possible old-growth stand is at **Buck Creek***--disjunct Northern White-cedar (some individuals 200 years old) with hemlock in a protected north-east facing cove (Pulaski County) (Walker 1987). Three stands on the bottoms of Blood River and Jonathan Creek, tributaries of the Tennessee River, are the only remaining bottomland forests in these watersheds never cleared for agriculture. The stands are **Blood River South*** (4.5 acres), **Blood River North*** (7.4 acres), and **Jonathan Creek*** (5.4 acres), all owned by the Tennessee Valley Authority. In 1993 their trees were more than a hundred years old (Shear et al. 1997).

Individually small and scattered, but in total covering a considerable acreage, Eastern Red-cedar communities inhabit cliff tops in the gorges of the Kentucky River and its tributaries in the Bluegrass region of Kentucky (Anderson, Fayette, Franklin, Jessamine, Madison, Mercer, and Woodford Counties). The communities, which range in size from 2 to 15 acres, are found where the limestone cliffs are topped by thin, clayey soil, low in nutrients and moisture. In these locations the trees are protected from fire. "Some grazing and logging ha[s] occurred in the past in a number of these stands," but others appear to be largely undisturbed. Major associates of the red-cedar, which itself accounts for more than 70% of basal area and density, are White Ash, Redbud, Slippery Elm, Honey Locust, and Chinquapin Oak. The small tree and shrub layer includes Redbud, Fragrant Sumac, and Carolina Buckthorn (Bryant 1989, 1993).

Blanton Forest State Nature Preserve, in southeastern Kentucky (Harlan County)

Within a preserve that in mid-2000 totaled 3055 acres, 2239 acres of little disturbed forest, encompassing an entire side of Pine Mountain. Communities include hemlock-mixed mesophytic, oak-pine, Appalachian oak (White Oak and Chestnut Oak most common but other species contributing), mountain bogs, cliffs, rock overhangs, and mountain streams. Pitch Pine dominates some areas; Shortleaf Pine and Virginia Pine are also present. The occurrence of pines is coincident with the driest forest at the summit. American Chestnut was once an important component but it all died in the 1930s and 1940s from blight. Traces of an old homestead can be seen at the mountain's base, one part of the forest apparently underwent limited logging, cattle may have grazed a section, and someone tried to cut an off-road vehicle trail in a corner of the tract; but these activities did little noticeable damage.

Blanton Forest supports more than four hundred plant species and scores of animal species, including more than a dozen that the State Nature Preserves Commission monitors because of their rarity within the state. One of the many streams that descend from the mountaintop bogs is home to a population of federally listed Blackside Dace (*Phoxinus cumberlandensis*).

The Kentucky Natural Heritage Program identified and began exploring the site in 1991. The Blanton family had owned and protected the old growth since the beginning of the century. In 1995 a 1075-acre portion was purchased from the descendants of Grover Blanton and a state nature preserve established. The Kentucky State Nature Preserves Commission has since acquired an additional 1164 acres of old growth from the Blanton family, plus 816 acres of forested buffer. It hopes to acquire gradually 3645 additional acres of buffer to expand the preserve to 6700 acres. The buffer will be comprised of forests of varying quality, some of which may include pockets of old growth (Evans 1993 and 2000, News 2001, Scott 2002).

Pine Mountain, the location of Blanton Forest, is in its entirety "a rugged, heavily forested" fault scarp, over 120 miles long, rising 1000 to 1500 feet above the adjacent valley floors and extending north from near Jellico, Tennessee to Elkhorn City, Kentucky. It covers some 150,000 acres, 40,000 of which lie in Virginia. The Kentucky Natural Lands Trust, which spearheads the campaign to raise money for Blanton Forest, decided in 2002 to work with the Kentucky Nature Preserves Commission to protect "the ecological and biological integrity of the entire mountain" (Evans 2002).

Latourneau Woods, western Kentucky (Fulton County)

An 870-acre bottomland hardwood forest in the Mississippi River floodplain. The forest is "largely undisturbed" by logging, as reflected in its relatively even-aged structure, because mixed stands of bottomland hardwoods were basically even-aged before logging and natural mortality changed composition and structure. The dominant trees in order of importance are Sugarberry, Green Ash, Pecan, and American Elm. A few Swamp White Oak are present. The trees are widely spaced, with many four and five feet in diameter. Catbriers, Cane, Poison Ivy, and Trumpet Vine are prolific. The site floods, four or five feet deep, with the spring rains. The state has acquired the site for the Kentucky Department of Fish and Wildlife Resources from a private owner. (Bryant 1990 and 1993; Boebinger 2001).

DANIEL BOONE NATIONAL FOREST, southeastern and east-central Kentucky

--**Right Fork of Elisha Creek**, in Redbird Wildlife Management Area (Leslie County). A 315-acre, proposed Research Natural Area (RNA), some 218 acres of which are old-growth Chestnut Oak and Tulip Tree-White Oak-Northern Red Oak. The old growth is on a southeast ridge and southwest facing slopes. The dominant canopy species are Chestnut Oak, White Ash, and Tulip Tree. In 1979 one of the Chestnut Oaks, with a 28.9 inch dbh (diameter at breast height), was cored and found to be 221 years old. Trees of secondary prevalence in the canopy are Sourwood, Black Oak, Scarlet Oak, and Mockernut Hickory. Trees prominent in the understory include Red Maple, Bitternut Hickory, Mockernut Hickory, Beech, Cucumber Tree, and Chestnut Oak (Demeritt 1992a).

--Rock Creek Research Natural Area, (Laurel County). A hemlock-mixed mesophytic forest within a gorge extending from a ridge crest of the Cumberland Plateau to the Rockcastle River. An RNA, which follows the outline of the gorge, occupies 190 acres; the gorge is approximately 148 feet deep and one and a quarter miles long (Winstead and Nicely 1976). Thompson and Jones describe the old growth as the 190 acres of the RNA (2001). Though often referred to as virgin, the gorge has undergone "some cutting," including removal of scattered large White Oak, Tulip Tree, mixed oak, and hemlock in 1915-1917. As of 1938 there was "little evidence of cutting" on the less accessible

land near the head of the creek (Hemingway 1938). The "approximately 120-acre central ravine forest" dates back to 1781 according to USFS, and another 54 acres in the upper tributary ravines date back to 1822-1831 (KSNPC 1996).

Dominant tree species on the upper- three fourths of the gorge are Eastern Hemlock, Sourwood, Sweet Birch, Tulip Tree, and American Holly. Most important in the shrub layer are thickets of Great Rhododendron. The floodplain is habitat for River Birch, Black Willow, and Silver Maple among other species. On the rim of the gorge the trees are second growth. The Forest Service clearcut an area there in 1965, and made another cut in the late 1980s. The gorge has been a National Natural Landmark since 1975 (Cameron & Winstead 1978, Kluempke 1993, Strojan 1993).

The Kentucky State Nature Preserves Commission has recommended that USFS expand the RNA to include the entire watershed of Rock Creek, 1029 acres in extent and 95% forested. Unusual features of the watershed in addition to the old growth are massive sandstone cliffs and rare plant and animal species including Lucy Braun's White Snakeroot (*Ageratina luciae-brauniae*) and Rafinesque's Big-eared Bat (*Corynorhinus rafinesquii*)(KSNPC 1996). Researchers have identified 117 woody species --112 native, 5 exotic--within the watershed as a whole (Thompson and Jones 2001). An estimated 85% of the watershed is owned by USFS. Much of the private land is along a road, which would make acquisition difficult (Wilcox 2000).

--Beaver Creek Wilderness Area* in the Somerset District (McCreary County). A "ravine system with several old-growth areas" within the 4791-acre Wilderness (Campbell 1995). The old growth includes 95 acres of A-quality Appalachian mesophytic and hemlock-mixed forest along Little Hurricane Fork and Freeman Fork. Within the watershed of Beaver Creek, USFS owns, in addition to the Wilderness Area, the Beaver Creek Wildlife Management Area, which is managed by the Kentucky Department of Fish and Wildlife Resources (KSNPH 1998). The Wildlfie Management Area is on ridges surrounding the Wilderness.

--Tight Hollow, in Red River Gorge Geological Area (Wolfe County). A 72-acre old-growth stand of virgin Tulip Tree-Eastern Hemlock with trees as old as 221 years (Richardson 1990, Demeritt 1992b). Only 283 acres of the 321-acre mesic sandstone gorges that make up the Hollow are within the National Forest, and the Hollow can only be entered by crossing private land. The staff of the Daniel Boone has proposed Tight Hollow for Research Natural Area status.

Hemlock, with dbh often 50-70 cm and occasionally 100 cm, dominates the old growth, most of which is on the east side of the Hollow. Co-dominant Tulip Tree range up to 150 cm dbh, with 70-120 cm frequent. Other canopy trees include American Beech (50 to 100 cm), White Pine (to 100 cm), Cucumbertree (50-70 cm), Red Maple (to 50 cm), Chestnut Oak, American Basswood, and Sweet Birch. Rhododendron dominates the understory. Rare plant species found within the area include Lucy Braun's White Snakeoot and Small Enchanter's Nightshade (*Circaea alpina*)(KSNPC 1996).

--Jellico Creek* in the Stearns District (McCreary County). Fifty to 100 acres of old growth, in which Eastern Hemlock, American Beech, and Sugar Maple are locally dominant. (Campbell 1995; Campbell 1998)

--Little South Fork,* in the Stearns District (Wayne/McCreary Counties). A mixed deciduous forest labeled by Campbell as an "outstanding old growth section" of at least 40 acres to possibly 100 acres (1998). The forest is on the slope above an impoundment of the lower section of the river. The Little South Fork corridor forms the southwestern boundary of the Daniel Boone National Forest (Campbell 1995, 1998).

--Blue Warbler Stand,* in the Berea District (Rockcastle County). Sixty or more acres of old-growth mixed mesophytic forest on a steep slope adjacent to land owned by Appalachia-Science in the Public Interest. With the permission of the US Forest Service, ASPI has made a trail above the old growth in order that visitors can look down into it (Fritsch 2002).

Big Woods, in Mammoth Cave National Park (Hart County)

Approximately 300 aces of primarily oak/hickory forest and mesic ravines with American Beech associates. A private owner preserved the forest prior to National Park Service ownership. Human disturbance has been minimal. American Chestnut trees that died were removed, as were, on a selective basis, a few other logs. A tornado toppled a swath in spring 1985 (Evans 1990, Gregory 1992, McCune and Henckel 1993).

Lilley Cornett Woods, in southeastern Kentucky (Letcher County)

Approximately 260 acres of largely uncut mixed mesophytic forest in a 554-acre wooded tract, owned by the state of Kentucky (Brotzge 1989). William H. Martin identified nine distinct communities in the old-growth portion of

the Woods. Beech communities comprise 50% of the forest. "Oak, sugar maple-basswood-tulip poplar, and hemlock communities comprise the remainder of the Woods, in order of decreasing area." The area has been grazed, and dead trees cut and removed (Martin 1975). Two mining companies owned the right to mine beneath the land. Through the Kentucky Heritage Land Conservation Fund, the state purchased the coal estate that belonged to Enterprise Coal. Kentucky River Coal still holds mining rights, but has not applied for a permit to mine (Martin 2001).

Pine Mountain Wildlife Management Area, in southeastern Kentucky (Letcher County)

Stands of old-growth mixed mesophytic and Appalachian oak forest, each possibly 50 to 100 acres in size. Many of the trees are several hundred years old. The Kentucky Department of Fish and Wildlife Resources owns the Management Area (Evans 1993, 2000; Walker 2002). Pine Mountain is a long mountain, only part of which is within the Management Area. Blanton Forest, described above, is on this mountain but outside the Management Area.

Shillalah Creek Wildlife Management Area, southeastern Kentucky (Bell County)

An estimated 100+ acres of old-growth forest, ranging from dry oak to mixed mesophytic, on a steep, rugged north-facing slope. The same slope has many small pockets of old growth in hollows and ravines. Shillalah Creek is managed by the Kentucky Department of Fish and Wildlife Resources (Evans 1993, 2000; Walker 2002).

Dinsmore's Woods State Nature Preserve,* in northern Kentucky (Boone County)

A 107-acre mesic, possibly old-growth, hardwood forest. There are no historical records or signs of any significant modification between the 1830s, when private owners obtained it, and 1974, when a tornado caused "selective" damage (Held et al. 1998). The Nature Conservancy, which owns the forest, describes it in a flyer as "relatively mature" and "relatively undisturbed." Before the tornado, the canopy and understory were dominated by Sugar Maple, with American Beech as the subdominant. Since 1974 the importance value of Sugar Maple has increased, as has that of oaks. The importance value of other species has declined (Held et al. 1998). The preserve is adjacent to the Dinsmore Homestead, and a state park is across the road from it. Because the state park is open to horses, the preserve has a problem with horses. Garlic mustard, which spreads rapidly and replaces native vegetation, is also a problem (Mazyck 2000).

Greenwood Forest,* south-central Kentucky (Christian County)

A 198-acre oak-hickory forest, of which 62 acres on the eastern side have experienced only minimal disruption. There in the 1940s a few hickories and oaks were cut for tobacco sticks, but no grazing took place during at least the period 1963 to 1993. The western side of the forest was selectively harvested between 1990 and 1995.

The forest is located on the Pennyroyal Plain, a karstic landscape, and is a remnant of the 5000-acre McGaughey Swamp. Most of the swamp had been drained and cleared by 1979, and is now growing crops. Fields border three sides of the 62 acres of little disturbed forest.

Oaks, hickories, Red Maple, elms, Sweetgum, and beeches make up more than 85% of the canopy importance value. Winged Elm, Slippery Elm, Red Maple, Pawpaw, Hackberry, Ironwood, and Shagbark Hickory account for more than 67% of the importance value of the sapling/small tree stratum. Beech, elms, Red Maple, Coralberry (*Symphoricarpos orbiculatus*) dominate the shrub/woody seedling layer. The evidence suggests that any major disturbance of the canopy, from natural or anthropogenic causes, would bring to an end oak domination of the canopy (Chester et al. 1995).

The forest is protected by the private partnership that owns it (Greenwood 2002).

Curtis Gates Lloyd Wildlife Management Area, north-central Kentucky (Grant County)

Forty acres of old-growth mixed hardwood forest divided into two twenty-acre tracts separated by a field. At one time the two areas were part of a single wooded tract. Tree species include Sugar Maple, White Ash, American Beech, Shagbark Hickory, and Black Oak. Very little of the native flora other than the trees is present, and Garlic Mustard is a major problem, despite attempts to eradicate it. The Kentucky Department of Fish and Wildlife Resources, which owns the area, allows it to be used for archery practice (Bryant 1993, Bryant 1985, KNPC 2000, Walker 2002).

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OHIO

Ecologists seem to agree that Ohio has no truly virgin forest. Probably all woods have had some trees removed; and most, if not all, have had some livestock grazing, at least in the nineteenth century. Still, the state does have old-growth tracts that resemble the pre-settlement forest. Of the old-growth areas 40 or more acres in extent that have come to our attention, the sites described individually below appear to be the least disturbed.

Smaller old-growth tracts of interest include **Ault Park** (Hamilton County): about 25 acres of mixed mesophytic forest in a 224-acre park owned by the Cincinnati Park Board (Bryant 1987, 1993, Carroll 2000); **Sigrist Woods** (Stark County): a selectively cut 25-acre tract, dominated by Red and White Oak, American Beech, and Sugar Maple, "many" trees with a dbh (diameter at breast height) of over 70 cm, in a forest owned by the non-profit Wilderness Center (Hawes 1992, ODNR 1990); **Rothenbuler Woodland** (Monroe County): a 20-acre mixed mesophytic woodland on a steep slope, with several Northern Red Oaks more than four feet in diameter, in a 45-acre Nature Conservancy preserve (Kromer 1993); **Davey Woods** (Champaign County): old growth Tulip Tree-red oak community, variously described as 40 acres (Kromer 1993) or 15 to 20 acres (Woischke 1993, Anderson 1993) in a 103-acre woods owned by the Ohio Department of Natural Resources (ODNR); **Little Rocky Hollow Nature Preserve** (Hocking County): 20 acres of hemlock-dominated forest "undisturbed except for windthrows" in a 259-acre preserve owned by ODNR but surrounded by Hocking State Forest; **Sheick Hollow Nature Preserve** (Hocking County): 8 acres of "little disturbed" forest dominated by Eastern Hemlock and Tulip Tree in a 151-acre preserve, owned by ODNR but surrounded by Hocking State Forest (Neal 2001); **Hocking Hills State Park*** (Hocking County): Old Man's Cave Hollow, with some 20 acres of hemlock-dominated old growth (Cornett 1993, Jones 2001); **White Pine Bog Forest Preserve*** (Geauga County)**:** a 14.5-acre tract of old-growth Eastern Hemlock, White Pine, and hardwoods within the 375-acre preserve, owned and managed by The Nature Conservancy (Jones 2001); **Clear Fork Gorge Nature Preserve*** (Ashland County): 8 acres of unlogged White Pine-hemlock forest in a steep gorge within a 29-acre preserve owned by ODNR (Denny 1999, Neal 2001).

Of special interest, though not, as far as we can ascertain, containing any true old growth, is the 130-square mile Oak Openings Region in northwest Ohio. At the time of settlement, the region supported beach ridges with oak savanna and woodland, interspersed with wet prairie. In the savannas and woodlands, White Oak and Black Oak were the dominant trees; beneath them grew a wide variety of herbs, grasses, and sedges. Agriculture and urbanization destroyed most of this habitat; drainage and fire suppression degraded what was left (Abella et al. 2001). Now conservationists are working to reverse the pattern. The Nature Conservancy in its 575-acre **Kitty Todd Nature Preserve** , formerly known as Schwamberger Prairie (Lucas County), is restoring some 100 acres of oak savanna and additional acreage of wet prairie. The condition of the land varies. For some areas, the only direct impact in the past has been logging (Seidel 2001). Burning, thinning trees, and restoring drainage patterns are among the restoration methods that The Conservancy is using (TNC [nd]). Meanwhile, Toledo Metroparks is restoring savanna remnants at its 3693-acre **Oak Openings Preserve Metropark**. As of 2001, Metroparks had restored 170 acres of savanna habitat. Its goal is restoring 250 acres of habitat in the next several years (Jaeger 2001). We describe below Old Parkway, the site in the Metropark that, before the restoration program began in 1988, came closest to being true old growth. Because of the large size of the maples among the oak, this site was not, however, one of those chosen for early restoration.

North Chagrin Reservation,* northeast of the city of Cleveland (Lake and Cuyahoga Counties)

A 1050-acre old-growth upland beech-maple forest (Tyler 2001), within the 1912-acre reservation owned by Cleveland Metroparks. The old-growth beech-maple forest includes the 65-acre A.B. Williams Memorial Woods. The beech-maple forest is 2.5 miles long north-south, and only 0.75 miles wide. The eastern edge adjoins a slope, indented by steep-sided ravines, that plunges 100-120 feet to the Chagrin River. The western edge abuts second growth on land that was used for pastures and crops prior to the 1930s and 1940s.

Williams, a naturalist, studied the ecology of the 65 acres named after him and also, in 1935, compiled an oral history of the 1050-acre forest. The only known logging of live trees (other than dying chestnut) was the removal of selected Tulip Trees and a few White Ash in 1871. The chestnut blight attacked the forest in 1936; some chestnut

trees that died or were ill were cut up and used for buildings on the site. In 1936-1938 Eastern Hemlock suffered a decline, but older hemlock are nevertheless well represented in the forest today. The forest supports some American Beech over 500 years old; Sugar Maple 250-300 years old (trunk rot in fallen Sugar Maple makes aging difficult); and White Pine over 300 years old. A Black Gum that fell had lived 486 years. The ground layer has been disturbed by the numerous trails that zigzag through the forest. The trails also appear to have impacted the surface drainage, which the staff of Cleveland Metroparks is trying to restore to its earlier condition. The old growth does not enjoy any formal protection (Tyler 2001).

Rocky River Reservation,* west of the city of Cleveland (Cuyahoga County)

Extensive old growth in the floodplain and smaller patches of old growth on the slopes of the valley cut by the Rocky River in a narrow 3432-acre reservation owned by Cleveland Metroparks. The largest concentration of old growth is toward the southern end of the reservation, which supports at least 600 acres of floodplain forest with American Sycamore, Eastern Cottonwood, and Black Willow, and here and there Tulip Trees and White Oaks. Where the land rises a few feet, beech grow, quite a few over 200 years in age. The walls of the valley have slumped in places, due in part to bad management and bad drainage. Uncut patches of old growth on the walls include sycamores, cottonwoods, and White Oak approaching 300-350 years in age. The Reservation Concept Value Plan states that southern part of the reservation "has been designated a conservation area," but the old growth has no formal protection (Tyler 2001; Cleveland Metroparks 1995).

Bedford Reservation,* southeast of Cleveland (Cuyahoga County)

Extensive old growth within Tinker's Creek Gorge, plus patches of old growth along some adjacent ridges, in the 2154-acre reservation owned by Cleveland Metroparks. The gorge, cut by the creek through Bedford siltstone, was designated a National Natural Landmark in 1968. It is 220 feet deep and approximately 900 acres in size. Some farming has occurred in the gorge, but Dick Squire of the Bedford Historical Society, who has written a history of Bedford and knows where logging took place, has found that approximately 60% of the gorge has not been disrupted by EuroAmericans. Among the numerous plant species in the gorge are American Sycamore, Bur Oak, Pumpkin Ash, Black Ash, Blue Ash, White Oak, Eastern Cottonwood, and Yellow Birch. Hemlock are as much as 200-250 years in age and 55-56 inches in circumference. The rich understory includes Spicebush, viburnum, and Mountain Laurel. The Reservation Concept Value Plan focuses "primarily on protecting, preserving, and enhancing this [Tinker's Creek Gorge] unique resource," but again the old growth is not formally protected (Tyler 2001).

Morgan Sisters Woods Special Interest Area, Wayne National Forest, in southeastern Ohio (Gallia County)

About 200 acres of apparently old-growth forest within a 355-acre Special Area. The primarily mixed mesophytic woods includes Sugar Maple, American Beech, White Ash, White Oak, Tulip Tree, Black Walnut, elm, and sycamore. On some upland areas, Northern Red Oak, Black Oak, and Chestnut Oak are prominent. The north-facing slopes have a dense understory with Red Elm, Sugar Maple saplings, and Spicebush. In much of the area and particularly on the south- and west-facing slopes, the understory is open and parklike.

As far as local residents know, the area was not cut when surrounding tracts were logged for charcoal to be burned in iron furnaces. Livestock grazing may have occurred on the slopes; during the early settlement period, farmers often grazed livestock in areas too steep for planting. Some of the flat ridgetops show evidence of grazing and farming more than 40 years ago. Within the boundary of the Special Area are a 10-15-year-old clearcut and open brush lands (Miller 1993, Smith 1992).

Goll Woods Nature Preserve , in northwestern Ohio (Fulton County)

A 32l-acre preserve, with 140 acres of old-growth beech-oak-Red Maple forest and 40 acres of old-growth oak-maple swamp. Outstanding among the preserve's large trees are Bur Oaks with dbh of up to 56 inches. Unfortunately, the preserve is also the site of a pine plantation, and has been drained, selectively cut, and crossed by a road and trails (Woischke 1992, 1993).

Johnson Woods State Nature Preserve* (formerly Graber Woods) (Wayne County)

A 206-acre preserve, the bulk of which is old growth. Lucy Braun described the forest "viewed in its entirety" as "a virgin white oak forest" moving toward "the ultimate establishment of beech-maple" (Braun 1950). The drier areas of the forest are today undergoing natural succession from an oak-hickory community to a beech-

maple community. In less well-drained sections are swamp forest communities dominated by Red Maple and Pin Oak. Depressions in the swamps harbor Buttonbush (Ohio DNR 2001).

The forest is in two sections, bisected by a road. Some 30 acres in the southeastern corner of the south side support forest planted in the twentieth century, with trees still noticeably smaller than most in the old growth. A 1.5 mile boardwalk allows visitors to tour the south section without trampling on wildlife. A gas well, which may still be operating, is located beside the road on the north side. Another gas well, probably no longer in service, is located in the southern area (Reed 2000).

The forest is believed to have escaped logging by early settlers to the area because of its wet condition. Later the Johnson family protected it. Mrs. Clela Johnson donated 155 acres on the south side of the road to the Division of Natural Areas and Preserves in 1994. She sold 51 acres on the north side of the road to the Division, which purchased the land with Income Tax Checkoff donations (Ohio DNR 2001).

Hueston Woods Nature Preserve , in Hueston Woods State Park (Butler and Preble Counties)

A much-studied, approximately 165-acre (Runkle 1990) or 200-acre (Woischke 1992) old-growth forest. Beech predominates (44% of the canopy), followed by Sugar Maple (33%) and, to a much lesser extent, White Ash and Tulip Tree. An abundance of saplings includes Black Cherry, Sugar Maple, American Beech, and White Ash (Runkle 1990). The stand occupies a flat upland and a slope through which a stream flows to a man-made lake. A road and trails also cross the preserve. A number of large individual trees, including Tulip Tree and Northern Red Oak, were removed in the 1930s for veneer. They were dug out, so left no stumps (Udstuen 1993). A National Natural Landmark, the woods are owned by ODNR but managed by the Division of Natural Areas and Preserves (Denny 1999)

Sears/Carmean Woods State Nature Preserve , in north-central Ohio (Crawford County)

Old growth within two adjacent areas that comprise a 138-acre preserve owned by the Ohio Department of Natural Resources.

A mature beech-maple and mixed swamp forest occupies some 75 acres in the center of a 99-acre area known as Sears Woods. The most abundant tree is Sugar Maple , followed by beech. Seven species of oaks are also present. The ecologist Paul Sears, who owned the preserve prior to its transfer in 1986 to ODNR, "considered that the old-growth portions of the [preserve] were essentially undisturbed" (Do-Soon and Boerner 1991). Other portions of the site show evidence of an orchard, farming, and burned buildings, and have young successional woodland (Woischke 1992). Unfortunately, Garlic Mustard, an exotic species, has gained a hold throughout the woods (Kershner 1990, Reed 2000).

Adjacent to Sears Woods is the 39-acre Carmean Woods, beech-maple forest owned by ODNR. "Large (mostly dead) oak stems" were removed from this woods over the past 30 years. Otherwise it is little disturbed, but Garlic Mustard is present (Do-Soon and Boerner 1991, Reed 2000).

The preserve has been leased to the Crawford County Park System. The Park System and the Ohio Department of Natural Resources share responsibility for protecting it (Reed 2000).

The Holden Arboretum, northeastern Ohio (Lake County)

More than a hundred acres of documented old growth on land owned by the non-profit Holden Arboretum. The 191-acre Little Mountain Preserve (Geauga and Lake Counties) supports approximately 50 acres of old-growth White Pine and Eastern Hemlock. A 500-acre conservation easement held by the Aboretum buffers the preserve. The 700-acre Stebbins Gulch (Geauga County) includes a mile-long, 20 foot to-30 foot-wide band of old-growth forest, mostly Chestnut Oak and hemlock, on one rim of a deep ravine (Parsons 2001). At least part of the beech-maple forest within the natural area may also have escaped logging and livestock grazing (Forrester and Runkle 2000, Parsons 2001). The Arboretum, which owns 3460 acres of land, plans to inventory its forests for old growth (Parsons 2001).

Caldwell Park , southwestern Ohio (Hamilton County)

A 122-acre park with an old-growth beech-maple segregate of the mixed mesophytic forest, in which Sugar Maple and American Beech are almost equal in importance. They are associated with Tulip Tree, Black Cherry, White Ash, Hackberry, Northern Red Oak, and other species. Caldwell Park is the property of the Cincinnati Parks Board (Carroll 2000).

The park is one of six old-growth forests in Hamilton County parks and preserves that William Bryant systematically sampled. He found that five of them appeared little disturbed and that, in dominant species and composition, they are similar to the area's forests at the time of settlement. Other forests in his study included California Woods Nature Preserve, Bowles Woods (described below) and Ault Park (mentioned above). One of the forests that he studied has since been cut (Bryant 1987, 1993).

Hawk Woods, in southeastern Ohio (Athens County)

An 86-acre (McCarthy et al. 1987) or 105-acre (Cantino 2003) old-growth forest on 25-40% slopes drained by intermittent streams. Mixed oak-Tulip Tree and mixed mesophytic communities predominate. The tract also has one large White Oak stand, and, on upper slopes and ridge tops, oak-hickory and oak-heath communities. Cattle grazed the area, probably only prior to 1910; but it now has a "rich herbaceous layer" and 240 species of vascular plants. Some logging may have occurred in the 19th century, although no stumps remain. Representatives of five tree species are 90-99 cm dbh (McCarthy et al.1987).

The longtime private owners sold 105 acres to Dale W. Riddle Forest Products in February 2003. Dale Riddle has agreed to sell the land to the city of Athens, which is applying for a grant to cover 75% of the purchase price from the Clean Ohio Conservation Fund. The matching 25% is expected to come from Dale Riddle (through the difference between the asking price and the assessed value), from the Athens Foundation, and from a variety of other donors (Martha's Journal 2003).

Old Parkway,* in Oak Openings Preserve Metropark, west of Toledo (Lucas County)

An 85-acre remnant of oak savanna within the Metropark in the Oak Openings Region of Ohio. The site supports large, widely-spaced White Oak with open-grown canopies. The older oaks are 300-400 years old and have dbhs of 80-120 cm. Mixed among the White Oaks are large Black Oaks, approximately 200 years old with dbhs of 80-100 cm, some with open-grown canopies. Younger oaks as small as 20 cm dbh are also present. Red Maple are numerous, both as trees, up to about 40 cm dbh, and saplings. Scattered Black Cherries are also present.

Indians likely maintained the site as a White Oak savanna for hundreds of years. White Oak still dominated the site in 1835, but by then Black Oak was becoming prominent, presumably as a result of draining and less frequent fires. The site has few herbaceous species, perhaps as a result of draining, distance from any former wet prairie, and light grazing. Any grazing would have stopped by about 1970 when the Red Maple invaded. Oak has not reproduced at the site for thirty years, and without removal of the Red Maple, the site will eventually be dominated by maple (Brewer [nd]).

Bowles Woods, in the Miami-Whitewater Forest, southwestern Ohio (Hamilton County)

An 80-90 acre old-growth woods within a 3648-acre forest owned by the Hamilton County Park District. Sugar Maple is by far the dominant species in this little disturbed Sugar Maple-oak and mixed hardwood forest. Oaks and hickories, which rank next to Sugar Maple in importance, are most prominent on west-facing slopes. Beech is found only on east-facing areas (Bryant 1987, 1993).

Howard Collier State Nature Preserve,* north-central Ohio (Seneca County)

An old-growth floodplain community of about 80 acres within a 200-acre preserve on the Sandusky River. The community harbors big oaks, cottonwoods, ash, American Sycamore, and Tulip Tree. The ground layer includes Marsh-Marigolds (*Caltha palustris*) and Skunk Cabbage (*Symplocarpus foetidus*). The preserve also includes ridge top forest with large beech. The Sandusky is a State Scenic River, and the Division of Natural Areas and Preserves originally acquired the site as a Scenic River Area (Denny 1999, Reed 2000).

Wadsworth Glen, in Ravenna Arsenal in northeastern Ohio (Portage County)

Some 60 acres of old growth in a gorge that have been lightly and selectively cut twice since 1940. The forest is beech-maple with Northern Red Oak and Black Cherry. Close to the borders of the gorge are remnants of hemlock, but hardwoods are crowding out the hemlock. The tract is the southernmost extension in Ohio of the White Pine-hemlock-northern hardwoods association.

The Army acquired the land on which the arsenal stands in 1940, and cut trees for timber to construct buildings for the installation. The forest as a whole has since been cut only selectively but repeatedly (Morgan 1993).

Dysart Woods , in eastern Ohio, south of Belmont (Belmont County)

A 57-acre tract of mixed mesophytic deciduous forest within a 506-acre research area, the former Dysart Farm, owned by Ohio University. The old growth is in three tracts. The two largest are separated from each other by a wide ridge. A hiking trail crosses each of the two. The balance of the property is in meadows, early successional old fields, and second-growth forest. " An occasional log was obviously removed from a damaged or windthrown tree, but for the most part the woods qualify as a virgin forest" (Ungar 1988). The University keeps the woods in their natural state, although it conducts research in them.

In the old growth, American Beech, Sugar Maple, White Oak, and Tulip Tree are "the major dominants." The beech and the maple are increasing in importance, and the oak is decreasing in importance. The oak, in fact, are in "an obvious state of decline," probably in part because of their age (up to 300-350 years), air pollution, and a severe drought in 1988. All other canopy species appear to be healthy (McCarthy et al. 2001).

Ohio Valley Coal Company owns the right to mine underneath Dysart Woods. Mining could cause a chronic water shortage and even subsidence. An application from the company to mine within the Dysart Woods watershed led the Buckeye Forest Council and Ohio University to file separate Lands Unsuitable for Mining petitions with the Ohio Division of Mines and Reclamation in early 1998. Later that year, the division's head, Lisa Morris, announced a decision to prohibit surface mining within a 605-acre buffer zone and longwall underground mining within an overlapping 622-acre buffer(for technical reasons the buffer zones have since been somewhat reduced in size). Room and pillar mining, an underground technique, would be allowed beneath the woods. The issue, which is complex from the point of view of the law, was expected to be tied up in appeals for years (Tochman 2000). As of May 2003, Ohio Valley Coal Company had filed for a permit to use room and pillar mining directly beneath the woods; and the new chief of what is now the Division of Mineral Resources Management, Michael Sponsor, was in the process of making a decision on the application.

Fowler Woods Nature Preserve , in north-central Ohio (Richmond County)

Fifty acres of forest that was selectively cut, but still has old-growth characteristics in the western half of a 148-acre preserve. Beech and Sugar Maple dominate. White Ash and American Basswood are common; and Spicebush and mesic herbs dominate the understory. The preserve, which is owned by the Ohio Department of Natural Resources, also includes scattered patches of maple-ash swamp and a Buttonbush shrub swamp (Woischke 1992, 1993, Web 2001).

Emerald Hills State Nature Preserve , in eastern Ohio (Belmont County)

A 74-acre forest that, according to the records of the Ohio Department of Natural Resources, includes 44 acres uncut though possibly grazed by livestock. Red and White Oaks (up to 70 cm dbh) and Sugar Maples (30-50cm dbh) dominate. Other species include American Beech, Black Gum, Tulip Tree, and Black Oak. Hickory is common in the subcanopy, and the herb layer is diverse (Ohio DNR 1990). The preserve is owned and managed by the state's Division of Natural Areas and Preserves (DNAP 2003).

California Woods Nature Preserve , in southwestern Ohio (Hamilton County)

An old-growth mixed mesophytic stand, more than 40 acres in size, known as the Cincinnati Water Works Woods. Sugar Maple, American Beech, Tulip Tree, Yellow Buckeye, Northern Red Oak, and Hackberry are most prominent. Braun described the forest in 1916 as part of a sequence in ravine development and in 1926 as a climax deciduous forest. The Cincinnati Parks Board owns the little-disturbed forest (Bryant 1987, 1993, Thorn 2000).

Crall Woods , in north-central Ohio (Ashland County)

A 40-acre tract of old-growth hardwood forest, described by Whitney and Runkle as "an essentially undisturbed remnant of the beech-maple forest type which once dominated the Till Plains of northern Ohio." Since their article was published in 1981, a tornado damaged part of the forest; and salvage cutting may have been carried out (Anderson 1993). Dominant species are Sugar Maple, American Beech, and basswood. Also present are Tulip Tree, White Ash, Red Oak, and Shagbark Hickory. The herbaceous layer includes Wood Nettle, Hairy Sweet Cicely, and violets. The woods are privately owned (Whitney and Runkle 1981, Runkle 1992, Jones 2001). On the north of the forest is a 19-acre tract of second growth, and on the south an Eastern Red-cedar field of 44 acres (Woischke 1992, Lindsey and Escobar 1976).

Gross Memorial Woods Nature Preserve, in western Ohio (Shelby County)

Within a 75-acre woods, a preserve, comprising 49 acres of old growth dominated by American Beech, Bur Oak, and Red Oak, among which are American Basswood, White Ash, White Oak, and hickories. Silver Maple is common in wet areas; Sugar Maple and basswood in the understory. The preserve is owned by the Ohio Department of Natural Resources; the other half of the woods, more disturbed than the preserve, is in private hands (Woischke 1992, 1993).

Hach-Otis Sanctuary State Nature Preserve ,* in northeastern Ohio (Lake County)

Unlogged hemlock forest within three deep ravines and mature beech-maple-oak mixed mesophytic forest comprising an 81-acre preserve. The upland forest is known to have been selectively logged in 1870. The preserve is on a bluff that rises 150 feet above the Chagrin River. It is owned by the Audubon Society of Greater Cleveland (Lillich 2001).

Daughmer Prairie and Bur Oak Savanna* (Crawford County)

A Bur Oak savanna 35-40 acres in size. The Bur Oak are up to 300 years old. The site has never been plowed, but is currently used to pasture sheep. A family owns the site. Guy Denny describes it as "the best prairie bur oak savanna in Ohio" (Denny 1999, Jones 2000).

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WEST VIRGINIA

West Virginia has more forest today than it did at the turn of the century, but most of it is second growth. The state's forests were clearcut on a massive scale between 1880 and 1920. Today's logging operations look small, compared with those early ventures. Old farms have grown over, and in some places the forest itself has come back. More than 90% of the state is now forested, yet some species have not recovered (Hill 1993). Also, the impressive figures we see about reforestation in the East can be a bit misleading, as much of what is now considered "forest" is little more than early regrowth following heavy logging. "Thicket" might better describe some of this regenerating vegetation. West Virginia once had over 500,000 acres of Red Spruce. Today there may be 50,000 to 70,000 acres. Only three known stands of Red Spruce are virgin (Adams and Stephenson 1989, Harmon 1989).

Nevertheless, Bill Ragette, a West Virginia conservationist who read this chapter wrote, "I believe that there is a lot more 'old growth' in West Virginia than we know about. Along the ridges/farm boundaries all over the state are old growth trees. One whose rings I counted after they timbered a nearby farm was 250 years old. Several people have told me about tracts that had untouched areas" (1993). Robert Mueller (1989 and 1993) and Steven Stephenson (1993) have told us of the existence of undocumented old growth on ridges and in ravines in the Central Appalachians (see Virginia). More recently James Vanderhorst of West Virginia Natural Heritage Program has written that the program is "coming across additional stands (on the ground and in the literature)." "There are likely to be other small virgin patches around the state. I'm sure many of the dryer types on cliffs etc. . . . have been overlooked because the trees aren't that big and they may not be forests but woodlands" (2002).

Small, documented old-growth sites include **Hungry Beech** (Roane County): a 107-acre preserve of The Nature Conservancy that includes a probably-uncut 14-acre tract, mainly beech-oak with Northern Red Oak predominant (Hill 1993); **Meadow River Wildlife Management Area*** (Greenbrier County): approximately 20 acres of old-growth swamp forest, shrub and herbaceous wetlands (Vanderhorst 2002); **Carnifax Ferry State Park*** (Nicolas County): two stands, the second uphill from the first—12 acres of Eastern Hemlock-White Oak/*Rhododendron maxim* forest and 13 acres of White Oak-Eastern Hemlock/*Thelypteris noveboracensis* forest (Vanderhorst 2002); and the **Horner State Game Refuge** (Lewis County): 12 to 15 acres of virgin oak, including large White Oak and Chestnut Oak, through which the owners, the US Army Corps of Engineers, built a road (Harmon 1989 and 1990); **Turkey Run on Shavers Mountain** (Tucker County): probably no more than 10 acres of virgin Red Spruce, with Great Rhododendron the most important shrub (Stephenson 1993, Adams and Stephenson 1989); and **Cave Mountain*** in Monongahela National Forest (Pendleton County): Northern White-cedar scattered over less than 5 aerial acres of steep limestone cliffs, which also support several plants rare in West Virginia (Vanderhorst 2002)..

Unfortunately the Hemlock Woolly Adelgid has been documented at Fanny Bennett and is likely to spread elsewhere rapidly (Vanderhorst 2002).

On May 3, 2002, the US Forest Service (USFS) issued a public notice of intent to prepare an Environmental Impact Statement as a step in revising the management plan for Monongahela National Forest. Old growth was one of the subjects on which the USFS staff was seeking comments, as they were in the midst of trying to decide what provisions to make for old growth. USFS hopes to have a revised forest management plan in place by mid-2005 (Adamo 2002). Known old-growth sites in the forest are included below.

MONONGAHELA NATIONAL FOREST, in eastern West Virginia

--**Gaudineer Scenic Area** on Cheat Mountain (Pocahontas County). A 140-acre area, of which about 50 acres are virgin Red Spruce-northern hardwood forest. Coring has shown that some trees are about 350 years old (Stephenson 1993). "The remaining 90 acres has had some cutting, mainly salvage of blow-down, with most of the original growth still standing" (Foss 1972). What was spared by an old surveying error is, however, suffering from contemporary pollution. In recent years a large percentage of the old-growth Red Spruce have died or shown signs of dying, apparently due to acid deposition, as in many other high elevation stands in the Appalachians (and Adirondacks). As a result of the death of the older spruce, the dominant canopy is becoming mixed hardwoods. Yellow Birch, Red Maple, Sugar Maple, and beech are among the hardwoods. Young spruce seem "healthy and vigorous" and form a "thick and strong" understory (Goodrich 1990 and 1992) (Harmon 1989 and 1990).

--Shavers Mountain Spruce-Hemlock Stand, in Otter Creek Wilderness (Randolph County). One hundred and five acres of never logged Red Spruce-Eastern Hemlock (Vanderhorst 2002). Dis pute over ownership of the land apparently prevented the tract's being cut. Much of the hemlock and older spruce are in decline here as in the better known Gaudineer Scenic Area, apparently due to acid rain (Goodrich 1990 and 1992).

--Seneca Rocks* (Grant County) . Twenty or more acres of old-growth Chestnut Oak and pines, including some Type A old growth [as a general rule, Type A old growth has no visible signs of anthropogenic disturbance; Type B does show some visible disturbance]. The stand is near the trail and surrounding cliffs facing west toward the North Branch of the South Fork Potomac River. The old growth, which as of mid-2002 was undocumented and unstudied, was discovered by Ken Hotopp (Hotopp 2002). Various sections of the Seneca Rocks Area are subject to three different management presciptions; a US Forest Service spokesperson was unable to tell us under which the old growth falls (Adamo 2002).

--Fanny Bennett Hemlock Grove (Pendleton County). A 15 to 20-acre grove of "old, mature and large" Eastern Hemlock and adjacent White Oak, within a 70-acre area on the lower south slope of Spruce Mountain. The stand appears to have been selectively logged. It is protected as a hemlock grove under the Monongahela land management plan in force in 2002 (Goodrich 1990 and 1992, Clovis 1974, Mueller 1998). An eccentric landowner preserved the stand prior to its ownership by the USFS (Vanderhorst 2002).

--Oak-Maple-Basswood Stand* (Pendleton County). A 16.6-acre (6.7 ha) unlogged, uneven-aged stand on a steep, talus slope. Northern Red Oak codominates with Sugar Maple and American Basswood. Abrams et al. believe that the "interaction of climatic, edaphic and disturbance factors" explain the fact that red oak dominates along with later successional species (1998).

--Clark Tract (Greenbrier County). A stand described by Abrams et al. as nine acres (3.6 ha) of uneven-age forest dominated by White Pine, White Oak, Red Maple, Northern Red Oak, and Black Oak, on the North Fork of Anthony Creek, near Neola (1995); and by Vanderhorst as 17 acres of White Pine-White Oak/American Hazelnut/Partridgeberry forest near Neola (2002). Pawelczyk posited light thinning in the 1930s or 40s (1993). However, Abrams et al. characterized the forest in 1995 as a "virgin white pine-mixed-oak valley floor forest." They hypothesize that periodic releases were the result of small disturbances such as fire and wind-throw. White Oak have been found to be up to 295 years in age, and White Pine, up to 231 years (Abrams et al. 1995).

Stonewall Jackson Lake State Park,* central West Virginia (Lewis County)

Fifty-four acres of never-logged White Oak-American Beech forest (Vanderhorst 2002).

Cheat River,* in north-central West Virginia (Preston County).

More than 150 acres of scattered, apparently "type B" old growth stands on private land. Location information was not available in mid-2002. The old growth, which was discovered by Ken Hotopp, is unprotected (Hotopp 2002).

Murphy Preserve , in western West Virginia (Ritchie County)

Approximately 100 acres of old growth on the larger of two tracts that make up The Nature Conservancy's 276-acre Murphy Preserve. The forest is mixed mesophytic with large Cucumber Tree. Apparently it was selectively logged long ago (Harmon 1989 and 1990, Hill 1993)

Cathedral State Park , in north-central West Virginia (Preston County).

Virgin hemlock and hemlock-hardwood forests covering much of a 133-acre park. The park contains several trails and a picnic area. Two species rare in the state, the Northeastern Aster and the Virginia Big-eared Bat, are found here (Harmon 1989 and 1990, Robinowitz 1993). Conservationist Mark Robinowitz writes that the park is "Extremely beautiful, but . . . surrounded by road and cow pastures" (1993).

Coopers Rock State Forest, north-central West Virginia

--Cheat River Canyon* (Monongalia County). Scattered stands of old growth along rim, boulder scree and steep streamsides on acid sandstone outcrops and breakdown. The total certainly exceeds 70 acres, of mostly "type B" old growth, but some "type A." The most common trees are Chestnut Oak and Sweet Birch, often with rhododendrons, though some areas are more diverse. As of mid-2002, the site was mostly undocumented and unstudied, although the state forest was conducting a forest inventory. Portions of the site were discovered

independently by Ken Hotopp, Rick Landenberger at West Virginia University, and Adam Polinski with Coopers Rock Foundation. The area is partly protected (Hotopp 2002).

--Land leased by West Virginia University's Division of Forestry* (Preston County). Approximately ten acres of old growth within 7500 acres leased by the university from the state. The site, which was never logged, supports 300-year-old hemlock, also oaks and Tulip Trees. The understory includes rhododendron, Mountain Laurel, and other shrubs. The management plan for the university forest identifies three or four areas of the leased land for preservation, including the old growth (Landenberger 2002, Hicks 2002).

North Fork Mountain, east-central West Virginia (Pendleton County)

Old growth of undetermined extent on the crest of the mountain with its sandstone outcroppings. Hotopp writes that he has visited one site with old-growth Chestnut Oak/Table Mountain Pine that is at least 50 acres in extent. He speculates that there may be hundreds of acres of old growth along the ridge where the 50 acres are located (2002). Stough writes that the crest of the mountain and, in particular, "the summit ridge from the Fire Tower Road (FR 79) north to the Hopeville Gorge," supports considerable old growth or near old growth with a wide variety of species, including eight species of conifers, several oaks, and Yellow Birch (1994). Vanderhorst speaks of stands of "very large Chestnut Oak." The biggest Pitch Pine he has cored was about 100 years old, but smaller Pitch Pine on cliffs may be older, as may be dwarf Pitch Pine on Panther Knob (2002).

Others have described a specific indigenous population of Red Pine at its southernmost limit. The stand, which faces north to north-west, stretches along the ridge at the top of North Fork Mountain. Buell estimated in 1938 that the stand covered 50 acres (1940). According to Stephenson et al. (1986), the area appears to have undergone some logging; but Harmon of the West Virginia Natural Heritage Program characterizes the Red Pine themselves as "virgin" (1989 and 1990) and has pointed out that foresters describe the stand as uncut (1981). Red Pine dominates the ridge. A few White Pine, Pitch Pine, Northern Red Oak, Eastern Hemlock, and Sugar Maple are also present. The maximum age of the Red Pine cored in 1984 was 107 years. The pine are successfully reproducing. (Stephenson et. al. 1986). Most of the acreage belongs to various private individuals, but a part is in Monongahela National Forest (Harmon 1990).

Helmick Rock on South Branch Mountain (Hardy County) is the site of a second indigenous population of Red Pine. This stand, the only other indigenous population identified in West Virginia, is privately owned. Like the North Fork stand, the smaller stand faces north to north-west and is on a relatively steep slope. Again the logging history is unclear. The importance value of the Red Pine at Helmick Rock is only 68.5%, and more additional tree species are present. The maximum age in 1984 was 132 years. As at North Fork, the trees are reproducing (Harmon 1989 and 1990, Stephenson et. al. 1986). Foresters who have used Red Pine extensively for reforestation learned that seeds from the West Virginia stands grow better in West Virginia than do seeds from Maine (Buell 1940).

West Virginia Botanic Garden,* on Tibbs Run (Monongalia County)

A total of about 40 acres of old-growth White Oak and Eastern Hemlock stands. The old growth occurs in a patchy mosaic. Natural and unnatural disturbance events, including chestnut blight and ice storms, resulted in much dead and downed wood in certain areas of the garden. Additional big trees are in a more managed area near the parking lot (Vanderhorst 2002).

Ice Mountain,* northeastern West Virginia (Hampshire County)

Old growth chestnut oak, sweet birch and white pine facing west on the North River, on screes and steep slopes below Raven Rocks. The site exceeds 25 acres and includes some Type A old growth. As of mid-2002, it was undocumented and unstudied. The Nature Conservancy owns and protects the area. Access is by permission only (Hotopp 2002).

Cacapon State Park,* northern West Virginia (Morgan County)

Possibly as much as 50 acres of old growth on the top and west-facing slope of the mountain. Oak dominates. Also present are White Ash, Sugar Maple, and American Beech (Sweeney 2002).

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Southern Midwest

ARKANSAS

The Arkansas Natural Heritage Commission and its predecessors have been locating and describing exemplary natural communities for twenty years, but they did not at first look for old growth as such. As the concept of old growth developed, the Commission applied the concept to the natural areas that it had previously identified. Most Arkansas forests "composed of 100 to 150 year old mid to late successional species are old growth," as they are showing "reduced net production" and "increased mortality," Thomas Foti of the Arkansas Natural Heritage Commission writes. Large-scale logging did not begin in Arkansas until around 1890; and the first cut was not completed until about 1950. Therefore, any forest without signs of logging and with "a substantial number of trees older than 100 years" is likely to have come into being as a result of natural forces only, rather than as the result of timbering (Foti 1993). In Arkansas, lightning, native Americans, and European-American settlers impacted large areas by starting fires.

In part because of recent fire suppression, a severe outbreak of the Red Oak Borer is heavily impacting old growth in Arkansas's Ouachita and Ozark National Forests, as in the Mark Twain National Forest in Missouri. In the Ouachita National Forest 30,000 acres of forest have been affected. In infected areas, mortality is as high as 50-60% in red oaks, less severe in white oaks (Hedrick 2003). The damage is even worse in Ozark National Forest. The Ozark has 700,000 acres of hardwoods, of which 300,000 have been impacted. USFS staff have not been able to determine the effect on old growth in particular, but they do know that the degree of impact varies with the stand. Some stands have been so heavily damaged that USFS would no longer classify them as old growth, while others might be classified as old growth with little red oak. Some old growth stands are doubtless as they were before the outbreak (Davis 2003).

The Red Oak Borer is a native insect that has been present in Ozark oak ecosystems for millennia (Simon 2002). The severity and scope of the present Red Oak Borer outbreak is, however, unprecedented (Hedrick 2003). Lack of fire combined with drought appear to have made the outbreak possible. Drought, like the borer, is part of Ozark oak ecosystems. However, as a result of fire suppression for the last 80-100 years, shrubs and trees have become unnaturally dense. With more, smaller trees competing for the same resources that were available a hundred years ago, they are stressed and vulnerable to insects and disease (Simon 2002). In 2003 USFS is using prescribed burns on a larger scale than previously to encourage oak regeneration (Hedrick 2003).

Evaluating Quachita National Forest in relation to types and extent of old growth, USFS has found that the forest is well stocked with old-growth hardwoods, at least on high, dry sites. However, it has little Shortleaf Pine-bluestem old growth. The staff therefore has developed and codified, in an amendment to the 1986 forest management plan, a program to restore old-growth Shortleaf Pine-bluestem. USFS will manage 80,000 acres of forest, including 50,000 acres classified as suitable for logging, to this end. On the land that is suitable for logging, the staff will use a 160-year rotation, conduct prescribed burns regularly, and thin if necessary. Hedrick remarks that the program has already made "good progress" and shows visible results (2003).

USFS is currently revising the management plans for the Ouachita National Forest and the Ozark-St. Francis National Forests. The Ouachita and Ozark-St. Francis Forests have separate plans, but they are revising them on approximately the same schedule. Notices of intent were released in April 2002. The plans are expected to be completed in 2004 or 2005. No field inventories of old growth specifically for the plans are envisaged (Dipert 2003).

The state has at least two sites that would be old growth were in not for a history of fire suppression. **Crystal Mountain Scenic Area** (Montgomery County). is a 100-acre area of Shortleaf Pine-White Oak-hickory, reputed to be virgin except for salvage cutting (Foti 1992). What makes the area unique is the pine, which was part of the original forest. The pine may be 200 years old, but the hardwoods are probably less than 100, as they presumably grew up after the suppression of fire (Hedrick 1993). **Turkey Mountain Savanna**, in Lower Buffalo Wilderness, Buffalo National River (Marion County) is comprised of some 1000 acres of "grown up savanna" with no evidence of

cutting, on the south side of Turkey Mountain and the north and south sides of adjacent mountains. Given the history of activities in the area, the site can be assumed to have been grazed by livestock although no evidence of grazing is apparent. Post Oak and Chinquapin Oak are scattered over limestone, dolomite, and sandy dolomite substrates. The trees are up to 16 inches in diameter, and most are hollow and scarred because of fires. The area is a fire-influenced community but has been denied fire for 40 or 50 years. As a result, "brush," composed of oaks, hickories, sumac, Persimmon, hawthorn, and briars, grows between the trees. Fire has been reintroduced to a portion of the area on an experimental basis, and effects on vegetation are being monitored by the Park Service (Foti 2001).

Bayou DeView, east-central Arkansas (Monroe County)

Several thousand acres of small to medium sized Water Tupelo with scattered Baldcypress, primarily in back swamps behind the natural levee of Bayou DeView. The swamps, which the Arkansas Natural Heritage Commission describes as old growth, extend along some five to ten miles of the bayou, a tributary of the Cache River. The cypresses are very large. They do not have much buttressing, but trunks are up to six feet in diameter above the swell. The trees are also very old, some approaching 1000 years in age. Although the forest is changing in composition, from cypress to tupelo dominance, logging does not seem to be the reason: large cypress stumps are lacking. "There has, however, been logging," especially of Overcup Oak on the natural levee. "The change in dominance within the swamp may represent natural succession of an even-aged cypress stand that became established hundreds of years ago" (Foti 1992, 1993).

The US Army Corps of Engineers owns 8000 acres along Bayou DeView, all of which it obtained as mitigation for failed attempts to channelize the Cache River and Bayou DeView. Of the 8000 acres, 4500 support the old cypress-tupelo swamps. The remaining old cypress-tupelo swamps are privately owned; or within a portion of the Arkansas Game and Fish Commission's Dagmar Wildlife Management Area (Foti 1992, Sharp 1993). In the Management Area "Some logging appears to have been conducted many years ago," but cypress as old as 860 years were spared. Under the Dagmar Master Plan, the old-growth portion of the Wildlife Management Area has been placed into a reserved class that will insure its protection (Coker 1992). The US Fish and Wildlife Service is creating a Cache River National Wildlife Refuge, encompassing parts of the basins of both Bayou DeView and the Cache River. As of early 2003, it had obtained 55,000 acres, including 33,000 acres of bottomland forest (Johnson 2003).

A dissenting voice as to the old-growth status of Bayou DeView comes from the manager of the Cache River Refuge, Dennis Sharp. He says that no forest "that would be considered old growth" is on the 25,000 acres that FWS had acquired as of 1993. The "majority" of the Cache and Bayou DeView floodplain has "a long history" of logging. To his knowledge, the only exceptions are "a few isolated very small tracts of old cypress along the Bayou DeView River." "Probably the most readily identifiable of these tracts" is in the Dagmar Wildlife Management Area (1993).

Black Swamp, east-central Arkansas (Woodruff County)

A complex of several thousand acres of selectively logged swamp and bottomland hardwood forest, broken occasionally by logged and developed areas or cropland, in the floodplain of the Cache River. The area includes old-growth Baldcypress, tupelo, and cypress-tupelo stands and hardwood areas with Overcup Oak, Nuttall Oak, and Willow Oak. The Arkansas Natural Heritage Commission has a conservation easement on 1000 of the several thousand acres owned by the Arkansas Game and Fish Commission as its Black Swamp Wildlife Management Area (Stahle et. al. 1985, Foti 1993).

Little River Swamp, southwestern Arkansas (Hempstead County)

In a backswamp along Little River, a privately owned, 2145-acre "virgin stand of baldcypress type," with various age classes represented (Foti 1992). Stahle et. al. describe the area as 3500 acres, "mostly wooded with virtually pure stands of large, virgin baldcypress," probably "few if any trees over 250 years old" (1985). Unfortunately, though, flood control projects elsewhere have reduced the frequency of inundations by turbid waters, and, as a result, the owners introduced grass carp in the seventies to control the growth of aquatic vegetation (Stahle et. al. 1985, Goodwin & Niering 1975).

Big Lake National Wildlife Refuge, in northeastern Arkansas (Mississippi County)

Over 1500 acres of uncut Baldcypress in an 11,038-acre Refuge on the Little River. The virgin cypress occupy the 500-acre Baldcypress RNA, and portions of the adjacent 2100-acre Big Lake Wilderness Area. The number of acres of virgin Baldcypress in the Wilderness is not known. Researchers believe that the Baldcypress stands may have originated as a result of the New Madrid Earthquake of 1811-12. Cypress have been cored and found to be no older than the earthquake; and researchers have discovered in the material on the lake bottom evidence that a riverine system gave way to a lacustrine system at the time of the earthquake.

The Refuge includes swamps with Baldcypress, Water Tupelo, Black Willow, and Buttonbush and, at a slightly higher level, bottomland hardwood forest with cottonwood, oaks, River Birch, Green Ash, Red Maple . . . . It also has 2600 acres of open water. Nevertheless, the Refuge is "only a little swath of land surrounded by agricultural land," Brian Braudis, Refuge manager states; and flooding has severely impacted it. Flowing into the Little River are a series of straight, manmade ditches that drain more than 2000 square miles of cropland in the Missouri Bootheel. For this cropland, the Refuge serves as a sump.

Whenever one of the area's frequent floods occurs, the Refuge is subject to sediment-laden floodwaters that may inundate virtually the entire area. In the northern end of the Refuge, where the RNA is located, more than five feet of silt and trash have collected around the trees. Because thousands of acres have been covered by silt, digging it out would be a monumental task. Early succession with grasses and young trees is taking place on the silt. Furthermore, according to a study conducted by the Secretary of the Interior for the US House of Representatives in 1995, the lake at the Refuge had lost one-third of its volume since 1935 due to sedimentation. Both the cypress and the hardwoods are suffering (Eggering 1993, Foti 1992, Braudis 2003).

White River National Wildlife Refuge, in southeastern Arkansas (Desha County)

A 157,000-acre Refuge, with several areas of old growth, including virgin tracts. The staff believes that old individual trees are scattered throughout the present Refuge--intermixed cypress, oak, sycamore, Sugarberry, and elm.

--**Sugarberry Natural Area**. A 973-acre bottomland hardwood forest. There are no stumps or other proof that the site has been cut, but the staff speculate that it may have been cut very lightly around the turn of the century, just an occasional tree here or there next to a bayou. The area has four forest types: a) Sweetgum-Nuttall Oak-Willow Oak; b) Sugarberry-American Elm-Green Ash; c) sycamore-Pecan-American Elm; and d) Baldcypress. The Baldcypress has replaced an Overcup Oak-Water Hickory community as a result of flooding caused by Beaver. Beaver impoundments have caused roughly 30% of the once completely forested natural area to become swamp. Trying to prevent additional damage to the old-growth forest, the staff operates an "aggressive direct beaver control program," which includes removing Beaver dams annually.

--**The Striplin Tract**. Thirty acres thought to be virgin, between a county road and the White River. On the upland, red oak, White Oak, and hickory dominate; in the bottomland, Sweetgum, Nuttall Oak, and Willow Oak are the main trees.

--**Big Island**. On a portion of the island, approximately 60 acres, very lightly cut at the turn of the century. Species have never been inventoried, but include Sugarberry, American Elm, Green Ash, and Nuttall Oak.

Two additional areas have been administratively removed from cutting: a 3700-acre Natural Area that was selectively cut in the 1930s but not much since; and the approximately 4200-acre Brooks Island, which was cut in the early 1970s, but which is now protected from logging and motor vehicles. These two areas are on opposite sides of the river, about a mile apart (Hurdle 1993, Denman 1993 and 2003, Foti 1992, 2001).

Ouachita National Forest, in western Arkansas

In the Ouachita Mountains, woodlands of stunted oak are common at elevations over 2500 feet and on steep, dry slopes. The trees in these woodlands are almost all oak (Northern Red Oak, White Oak, Post Oak, and Blackjack Oak). Presumably the stands have not been logged, as they would not have been worth harvesting. The Forest Service manages this type of woodland today for diversity, old growth, and wildlife. Blackfork Mountain, described below, may be the best known, he says, because it has been cored (1993, Stahle et. al. 1985).

Larry Hedrick of USFS has the same view of old growth on steep, dry slopes as Bill Pell. He told us that 800,000 acres in Ouachita National Forest are not under vegetation management. They are mostly hardwood and hardwood-pine forests on steep slopes at relatively high elevations. Most of the 800,000 acres have never been logged as they are what USFS calls "non-commercial" sites. The upper-elevation old growth can be readily seen from

the Talimena Scenic Byway over Winding Stair and Rich Mountains between Mena, Arkansas, and Talihina, Oklahoma (2003).

At lower elevations in the Ouachita Mountains, particularly along streams, are dry, old-growth woodlands with Eastern Red-cedar, Gum Bumelia, Winged Elm, and Yaupon, among other species. Small, scattered stands can be found in the Cossatot River State Park adjacent to Ozark National Forest, for example.

--**Blackfork Mountain Wilderness Area** (Polk County). Within the 7568-acre Wilderness Area, a complex of old-growth communities, some of them very large, but for the most part acreage has not been determined. Along the ridge line of Rich Mountain is an "extensive," almost pure stand of stunted but very old White Oak, with a sedge understory and lichens and mosses. A steep north-facing slope has an area of old growth in which Sugar Maple is prominent. Stunted Post Oak and Blackjack Oak form a ridgeline woodland, reputed to be virgin (Foti 1992, Hedrick 1993). Stahle et. al. write of a 60-acre "virgin dwarf oak-hickory forest" (1985) on the 24-km-long crest of Blackfork Mountain, and note that "several thousand acres of stunted old-growth post oak, and some shortleaf pine" can be found elsewhere along the ridge (1985). In *A Journal of Travels into the Arkansas Territory during the Year 1819*, Nuttall wrote of crossing Rich Mountain "through thickets of dwarf oaks none of them scarcely exceeding the height of a man." Larry Hedrick of Ouachita National Forest reports that the stunted White Oak forests on Rich and Blackfork Mountains appear to be just as they were when Nuttall saw them (1993).

--**Roaring Branch Research Natural Area**, central-western Arkansas (Polk County). Three hundred and thirty acres of "old-growth hardwood and shortleaf pine, probably components of the virgin stand." There is "no evidence of commercial harvest or recent fires," a Southern Forest Experiment Station report states (Fountain and Sweeney 1985). However, according to another Forest Service description, "there is abundant evidence for past fires" (USFS [nd]b). The south-facing slope is dominated by Shortleaf Pine. The north-facing slope has a mixture of White Oak, Northern Red Oak, and hickory. Both grade into mixtures of basswood, beech, Black Gum, and Sweetgum. Black Locust, Witch-hazel, Ozark Chinquapin, dogwood, and Eastern Redbud are among the trees along the stream (USFS 1968).

--**Lake Winona Research Natural Area**, western Arkansas (Saline County). A stand of virgin Shortleaf Pine and hardwoods, particularly White Oak, which occupies most of the 280-acre Research Natural Area. The soil is rocky and thin. The Shortleaf Pine is not reproducing as well as other species, and many of the pines are reaching maturity (150 to 200 years) and seem to have red heart rot. As they die, shade-tolerant species such as White and Black Oak are replacing them. Yellow Lady Slipper, on the Arkansas endangered or threatened species list, is present and, as of 1975, the Red-cockaded Woodpecker. In 1982 a tornado did extensive damage. The boundaries of the RNA were redrawn to add other areas of undisturbed Shortleaf Pine and to eliminate the damaged acres, 120 of which were salvage cut and the other 25 left as was for research purposes. According to the Forest Service, human disturbance in the original RNA appeared to be limited to a Forest Service road and the cutting of a few trees near the road (Pell 1993, Fountain and Sweeney 1987, USFS 1975, USFS 1983, USFS [nd]a).

OZARK NATIONAL FOREST, in northwestern and north-central Arkansas

During the winter of 1991-92 the Arkansas Tree Ring Laboratory sampled forest on Enders soils on south-facing slopes in the Arkansas Ozarks. Based on their findings, Cleaveland and Stahle estimate that, on this type of site alone, the Boston Mountain portion of the Ozarks has, in scattered areas, the equivalent of 70 square miles of old growth; and Stahle notes that there are other "likely soil types and slope aspects" they have not yet sampled. As in the Ouachita Mountains, the trees on the sampled sites are oak, in particular here Post Oak, with trees up to 400 years in age (Spencer 1993). Foti of the Arkansas Natural Heritage program says that the whole Boston Highlands plateau was heavily logged around 1890, but he thinks that "steep slopes/unproductive sites" on Bean Mountain and in the Boston Highlands as a whole may have "a significant amount of old growth," as Stahle claims (Foti 1993).

--Bean Mountain (Newton County). Old-growth hardwoods of uncertain extent on and around Bean Mountain. Hardwood stands on the mountain over 50 years old are uneven aged and include old-growth remnants, local conservationists asserted in 1993. Some areas, such as Bean Point and Magnolia Grove, are particularly rich in old growth (Bonar 1993, Alexander 1993). Bean Mountain is drained on the east by the East Fork of the Little Buffalo River and on the west by Stepp Creek. At the bottom of the east side of the mountain are four big hollows: Dismal Hollow, Buckner Hollow, Lee Hollow, and Thomas Hollow. On the west side are several shorter hollows including Coon Hollow. Jimmy Dixon, Silviculturist for the Buffalo District, states that uncut forest is likely to be found at the bottom of these and other hollows scattered through the Buffalo District. The hollows are often lined by very steep bluffs. On the creeks in the bottom there may be big boulders. Loggers working with mules would have had to climb

over the bluffs with their animals before they could descend to the bottoms and, when they succeeded in doing so, they were likely to find boulders that the mules could not get around (2003). The Forest Service has protected a portion of Dismal Hollow as a Research Natural Area (see below).

--Dismal Hollow Research Natural Area (Newton County). According to the Arkansas Natural Heritage Inventory, an estimated 400 acres of undisrupted forest in the 670-acre bottom of a steep canyon (Smith 1993, Foti 1992). Beech, with dbh (diameter at breast height) up to 37 inches, dominate. Also abundant are Northern Red Oak, basswood, and magnolia. The "rich understory includes several relictual species" (Foti 1992). The Forest Service says that "parts of the RNA may in fact be old growth while other parts have been disturbed to one degree or another" (Smith 1993). Local conservationist Doug Alexander believes that Dis mal Hollow has much more than 400 acres of old growth (1993).

--Clifty Canyons Special Interest Area (Baxter County). Tracts of "very high quality old growth forest of red and white oaks" within a 1655-acre Special Interest Area. The SIA is a complex of different forest communities and conditions (Foti 1992, 1993). Data are not yet available to say exactly what is old growth or how extensive the old growth is. Sugar Maple, Black Walnut, White Ash, and several hickories are present, in addition to the oak (Tucker 1990). The understory is rich (Foti 1992).

--**Magazine Mountain** (Logan County). Small areas of old-growth hardwood scattered through several thousand acres of mature forest on the slopes and top of the mountain. The old-growth areas have never been mapped and distinguished from the forest in general. Northern Red Oak is dominant. Sugar Maple, walnut, Chinquapin Oak, and hickory are also frequent. The understory is diverse (Foti 1992). The Forest Service has proposed that Magazine Mountain be designated a Special Interest Area (Smith 1993, Foti 2001).

--**Mixed Mesophytic Forest**, in the Upper Buffalo Wilderness Area (Newton County). An 85-acre "high quality stand of beech, oaks, basswood, and magnolias" on a rugged slope that faces north (Foti 1992).

--Wedington Mountain (Washington County). "A relatively undisturbed post oak dominated forest along the xeric upper slopes of Wedington Mountain." Trees were cored in 1977 and 1982 on a 40-acre site, which was later artificially disturbed by firewood cutting and clearing of a power line corridor. As of 1985, the upper slopes of the mountain still had many other areas of old-growth Post Oak. The trees had not been cut, because they were small, hard to reach, and unshapely. The canopy was 12 to 15 meters tall, and the biggest trees had only 60 to 75 centimeter dbhs. The mountain is on a western border of the National Forest, and is partly privately owned (Stahle et. al. 1985).

Big Creek Bottoms, southeastern Arkansas (Columbia County)

A 720-acre privately owned old-growth area that apparently extends across several creek channels through bottomland a mile wide. Lowland pine-oak occupies the high ground; Willow Oak, the flats; Overcup Oak and cypress, the depressions. A "few stumps" dot the site; but along the creek there is "little evidence of management." Willow Oak are up to 40 inches dbh; Overcup Oak, to 30 inches. The site also has large specimens of beech, Water Oak, and Sweetbay; but many trees are smaller. A cored pine was estimated to be 120 years old. Beaver and wind have helped shape the site (Foti 1992).

Hot Springs National Park, in central Arkansas (Garland County)

--North Mountain and Hot Springs Mountain. A 230-acre old-growth Shortleaf Pine-oak forest, within the park's 4000 acres of forest. The south-facing portion of the acreage is xeric; the north-facing dry. The southern supports a fairly open, stunted forest; the northern a more luxuriant, closed forest. Many trees are older than 130 years. Blackjack Oak is mixed with the pines of the south-facing slope; White Oak is frequent on the north-facing. Some wood was cut for fuel in the nineteenth century, but there are no signs that the forests have had "extensive cutting during the last 150 years."

--Sugarloaf Mountain. Approximately 90 acres of old-growth Shortleaf Pine-oak forest, similar to that on North and Hot Springs Mountains. A tree on the south-facing slope was cored at 191 years; and a tree on the north-facing slope had 242 growth rings (Foti 1992, Giddings 1993, Pell 1982).

Beech Creek Tract*, in Overflow Bottoms National Wildlife Refuge (Ashley County)

A 230-acre unlogged forest with an overstory of diverse hardwoods, including large American Beech. The understory is dominated by large Sugar Maple. The presence of large Sugar Maple in Arkansas is unusual. The tract was owned by Georgia Pacific, but the company's foresters left it alone, because they recognized its distinctiveness.

The Nature Conservancy purchased it in 1996 and transferred it to the US Fish and Wildlife Service, which added it to the southern end of the Overflow Bottoms Wildlife Refuge (Shepherd 2003, Sundell 2003).

Coastal Plain Beech Forest, in southeastern Arkansas (Columbia County)

A 200-acre beech-terrace hardwood forest, with beech to 42 inch dbh, also large Sweetgum and White Oak. The understory is mostly Muscadine Grape and Partridge-Berry. "A" quality, the area has a "very few stumps" but no other signs of disturbance. It is privately owned, and is in the well-drained bottoms of Cornie Creek, where it is associated with a high-quality lowland pine-oak forest and an aquatic community. (Foti 1992).

Sugarberry-Elm-Ash Forest, in southeastern Arkansas (Hempstead County)

A 160-acre old-growth forest with no evidence of disturbance. Owned by a private hunting club, the forest is inside a bend in the Little River. A Sugarberry-elm-ash complex is here succeeding to lowland oak-hickory. Typical species and maximum sizes are American Elm, 40 inches; Green Ash, 32 inches; Cherrybark Oak, 32 inches; Pecan, 30 inches; Nuttall Oak, 40 inches (Foti 1992).

Moro Creek Bottoms Natural Area, in south-central Arkansas (Cleveland County)

Within the 173-acre preserve, approximately 100 acres with two types of old-growth forest: lowland oak-Sweetgum and, along a creek, Baldcypress. The former is a "mature, little-disturbed forest of Sweetgum, Water Oak, and Cherrybark Oak, with trees up to 50 inches dbh and 100 feet tall. The latter has "large well-formed" Baldcypress but also "some stumps." The Arkansas Natural Heritage Commission (a state agency) and the Arkansas chapter of The Nature Conservancy jointly own the tract, which they acquired from Georgia-Pacific Corporation (Foti 1992, 1993).

Devil's Knob--Devil's Backbone Natural Area, north-central Arkansas (Izard County)

A complex of old-growth juniper-hardwood woodlands, younger successional communities, and glades. The old growth, which is dominated by Ashe Juniper, may occupy 60 to 80 acres of the flat top of the steep-sided plateau that comprises the Natural Area. The Arkansas Natural Heritage Commission owns the Area (Foti 1992, 1993).

The Lost 40,* south-central Arkansas (Calhoun County)

Forty acres of land that may never have been never logged or have been only selectively logged. Scattered, huge Loblolly Pines, up to 53" dbh, may be 150 years old. A few very large hardwoods--Water Oak, Sweetgum and a single Mockernut Hickory (all up to 3' dbh), and Sassafras (up to 18" dbh--may be 120 years old. Most of the hardwoods are noticeably smaller. The high understory includes Ironwood and Sweetleaf (*Symplocos tinctoria*). Common in the groundcover are American Beautyberry (*Callicarpa americana*) and the grass *Chasmanthium sessiliflorum.* No herbaceous species that would indicate disturbance are present, but the tract's early disturbance history is not known. The tract was for some time the subject of a dispute about ownership, which was decided in favor of the Potlatch Corporation, the present owner. A tornado crossed the northwestern corner of the tract in the 1990s. The corner has been allowed to regenerate, but the land managers have a policy of salvaging the occasional large pine that succumbs to pine beetles. The forest is buffered by uneven-aged Potlatch forest on three sides and by another landowner on the fourth side (Foti 1996).

Cossatot River State Park Natural Area, western Arkansas (Howard County)

Small areas of old-growth pine, pine-hardwood, and glade communities with Eastern Red-cedar. Not enough inventorying has been done to calculate acreages. The 4000-acre Natural Area is owned by the Arkansas Natural Heritage Commission and Arkansas State Parks (Devall and Rudis 1991, Pell 1993, Foti 1993).

Shrub Swamp, in the Sulphur River Wildlife Management Area, southwestern Arkansas (Miller County)

A 20-acre Planertree forest "in a backwater low swamp behind the natural levee along the Sulphur River." The Water Elm reach up to 50 feet in height and 18 inches dbh. Other smaller trees nearby have been cored and found to be 120+ years old. Although the area is almost pure Planertree, it has a few scattered locust and willow as well as Water Elm. The site is owned by the Arkansas Game and Fish Commission, and is well buffered (Foti 1992).

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KANSAS

For our 1993 survey, Chris Lauver of The Kansas Biological Survey described three old-growth sites in eastern Kansas. These sites still exist (Kindscher 2002) and are presented below. To our original three we add a site of "ancient" Cross Timbers (Cross Timbers State Park at Toronto Lake) that in 2002 was receiving wide publicity. Jennifer Delisle, information manager with the Kansas Natural Heritage Inventory, writes that it is "possible that other remnant stands exist" but that Natural Heritage has not had the funding that would enable the agency to locate them.

The Cross Timbers form the transitional boundary between the eastern deciduous forest and the prairie. They stretch from the Chautauqua Hills of southeastern Kansas, south through eastern Oklahoma, into northeastern Texas. Cross Timbers State Park described below is the northernmost extension of the Cross Timbers (Niemeyer 2002). The dominant trees of the Cross Timbers are Blackjack and Post Oak. Other species include Eastern Red-cedar, Northern Red Oak, White Oak, White Ash, Bitternut, Mockernut Hickory, and Winged Elm (U. of AR. 2002).

In Kansas, the Cross Timbers region encompasses Chautauqua, Elk, Greenwood, Montgomery, Wilson, and Woodson Counties. The Cross Timbers flourishes on a sandstone substrate, which traps within it water on which the trees can draw. Thus trees can survive in what would otherwise be prairie. The University of Arkansas Tree Ring Laboratory has identified ancient Cross Timbers at Elk City Lake (Montgomery County) and near Fall River (Elk or Greenwood County) in addition to the state park (U. of AR. 2002). The extent of ancient Cross Timbers prairie and savanna in Kansas has not been determined. Remaining sites would likely have been grazed by livestock (Lauver 1992).

Fort Leavenworth Military Reservation, northeastern Kansas (Leavenworth County)

--Old-growth eastern floodplain forest on the south and west side of the Missouri River. Lauver describes the site as about 1000 acres dominated by sycamore, cottonwood, elm, and Pecan. Its condition is "AC," with "A" representing about 55% of the land, "AB" 25%, and "C" 20%. In the past the section rated "C" was "selectively thinned" (Lauver 1992). Matthew Nowak, Forester at Fort Leavenworth, speaks of 1200 to 1500 acres of bottomland, which have not been cut except for the removal of walnut from one area. The lower areas are virtually solid Pecan, around 140 feet tall, he says. Nearer to the river, on ripples of slightly higher land, are massive sycamore. The elm in the forest are now just "great white ghosts of trees." Walnut is scattered among the sycamore. Also intermixed are Bur Oak, White Oak, Green Ash, Hackberry, Sugarberry, and, as a recent addition, some Box Elder. Cottonwood grow only in places that have been disturbed, and are found along a road or two that were pushed through so people could gather mushrooms. As far as Nowak knows, nobody has cored the trees to determine their age. The state estimates that the average Pecan tree on this fertile site is 120 to 130 feet tall at 50 years of age (Nowak 1993).

--About 125 acres of old growth on the steep slopes of bluffs that face east and northeast across the Missouri River. Red and Black Oaks, basswood, walnut, and Sugar Maple dominate. Eighty percent of the site is ranked "A" and 20% "AB," the latter because the area includes a horse trail and "some evidence of selected thinning." At the base of the bluff are found 2 species rare in Kansas: the Large-flowered Bellwort and Appendage Waterleaf (Lauver 1992).

Cross Timbers State Park at Toronto Lake,* in southeastern Kansas (Woodson County)

A 1075-acre park, much of which is Cross Timbers woodland and savanna dominated by Blackjack Oak and Post Oak. The area experienced some logging, but there are no signs of systematic tree removal. The rocky terrain and twisted trees would not have been attractive to loggers. Researchers from the University of Arkansas's Tree Ring Laboratory cored 26 trees in 1982 and found that many of them date back to the early 1700s. Some of the park was never grazed by livestock; a small part was grazed by livestock up until four years ago; the balance was grazed many years ago. The park is owned and managed by the Kansas Department of Wildlife and Parks, which protects the old growth. By act of the Kansas legislature the name of the park was changed from Toronto Lake State Park to Cross Timbers State Park at Toronto Lake, and in May 2002 an Ancient Trees of the Cross Timbers trail with signs describing the ecosystem was inaugurated (Fisher 2000, Niemeyer 2002).

Eudora Floodplain Forest, northeastern Kansas (Douglas County)

Approximately 50 acres of privately owned eastern floodplain forest on the south side of the Kansas River. The dominant trees are cottonwood, sycamore, and Silver Maple. The site is ranked "A," but shows some signs of disruption by off-road vehicles (Lauver 1992).

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LOUISIANA

The Louisiana Natural Heritage Program distinguishes two types of savanna: upland Longleaf Pine forest and (wet) Longleaf Pine savanna. The Kisatchie has the finest remaining upland savanna. The finest wet savanna, at least in the southeastern part of the state, and the only such savanna under conservation management, is within what is known as **Lake Ramsay Savanna**, a somewhat fragmented area, comprised of a mosaic of communities and probably more than 2000 acres in size (Saint Tammany Parish). Little Ramsey is not described below, because most of the Longleaf Pines in the savanna were removed, possibly as recently as 1920. However, the ground cover is intact, and, as Nelwyn McInnis points out, it is easier to restore one species of tree than the many plant species in the ground cover. The Wildlife and Fisheries Department owns the 800-acre Lake Ramsay Wildlife Management Area, and The Nature Conservancy owns the 414- acre Lake Ramsay Preserve. In parts of the savanna, young trees are growing, but where trees are not coming back naturally, restorationists can use cones from a nearby genetic source (McInnis 1993 and 2001, Carr 1993). **Talisheek Wetlands** , southeastern Louisiana (across Lake Pontchartrain from New Orleans, Saint Tammany Parish) is another example of an area with high quality Longleaf. Here 4000 acres of mature Longleaf Pine uplands grade into wet pine savanna and bayhead forest. The Longleaf was cut in the past (Martin 1998) and is now periodically thinned; but the ground cover is very good (McInnis 2001). The Nature Conservancy owns 2770 acres as the Talisheek Pine Wetlands Preserve. The balance is in private hands.

In the 35,032-acre **Pearl River Wildlife Management Area**, Margaret Devall and colleagues have cored several cypress trees that were around 1000 years old. The oldest was 1172 years. The swamp, in St. Tammany Parish, is owned by the Louisiana Department of Fisheries and Wildlife (Devall 2003).

David White and Stephanie Skojac searched for remnant bottomland hardwood forests in extreme southeastern Louisiana, around and south of New Orleans. Using aerial infrared photography followed by ground truthing, they found nothing that they could characterize as old growth. They located only seven small areas "that in whole or in part could be labeled older-growth—**Sauvage**, **Airline**, **Lafitte**, **Oak**, **Verret**, **Hermi**t, and **Jackson**. . . . . It seems likely that these forests became established by the turn of the last century on abandoned plantation land or on variously disturbed land near plantations." Two of the forests are on federal land: Sauvage (Bayou Sauvage National Wildlife Refuge) and Lafitte (Jean Lafitte National Historical Park). Two others were wholly or partially logged between the time that White and Skojac did their research and the publication of their article on the research. The rest were threatened (2002).

The 13,168-acre **Bayou Cocodrie National Wildlife Refuge** in east-central Louisiana (Concordia Parish) is "thought to represent one of the least disturbed areas of bottomland forest remaining in the" Lower Mississippi Alluvial Valley (Ouchley et al. 2000); but it apparently is not primary forest. The highest quality portion, a 750-acre area, was logged as recently as the thirties. Usually loggers left young trees and malformed trees, and this appears to have been the situation here. Today the site has trees up to 100 years in age representing 30 bottomland hardwood species (Simpson 2003). The tract will be proposed as a Research Natural Area (Ester 2003), and the US Fish and Wildlife Service (FWS) uses it as a model for old-growth restoration in southeastern Louisiana (Simpson 2003).

Ouchley et al. have a contrasting view of the Refuge. Although they agree that the Refuge is less disturbed than most bottomlands in the Lower Mississippi, they have found that the entire Refuge has "undergone several timber harvests dating back to the late 1920s." Furthermore, they sampled the Refuge as a whole and discovered that the composition of the forest has changed since 1830. At that time the most abundant tree species were, in order of occurrence, Sugarberry, Sweetgum, and all oak species combined. In 1994 oak species combined were the most abundant. Sugarberry and Sweetgum were tied for second place. Oaks combined were 9.54 per acre in 1830 but 40 per acre in 1994. Ouchley et al. draw the conclusion that the Refuge, does not represent historic conditions and therefore should not be used as a model for restoration (Ouchley et al. 2001).

We have not been told of any specific old-growth areas in the **Tunica Hills**, but the thousands of acres in this region of eastern Louisiana likely include four- to five-acre pockets of western mesophytic old growth. The old growth would be found in narrow coves at the bottom of steep ravines (Meier 1997). The Tunica Hills are the southern end of the loess zone that begins in western Kentucky and Tennessee (see the introduction to Mississippi). The Tunica Hills Wildlife Management Area, owned by the Louisiana Department of Wildlife and Fisheries, encompasses some 5000 acres of the Tunica Hills. The terrain in the Wildlife Management Area is characterized by "rugged hills, bluffs and ravines" (LDWF 2003).

A revision of the management plan for the Kisatchie National Forest was adopted in 1999 (see below).

KISATCHIE NATIONAL FOREST, in several segments in west-central and northern Louisiana

The Forest has considerable old growth, but it is fragmented, usually in sites of 50 to 100 acres in size, often embedded in regenerating forests. There are many riparian sites, and scattered small pieces of upland old-growth forest. When the areas that are now the National Forest were logged between 1890 and 1930, the uplands were more thoroughly cut than the land along rivers and streams.

Through a challenge cost-share program involving the US Forest Service (USFS), The Nature Conservancy, and the Louisiana Department of Wildlife and Fisheries Natural Heritage Program, David Martin and Latimore Smith conducted and published analyses of the natural plant communities of the Winn, Kisatchie, Evangeline, and Catahoula Districts; Roger A. Williams and Smith of the Caney District; and Susan L. Grace and Smith of the Vernon Unit of the Calcasieu District. The sites below are drawn from these reports. For lack of space, the authors describe in detail only a selection of the sites they studied, those "most similar to their assumed presettlement condition." We summarize here their descriptions of sites they characterize as old-growth that are forty or more acres in size or that are the largest old-growth areas representative of particular types.

In deciding which sites constitute old growth the authors looked for forests in which "the relative abundances and age-class distributions of the dominant species approximate those expected under presettlement conditions." For their purposes, presettlement is the period from 1830 to 1880, after which industrial technology, particularly railroads, began to make itself felt. They considered the presence of trees obviously predating the logging period and of old-growth characteristics such as snags more important than evidence of selective logging.

The researchers did not survey the following management zones: "Research Natural Areas, recreation areas, seed orchards, military bases, no-entry zones, scenic areas, administrative sites, and cultural resources sites." Therefore the list below does not represent all old growth on the Kisatchie. The Forest's only designated Wilderness, the Kistachie Hills Wilderness, for example, probably has pockets of old growth (Dancak 2000). Lands allotted to Fort Polk are the site of hundreds or thousands of acres of Longleaf Pine that would have had logging at the turn of the century but that are now a hundred years old and in good condition due to fires sparked by military activities (Smith 2000).

The Revised Land and Resource Management Plan for the Kisatchie adopted in 1999 states that "most high-quality (A and AB) natural community sites identified through [the challenge cost-share program] were included in old-growth patches or streamside protection zones." Remaining A and AB sites will be tracked "through at least the next stand examination and silvicultural prescription period." At that time USFS will decide whether to continue tracking them and offering them special protection or to release them for management according to the prescriptions for the areas in which they are located (USDA 1999).

The Kisatchie has an ongoing problem with military use. When the plan was adopted, the US Army at Fort Polk was authorized to use intensively 40,026 acres and to make limited use of 44,799 acres on the Vernon Unit of the Calcasieu District. It was also authorized to make special limited use of 12,820 acres and intensive use of 480 acres on the Kisatchie District. The Army had proposed conducting increased military training in the southern portion of the Vernon, the then 44,799-acre Limited Use Area, and was preparing an environmental analysis of the proposal. The US Air Force Reserve unit at Barksdale Air Force Base in Bossier City, Louisiana, operated the Claiborne Bombing and Gunnery Range on the Evangeline Unit of the Calcasieu District. The range was a 3207-acre intensive use area composed of a 672-acre impact area and a 2535-acre safety fan. The Air Force had proposed expanding buffer zone and was to draft an environmental document for public comment. The Louisiana National Guard was authorized to use a total of 27,106 acres on the Caney, Catahoula, and Evangeline Districts for bivouac and other military training activities. However, it could not actually conduct a training exercise on that land without an additional permit for that specific activity, and each permit normally involved only 10 acres or less. Another authorization allowed the use of 11.48 acres on the Catahoula for training in rapid runway repair (USDA 2000).

Caney District,* northern Louisiana (Webster and Claiborne Parishes)

The Caney Ranger district is composed of the last land to become part of Kisatchie National Forest and was created out of federal Land Utilization Projects. Therefore much of the land has been farmed. In the pre-settlement era Shortleaf Pine/hardwood forests dominated the northern Louisiana uplands, while mixed hardwood-Loblolly Pine forests grew in small bottoms and on lower slopes and stream terraces. Today Shortleaf Pine and Shortleaf Pine-oak

account for only 3 percent of the forest cover on the Caney District. Loblolly Pine and Loblolly Pine-hardwood account for 72 percent.

Williams and Smith identified only one class "A" old-growth stand in the district, 18 acres of Loblolly Pine/Water Oak/Laurel Oak riparian forest in the Corney Bayou floodplain. The 19 "AB" sites are mostly in small, though valuable, remnants. They include 55 acres of Shortleaf Pine/oak-hickory forest that is even-aged and is found in a location that was presumably farmed. However, the site supports the species described by early surveyors (Williams and Smith 1995).

Catahoula District, west-central Louisiana (Grant Parish)

The Longleaf Pine forest that once covered the district has shrunk to only a few large islands surrounded by Slash and Loblolly Pine plantations. Much Shortleaf-dominated forest can still be found but, because canopies have closed due to fire suppression, the herbaceous ground cover has often been lost and there is little Shortleaf regeneration. The district still has many old-growth riparian stands, and also many riparian stands that are classified as mature but not old growth because of evidence of widespread selective cutting.

--**Spanish Mound Riparian** (Catahoula District). Three hundred and fifty-nine acres of riparian forest of the US Forest Service's Sweetgum-Nuttall Oak-Willow Oak type. The US Forest Service has assigned it a 1932 birth date, but Martin and Smith found the forest to be old growth. It is in the Iatt Creek floodplain, which has big tracts of old-growth riparian forest that have characteristics approaching those of bottomland forest. The area has very few stumps, but feral hogs are present.

--**Dyson Creek Riparian** (Catahoula District). A 40-acre beech-magnolia forest, in which a "very few stumps" can be seen. Logging has "encroached into its perimeter" (Martin and Smith 1993).

Calcasieu District, **Evangeline Unit,** west-central Louisiana (Rapides Parish)

The entire district was within the range of Longleaf Pine. In the northern part of the district a mixture of public and private lands makes prescribed burning difficult. Therefore Longleaf forests have been reduced in size and degraded. Large areas of Longleaf remain in the southern part, but the vast majority of this forest is immature and even-aged. Loblolly Pine plantations have replaced most of the Shortleaf Pine/oak-hickory forests, although small patches of old growth remain. Little old-growth mixed hardwoods-Loblolly can still be found. Shortleaf remain along the shore of Lake Kincaid. On a more positive note, "Evangeline has a wealth of superb riparian forest, much of which is old-growth" (Martin and Smith 1993).

--Brushy Creek Riparian (Evangeline District). On a tributary of Castor Creek, a 188-acre beech-magnolia forest, adjacent to "relatively undisturbed uplands, including a hardwood slope forest." Beech, Southern Magnolia, White Oak, Black Gum, Sweetgum, and Loblolly Pine dominate the canopy, which also includes Cherrybark Oak, Water Oak, Pignut Hickory, and Laurel Oak. The well-developed midstory includes Ironwood, Common Sweetleaf, Winged Elm, Eastern Hophornbeam, Flowering Dogwood, Red Maple, and Black Cherry. The understory is sparse but varied, with blueberries, hawthorns, and viburnums among other taxa.

--**Loving Creek Riparian** (Evangeline District). A 101-acre beech-magnolia forest on a tributary of Castor Creek. American Beech, White Oak, Southern Magnolia, Black Gum, and Loblolly Pine dominate. The midstory includes Ironwood, Common Sweetleaf and Red Maple. With only a few stumps, the "forest has been very little disturbed."

--**Castor Creek Riparian** (Evangeline District). A 70-acre beech-magnolia forest on "an exceptionally unpolluted and unaltered stream." The species in the canopy and midstory are similar to those at the Loving Creek site. The understory includes both woody species, like blueberries, and herbs such as Partridge Berry and Elephant's Foot. A few stumps, mainly Loblolly Pine, are found; but the site includes very large Loblollies.

--Cathedral Longleaf (Evangeline District). Fifty-five acres of upland Longleaf Pine forest, with tall Longleaf variably spaced, and lesser numbers of Shortleaf Pine, Loblolly Pine, Blackjack Oak, Southern Red Oak, Post Oak, Black Gum, Flowering Dogwood, and Sweetgum. The understory, which consists mostly of vines and shrubs, includes Wax Myrtle and Farkleberry. The canopy is closed, and the herbaceous layer sparse. A few stumps appear; and a new logging road to another site passes through the area. The site has not had a fire for at least fifteen years and is suffering from fire suppression; but could be restored by burning.

Other identified upland Longleaf Pine forests are the 18-acre Sand Spur Longleaf in Catahoula District and the 14-acre Bayou Luce Longleaf and the 14-acre Stunted Longleaf in the Kisatchie District. The last includes four

Longleaf that were cored and dated at 150 to 250 years. One of them had a dbh of only 9 inches yet was 196 years old.

--Bayou Boeuf Cypress (Evangeline District). A 37-acre cypress-tupelo forest along Bayou Boeuf in the floodplain of the Red River. Additional species in the canopy include Overcup Oak, Water Oak, Water Hickory, American Elm, Sugarberry, Green Ash, and Red Maple. The mid-story and understory are sparse. The stand has "a few stumps." The survey identified two other old-growth cypress-tupelo forests: the 15-acre Castor Creek Cypress in the Evangeline District and the 3-acre Drake's Dome Cypress, part of a larger old-growth swamp in the Winn District (Martin and Smith 1993).

Kisatchie District, west-central Louisiana (Natchitoches Parish)

As in the Winn District, the predominant pre-settlement communities were upland Longleaf Pine, Shortleaf Pine/oak-hickory, mixed hardwood-Loblolly Pine, and riparian. In the Kisatchie, the initial loggers left many patches of Longleaf; and USFS and CCC replanted with Longleaf many of the uplands that had been cut. Wildfires and then prescribed burning prevented major hardwood invasion, although most of the Longleaf has experienced some degree of unnatural hardwood growth. In the stands that Martin and Smith surveyed, around 70 percent of the original Longleaf had remained as Longleaf.

A substantial amount of Shortleaf Pine/oak-hickory forest remains in the northern part of the district, but only a little of this is old growth. The hardwood forest slopes that occurred in a few steep areas "are essentially untouched." "Very few of the stream bottoms have been clearcut." In fact, the first wave of logging in Louisiana spared many of the stream bottoms throughout Kisatchie National Forest.

--Middle Creek Riparian (Kistachie District). A 115-acre forest "intermediate between riparian forest and bottomland hardwood forest." In the south part are American Beech and a little Loblolly Pine; in the north, Nuttall Oak and Overcup Oak. The dominant midstory species throughout is Ironwood. A "number of stumps" and "some old roads" indicate past disruption.

--Bayou L'Ivrogne Riparian (Kisatchie District). Eighty acres of riparian forest, dominated by American Beech, Loblolly Pine, White Oak, Cherrybark Oak, Laurel Oak, Southern Magnolia, Sweetgum, and Pignut Hickory. Ironwood dominates the midstory, in association with Eastern Hophornbeam, American Holly, Common Sweetleaf, and Flowering Dogwood. The canopy is closed, and the understory sparse. A few stumps are the only signs of disruption. "This is an excellent examp le of riparian forest . . . The streams themselves are magnificent and appear quite undisturbed."

--**Jackson Ravine** (Kisatchie District). In a ravine, an 80-acre hardwood slope forest dominated by American Beech, White Oak, Cherrybark Oak, Southern Magnolia, Sweetgum, Black Gum, and Mockernut Hickory. The midstory includes unusually big American Holly. The herbaceous layer is sparse. The site has "only a few stumps" and "seems very pristine." The US Forest Service birth date is 1873. The two other examples of hardwood slope forest that have been identified are the 29-acre Kisatchie Bayou Ravines and the 11-acre Bynoque Branch Ravine, both in the Kisatchie District.

--Gibbs Slough Bottom (Kisatchie District). In the Kisatchie Bayou floodplain, a 72-acre bottomland forest, dominated by Overcup Oak, Nuttall Oak, Water Oak, Sweetgum, Sugarberry, American Elm, Green Ash, and Water Hickory. In the lower patches are Water Tupelo and Baldcypress. The sparse midstory includes Red Maple, Deciduous Holly, and Ironwood. Because the site is frequently flooded, the ground cover is very sparse. The Forest Service assigns the stand a birth date of 1875. Apart from off-road vehicle trails, the area appears undisrupted.

--Old Shortleaf Slope (Kisatchie District). A 37-acre Shortleaf Pine/oak-hickory forest, dominated by Shortleaf Pine, Southern Red Oak, Post Oak, White Oak, and Mockernut Hickory. Elliott Blueberry (*Vaccinium elliottii*) is the main species in the sparse shrub layer. Eastern Hophornbeam and Flowering Dogwood dominate the midstory. Under the closed canopy, the herbaceous layer is sparse. A selective cut has taken place, and fire has not occurred for at least fifteen years. Before fire suppression, the fire frequency probably averaged a fire every five to fifteen years.

The other Shortleaf Pine/oak-hickory forests identified are the 20-acre Bobs Creek Shortleaf on the Kisatchie District and the 15-acre Kincaid Shortleaf in the Evangeline District.

--Kisatchie Loblolly (Kisatchie District). An 11-acre mixed hardwood-Loblolly forest, dominated by American Beech, Loblolly Pine, White Oak, Southern Red Oak, Laurel Oak, Southern Magnolia, White Ash, and Mockernut Hickory. Old-growth examples of this community are rare. Two other "A" quality sites were identified in the survey, one of them the 6-acre Pine Grove Church Loblolly in the Kisatchie District.

--**Flat Glade** (Kisatchie District). A 9-acre sandstone glade on a flat-topped knoll on a ridge crest. Old Longleaf Pine and a smaller number of Shortleaf Pine and Loblolly Pine grow in the very open forest. Yaupon and Wax Myrtle are the most common of the few understory shrubs. The many rock outcrops bear only lichens. The site has burned every two to five years. It seems to have been only selectively cut and is in excellent condition. This is the only old-growth sandstone glade located in the survey (Martin and Smith 1991).

Winn District, west-central Louisiana (Winn Parish)

In the Winn District many of the upland forests logged between 1890 and 1930 have not yet been cut a second time. The ground cover would by now be essentially intact had not fire suppression following the logging allowed hardwoods to increase in size and density. Prescribed burning was begun in the 1960s and is restoring some areas. Substantial acreage in stream bottoms has been and continues to be clearcut in this district, although essentially intact old-growth riparian forests remain.

--Mile Branch Riparian (Winn District). A 118-acre riparian forest on a swift-running creek with a sandy bed. American Beech, Loblolly Pine, White Oak, Sweetgum, Cherrybark Oak, and White Ash dominate the closed canopy. Some Loblolly Pine stumps and old logging roads evidence past cutting. Neighboring clearcuts have "heavily encroached" on the floodplain in places. Miles Branch is among the largest of the 133 old-growth riparian sites identified by Martin and Smith.

--**Malaudos Creek Riparian** (Winn District). A 106-acre forest of the American Beech-Loblolly Pine-Sweetgum type. Many large Cherrybark Oak and Sweetgum grow here, at least six of the Sweetgum with dbhs of 32 to 46 inches. Ironwood, Eastern Hophornbeam, Winged Elm, and Chalk Maple are among the species in the understory. The ground cover is sparse. Signs of disruption are a few softwood stumps, an off-road vehicle trail, and encroachment of a clearcut to the south.

--Dugdemona Bottomland (Winn District). An 83-acre bottomland hardwood forest, dominated by Overcup Oak, Cherrybark Oak, Nuttall Oak, Sugarberry, Water Hickory, and Sweetgum. Red Maple and Winged Elm are found in the midstory, and vines, including Poison Ivy and Trumpet Vine, are common. The forest has "a few stumps," but seems "essentially undisturbed."

Other old-growth bottomland forests are the 29-acre Little Bear Creek Bottomland, also in the Winn District; and the 23-acre Middle Creek Bottom and the 6-acre Shagbark Bottom in the Kisatchie District.

--**Wolf Creek Riparian** (Winn District). Sixty-six acres of riparian forest dominated by American Beech, Loblolly Pine, White Oak, Laurel Oak, White Ash, and Black Gum. The site is "largely undisturbed," but includes "a number of stumps" and a logging road.

--Caskey Branch Riparian (Winn District). A 43-acre riparian forest of the US Forest Service's Sweetgum-Nuttall Oak-Willow Oak type. Apart from a few Loblolly Pine stumps, the site appears to be undisrupted (Martin and Smith 1991).

Calcasieu District, Vernon Unit,* west-central Louisiana (Vernon Parish)

In the pre-settlement era, Longleaf Pine forests dominated the sandy uplands and most of the coastal plain in the Vernon District. The predominant forest types were upland Longleaf Pine, Longleaf Pine/flatwoods/flatwood savannah, mixed hardwood-Loblolly forest, and riparian forest. Most of the district was clearcut by the 1930s, and much of the Longleaf Pine has been replaced by Loblolly Pine or Slash Pine. However, of the 45,000 acres in the surveyed part of the Vernon District, around 15,000 acres (42%) are still Longleaf.

--Big Branch Longleaf (Vernon District) Two hundred and fifty acres of relatively intact Longleaf Pine forest. The stand exhibits many old-growth characteristics, including numerous age classes, standing dead trees, and woody debris. Some of the Longleaf are more than 100 years old. The mid-story is composed of scattered Yaupon, Southern Red Oak, and small dogwoods. Sassafras, sumac and huckleberry dominate the understory A diverse herbaceous layer is dominated by legumes and Little Bluestem and other grasses. The site has experienced fire once every year to three years. On the negative side, the area has some stumps, old fire breaks, and old haul roads. Moreover, little natural regeneration of pine is taking place. It is ranked A/AB.

--Sixmile Uplands (Vernon District). One hundred and two acres of upland, uneven-aged Longleaf Pine forest. A few of the large trees, which are older than 75 years, shelter Red-cockaded Woodpeckers. The site has scattered hillside bogs and a diverse ground cover dominated by Little Bluestem, other grasses, legumes, and Bracken Fern. Some natural regeneration of Longleaf is taking place. The site has burned once every three to five years. Fire breaks and a road cross a part of the stand.

--Drake's Creek Fishing Trail (Vernon District). Some 100 acres of closed canopy riparian forest, dominated by Loblolly Pine, American Beech, and White Oak. The canopy also includes Sweetgum, Black Gum, and Water and Laurel Oaks. The mid-story is largely composed of saplings of the canopy species plus Red Maple. The forest is along the flat bottoms of Drake's Creek. Some trees have been removed, and a parking area has been cleared. However, the stand is uneven aged, and there are many standing dead trees and many fallen trees. It includes some of the largest Loblolly in the Vernon District.

--Whisky Chitto Loblolly (Vernon District). Some 90 acres of mixed hardwood-Loblolly forest grading into riparian forest near Whisky Chitto Creek. The site shows few signs of disruption: some stumps and, on the north side, an old logging railroad bed. The mostly closed canopy is dominated by Loblolly Pine. The structure is uneven-age.

--**Black Branch Bottoms** (Vernon District) . Approximately 80 acres of mixed hardwood-Loblolly forest along the banks of Black Branch, a small tributary of Drake's Creek. The site has some stumps and shows evidence of past fire breaks; but otherwise has been little disrupted. The canopy species represent different age classes and include many Loblolly Pines that are probably more than one hundred years old, older Southern Red Oaks and White Oaks and American Beech, and hickory and Sweetgum.

--Drake's Creek Bottoms (Vernon District). A 60-acre riparian forest that follows the floodplain of Drake's Creek. Loblolly Pine, Water Oak, Laurel Oak, White Oak, and American Beech dominate the canopy. The midstory is diverse, but includes young canopy species. The ground layer is dominated by sphagnum moss, sedges, spangle-grasses, and panic grasses. The forest has previously been thinned, as is indicated by stumps and some open canopy gaps. The majority of trees are less than sixty years in age, but older trees are scattered throughout the stand, and the structure is uneven age. The rank is A/AB (Grace and Smith 1995).

Fort Polk Army Reservation,* west-central Louisiana (Vernon County)

At the 67,000-acre property, 1200 acres of Longleaf-bluestem ecosystem that has never been logged. The Army maintains the area by burning. Furthermore, scattered old Longleaf Pine can be found in various stands across the Reservation (Mann 2000). The Reservation is located just north of the Vernon District of the Kitsachie National Forest.

Chenier Plain,* southwestern Louisiana

The Chenier Plain is a complex of uplands, wetlands, and open water, created from Mississippi River sediment that currents in the Gulf of Mexico had pushed westward. Within this ecosystem, the cheniers are themselves wooded, "linear-arrayed ridges," now surrounded by marsh (to the extent that they are in a natural condition). Tree species commonly found include Live Oak, Sugarberry, American Elm, Pecan, and Honey Locust. Buttonbush and Black Willow are common where the cheniers grade into marsh. Since Native Americans came to the area before the cheniers were created, the ridges have always been affected by human activity, but the remnants listed below have been relatively undisrupted since European settlement. All have at least some Live Oak with diameters at breast height of at least one meter.

--Tiger Island (Cameron Parish). Some 740 acres (300 ha) of unlogged forest bisected by a north-south road. The forest interior on the west side of the road, the portion analyzed by Neyland and Meyer, has a mesic-type herbaceous groundcover, unfortunately invaded by the exotic Chinese Tallow (*Sapium sebiferum*). Sugarberry is the most prevalent tree. The forests to the east and to the west of the road have separate private owners.

--Pecan Island (Vermillion Parish). Two hundred and fifty or more acres (100 or more ha) of chenier swamp with many "very big trees." The forest has apparently not been logged. Buttonbush is the most important species. The center and east and west sides are in natural condition. Pasture now edges the south and north sides, but cattle do not seem to be on the chenier itself. Chinese Tallow is present. The chenier is privately owned.

--Grand Chenier 2 (Cameron Parish). Some 74 acres (30 ha) of forest that have been no more than selectively logged. The chenier has retained its original dome-shaped architecture with the forest tapering down to marsh on all edges. The interior has a mesic-type herbaceous groundcover; Live Oak is the most important woody species. Large, old Osage Orange trees are present. They are not native to the parish and may have been introduced by Native Americans. Unfortunately cattle are on the site, and Chinese Tallow has invaded even the interior. The chenier is privately owned (Neyland 1998, Neyland and Meyer 1997).

Sicily Island Hills Wildlife Management Area,* north-central Louisiana (Catahoula Parish)

Possible old growth within a management area of 7505 acres. "The terrain is extremely rugged with high ridges dropping sharply into the creek bottoms" (LDWF 2003). The soil is loess (Faulkner 2003). The predominant tree species on ridges are Loblolly Pine, Shortleaf Pine, and a mixture of hardwoods including White Oak. At the lower elevations trees include beech, magnolia, hickory, Sweetgum, Black Gum, and Water Oak (LDWF 2003). Smith reports that the Wildlife Management Area may support more than 1000 acres of mesic old growth. The area may have had selective logging to remove big pines; but human disturbance has been minimal (Smith 2000). Faulkner thinks that the old growth is less extensive (2003). The Louisiana Department of Wildlife and Fisheries owns and manages the area.

White Kitchen Preserve , in eastern Louisiana (Saint Tammany Parish)

Five hundred and eighty six acres of high quality, mature cypress-tupelo swamp and freshwater marsh, including possible old growth, within the Pearl River basin. Bald Eagles are among the preserve's wildlife. White Kitchen is The Nature Conservancy's first Louisiana preserve. The property links the Bogue Chitto National Wildlife Refuge and the Pearl River Wildlife Management Area. The Pearl, which has no levees, is one of the least disturbed rivers in the South (TNC 1989, Pashley 1989, R. Martin 2000).

Bayou Bodcau, northwestern Louisiana (Bossier Parish)

Approximately 400 acres, including a large area of apparently undisturbed Baldcypress and Planertree. The Nature Conservancy owned the tract, but sold it to the US Army Corps of Engineers under an agreement requiring the Corps to protect it (Pashley 1991, R. Martin 2000).

Louisiana State Arboretum,* south-central Louisiana (Evangeline Parish)

A 300-acre climax upland hardwood forest, which "escaped logging for the most part," because of the steepness of the terrain (Robinson 2000). An analysis of the vegetation in 1994 found that Ironwood (locally known as Blue Beech), Flowering Dogwood, and American Beech were the dominant trees over six feet tall. Giant Cane, Paw Paw, Pignut Hickory, and American Beech were dominant among the shrubs and saplings (Allen 94). American Beech are the most important large trees with individuals as much as 250 years in age and ll.5 to 12.5 feet in circumference (Robinson 2000).

The forest, which is crossed by trails, occupies the entire arboretum, but two buildings have been constructed near the entrance. The arboretum is a part of the 6400-acre Chicot State Park, composed of woods and a 2000-acre man-made lake. Two sides of the arboretum are adjacent to other wooded portions of the park. The two sides away from the park are bordered by a hunting club and a logged area. In the late 1990s a straightline wind tore through the arboretum, felling trees and opening the way for the incursion of pine and Chinese Tallow. Jim Robinson, park spokesperson, notes that the wind came from the northwest, across open land, and believes that the lack of a buffer made possible the heavy damage in the arboretum. The park outside the arboretum was salvage logged. The arboretum is protected, and no salvage logging took place (Robinson 2000). In 2002 the arboretum again was heavily damaged by wind, this time by Hurricane Lilie. Again no salvage logging has taken place in the protected area (Robinson 2003).

Bogue Chitto National Wildlife Refuge* (Tammany Parish)

A 40,000-acre Refuge on the Bogue Chitto River, supporting forest with old-growth characteristics, if not actual old growth. The Refuge is almost completely surrounded by rivers, bayous, and lakes, so timber companies had difficulty in logging. They tended to high grade, cutting out a lot of the big trees. A large part of the refuge was logged in the 1920s but not everything was cut down. Today the Refuge has big cypress, oaks, Sweetgum and ash, apparently spared logging because they were small or oddly shaped. Probably the area looks much as it did 80 years ago. The same complex of species is there although perhaps not in the same percentages, Daniel Breaux, administrative forester says. Today it is "somewhat of a pristine environment" (2003). David White suggested that we contact the Refuge for examples of old-growth bottomlands, as he had heard reports that the Refuge has areas that were spared clearcutting and now are considered to be old growth (2003). However, Breaux did not name any specific sites.

To the north of the Bogue Chitto Refuge is the state's 15,000-acre Old River Wildlife Management Area. To the south is its 20,000-acre Pearl River Wildlife Management Area. The forest is similar to that in the Bogue Chitto Refuge, but the state does more timber management than does the USFWS (Breaux 2003).

Atchafalaya Swamp* (Saint Martin Parish)

Areas of virgin cypress swamp within 700,000 contiguous acres of wetland. In 2000, The Nature Conservancy negotiated a purchase of 3500 acres of wetland reportedly in "great condition," with at least five cypress over five feet in diameter per acre and no stumps. Undoubtedly, the wetland contains a few more such blocks, Rick Martin of The Conservancy reported (Martin 2000). P. Faulkner of Louisiana Natural Heritage is more cautious. The area surely has some small unlogged stands, she says (Faulkner 2003). The land is privately owned and can be reached only by boat (Martin 2000). Through its Atchafalaya Basin Floodway Project, the US Army Corps of Engineers is purchasing 50,000 acres of land in-fee and buying easements on 338,000 additional acres (USACE 1997).

Cat Island,* southern Louisiana, north of Baton Rouge (West Feliciana Parish)

Possible old-growth cypress-tupelo of undetermined extent within nearly 30,000 acres of forested wetland. The 30,000 acres are dominated by cypress, oaks, ash, and elm, and interspersed with several areas of farmland. According to The Nature Conservancy, Cat Island, actually a peninsula and known also as Tunica Swamp, "supports one of the highest known densities of ancient bald cypress in Louisiana" (TNC 2000, Martin 2000). Margaret Devall has cored a number of trees. The longest core that she obtained represented 400 years. The big cypress trees are much older than that, she points out, but are hollow. The rotting may be caused by intermittent wetting and drying, as the land is dry for months at a time and then may be covered with 15-20 feet of water t (Devall 2003).

Cat Island National Wildlife Refuge was established in 2000 with an acquisition boundary of 36,500 acres. The USFWS already owns 6534 acres. The Nature Conservancy owns an additional 3000 acres that USFWS will eventually purchase. Most of the land is still in private hands.

The Refuge is along the Mississippi River and is completely inundated each year when the Mississippi is at flood stage, generally from January to June (USFWS 2003).

Abita Creek Flatwoods Preserve ,* southeastern Louisiana, across Lake Pontchartrain from New Orleans (Saint Tammany Parish)

Within an 834-acre preserve, about 300 acres of bayhead swamp in very good condition. The bayhead swamp, which has suffered only minimal logging, includes trees three or four feet in diameter. The Preserve also has approximately 100 acres of Slash Pine/ Pond Cypress wetland in fair condition. Some large trees were apparently removed from the pine/cypress area, and it has become overgrown with hardwoods due to fire suppression. However, it includes pockets of Pond Cypress trees more than 300 years old. The balance of the preserve, which hosts at least 25 endangered, threatened, or rare plant species, is Longleaf Pine savanna and Longleaf flatwood forest. The preserve is surrounded by heavily managed forest on which suburbs are encroaching. The Nature Conservancy owns and is restoring Abita Creek (Martin 1998).

Persimmon Gulley Preserve ,* in southwestern Louisiana (Calcasieu Parish)

A 255-acre Preserve with wet Longleaf Pine savanna. Because the wetland is highly saline, the Longleaf have an average dbh (diameter at breast height) of only 16 inches, but the savanna exhibits old-growth characteristics, with mixed age classes and some trees over 200 years in age. The site shows no cut stumps and apparently has experienced little logging. Certainly it was never cleared. The Nature Conservancy owns the area. Pine plantations occupy most of the surrounding land (Martin 1998).

Old-Growth Loblolly Stand,* central Louisana (La Salle County)

A 200-acre old-growth Loblolly Pine stand set aside many years ago. It has only had salvage logging. A timber company owns the land (Smith 2000).

Charter Oak Preserve ,* southeastern Louisiana (Saint Tammany Parish)

A 160-acre bayhead swamp along the slopes of the Pearl River. The swamp has no visible signs of disruption. Dominant tree species are Swamp Black Gum up to 35.4 inches (90 cm) dbh, Sweetbay up to 29.9-35.4 inches (76-90 cm) dbh, and Red Maple. In the understory are Redbay, *Cyrilla*, and *Cliftonia*. This preserve is "one of the best representatives of the bay forest type in Louisiana" but the age of the below ground components, a key element in determining whether a forest of this type is old growth, has not been determined (McKevlin 1996).

Faulkner, like some other researchers, does not think that bay can ever be considered to be old growth (2003). The Nature Conservancy owns and manages the Preserve.

Transitional Wetland,* southeastern Louisiana (Saint Tammany Parish)

An old-growth forest of unknown extent, possibly around 100 acres, in the Pearl River basin. The site encompasses a transition between cypress-tupelo swamp and bottomland hardwoods. Trees include Bald Cypress, Water Tupelo, Overcup Oak, Water Hickory, and Sweetgum. From visiting the area, David White is "almost certain" that it has never been logged. Access is by boat only (White 2003).

Zemurray's, southeastern Louisiana (Tangipahoa Parish)

An unlogged forest of 40 to 80 (LNHP 1989) or 86 acres (White 1987). American Beech, Spruce Pine, Southern Magnolia, and Sweetgum dominate. Many trees are more than three feet in diameter, about 150 feet tall, and more than 150 years old. The forest is privately owned (LNHP 1989, White 1987, Martin 2000).

Big Cypress, northwestern Louisiana (Bienville Parish)

A virgin cypress stand within a 326-acre tract. The tract modulates from upland pine forest to cypress swamp in the floodplain of a small creek. Within the swamp are 50 to 100 cypress trees, each from 18 feet to 26 feet around. Individual trees are as old as 1500 years; and the larger trees, hollow. The Office of State Parks owns the stand (LNHP 1989).

Jim Reed Bayou Swamp and Black Bayou Swamp (Ponchatoula Old-Growth Cypress), southeastern Louisiana (Tangipahoa Parish)

Reported to be very old stands of cypress of undetermined acreage. The area is in private hands (LNHP 1989, R. Martin 2000).

Manchac Swamp* (Tangipahoa Parish)

Patches of virgin Baldcypress. The biggest is 5-10 acres in extent. Most of the area is privately owned; but the Joyce Widlife Management Area owns a corner (Smith 2000).

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Stephen Shifley wrote in 2000 that "In Missouri there are about 62,000 acres of forest with some trees that are at least 130 years old. Fewer than 8,000 acres would be considered good examples of relatively undisturbed old-growth forest. Only about 800 acres would be considered excellent examples of old growth" (Shifley 2002b).

Nevertheless, sorting through the available information on Missouri old growth is challenging. Specifying exact acreage for many old-growth sites is impossible given variations in data on the sites. Researchers differ in their definitions of old growth and many sites appear to be a mixture of old growth and second growth, difficult to separate from one another in statistics. For the first edition of this survey, Tim Nigh of the Missouri Department of Conservation (MDC) furnished us with a list of "all known high quality forest tracts" (Nigh 1992). The department's grade "A" meant "relatively stable land undisturbed (e.g. old growth, ungrazed forest, ungrazed prairie with few or no exotic plants and good diversity of conservative species)"; and "B," "late successional or lightly disturbed communities" (Sweet 1989). Michael Leahy, Tim Nigh's successor in MDC, compiled a table of sites for our revision. The table outlines "representative old-growth sites on public lands." "These sites are a mix of old second growth (90-120 years) and old-growth (120+ years) sites with minimal grazing and exotic species influences" (Leahy 2001). Stephen Shifley gave us a list of "upland old-growth forest tracts" in Missouri and Illinois "compiled from state natural areas inventories in 1992." "Minimally disturbed old-growth forest" is Class A; "high-quality old forest" is Class B, and "previously disturbed (mature second-growth forest)" is Class C (Shifley 2000). Given the large number of sites described as old growth by these and other sources, and the fact that the history of many sites is unclear, we present below only a selection of sites that appear to have experienced relatively little disruption.

The state has changed its definitions of forest types since we compiled the first edition of the survey. We have altered our terminology to reflect the shift. According to the new definitions, forests are multistoried, are "dominated by trees," and have a closed canopy "with trees reaching heights of 60-100+ feet." "Woodlands are natural communities with an overstory of trees ranging from 30 to 100% canopy closure with a sparse understory and a ground layer rich in forbs and graminoids." Canopies are from 20-90 feet high. Savanna is "essentially a prairie with scattered, open-grown trees. The ground is covered by a thick stand of warm-season grasses, perennial forbs and sedges" (Leahy 2001). As a result of the new definitions, various sites that were classified as savannas are now classified as woodlands.

As of early 2003, Mark Twain National Forest is managed under a management plan approved in 1986 and since amended twenty-five times. April 16, 2002, USFS announced its intent to prepare an Environmental Impact Statement for revising this plan. Public meetings on the revision began in that year.

Small areas of old growth in Missouri include **Fountain Grove** (Linn County): 35 acres of mostly old-growth wet-mesic bottomland forest, owned by the Missouri Department of Conservation (MDC); **George A. Hamilton Forest** (Lincoln County): 33 acres of "outstanding" dry-mesic forest with White Oak averaging 51 inches dbh (diameter at breast height), large Northern Red Oak, Black Oak, and Shagbark Hickory, owned by the Missouri Department of Natural Resources (MDNR); **Salt River Narrows*** (Monroe County): 14 acres of dry limestone/dolomite forest with old growth and old second growth, "A-B" quality, owned by the US Army Corps of Engineers (USACE); **Buck Mountain Natural Area** (St. Francis County): 13 acres of undisturbed dry, dry-mesic, and xeric igneous forest with Post Oak, Blackjack Oak, and Black Hickory in a 194-acre Natural Area, owned by MDC; and **Hughes Mountain Natural Area** (Washington County): 10 acres with small areas of old-growth Blackjack Oak, Eastern Red-cedar, and Black Hickory that intersect igneous glades, owned by MDC (MDC 1992).

MARK TWAIN NATIONAL FOREST, southern Missouri

The National Forest includes many trees 200 to 300 years old scattered in younger stands and pockets of old trees on relatively inaccessible slopes. Dry woodlands and flatwoods, however, are the two types of areas where extensive old growth may exist (Richards 1993).

The dry woodlands are located in central Missouri and in a swath across southwest Missouri on soil over bedrock at a depth of 20 to 40 inches. They take the form of narrow ridges and southwest aspects on side slopes with scattered trees, mostly Post Oak and Chinquapin Oak. The total of the dry woodlands and of the flatwoods

described below may reach 30,000 acres. Some areas have been harvested; some not. Most of the dry woodlands are overgrown from decades of fire suppression, but the Forest Service has started to restore fire on a landscape scale, and in conjunction with The Nature Conservancy is studying the plants in the dry woodlands and flatwoods (Amelon 1993, Richards 1993). An example of dry woodlands, in the vicinity of the White River, is Hercules Glade Wilderness (Paney County): a 12,314-acre federally designated Wilderness, including treeless glades, with woodlands on the slightly deeper soil around the edges. Prescribed burns have been conducted in the White River region of the National Forest for more than twenty years (Amelon 1993, Richards 1993, Alden 1992, Furness 2001). Two possible old-growth xeric pine and pine-oak woodlands are 15 acres in Kaintuck Hollow (Phelps County) and 50 acres in Paddy Creek Wilderness Area (Texas County) (Murphy and Nowacki 1997).

The flatwoods are primarily in central Missouri and have scattered Post Oak on upland plateaus underlain by fragipan. Little Bluestem and other of the shorter prairie grasses grow here. Many of the Post Oak flatwoods were once old fields (Amelon 1993, Richards 1993).

Caney Mountain Wildlife Area, in south-central Missouri (Ozark County)

Extensive virgin Post Oak woodland within a 6574-acre Wildlife Management Area. The virgin woodland covers "several thousand hectares," according to R. P. Guyette and B. E. Cutter (1991). Area manager Daniel Billings thinks that approximately 60-70% of the area is in glade or woodland, which would mean some 4000 or 4500 acres (1993). The refuge shows some signs of cutting of Shortleaf Pine, White Oak, and Eastern Red-cedar; but most of the woodland was never logged, and many Post Oaks are over 200 years in age. On the outskirts of the woodland are old Eastern Red-cedar, one more than 500 years in age. Due to fire suppression since the 1940s, small trees have overgrown parts of the woodland. Nevertheless, all tree sites have some "grass and herbaceous cover." In the selected segments of the area now burned periodically, many native species are returning. MDC owns the Wildlife Area (Billings 1993, Guyette and Cutter 1991).

Within the woodland is the Caney Mountain Natural Area of more than 1000 acres, including the former Upper Caney Creek Natural Area and White River Bald Glade. The 230 acres of the former Caney Creek Area include dry-mesic old-growth forest on a "steep, rocky, chert-covered, E and N-facing sideslope from near bottoms to near ridgetop." In the Bald Glade are Post Oak on knobs and primarily warm season grasses and forbs (Billings 1993). Leahy attributes 200 acres of old-growth dry-mesic chert woodland and 200 acres of old growth dry chert woodland to Caney Mountain Natural Area (Leahy 2001).

AB Ranch,* central Missouri (Camden County)

An approximately 4900-acre (2000 ha) mosaic of dry woodlands and glades, dominated by White Oak, Post Oak, and Black Oak. Black Hickory and Blackjack Oak are the other species present. The woodland is located for the most part on xeric, south-westerly aspects, and the dry forest on mesic north-easterly aspects. Light grazing by livestock occurred until the early 1970s, but the site has never been logged. It has experienced fire of anthropogenic origin semiannually since settlers arrived. AB Ranch provides habitat for more than 300 native vascular plant species and few exotics (Rebertus and Burns 1997, Leahy 2001).

St. Francois Mountains Natural Area,* southeast Missouri (Iron County)

Three types of old-growth woodland within a 7028-acre Natural Area, which includes parts of seven igneous knobs in the St. Francois Mountains, takes in all of Taum Sauk Mountain State Park and Proffit Mountain Conservation Area, and 80 acres of Johnson's Shut-Ins State Park. Taum Sauk Mountain State Park has 500 acres of dry-mesic igneous woodland with White Oak, Black Oak, and Shortleaf Pine. Elsewhere in the St Francois Mountains Natural Area, are 80 acres of dry-mesic bottomland woodland with White Oak and 500 acres of dry igneous woodland with Post Oak, Blackjack Oak, Black Oak, Scarlet Oak, and Shortleaf Pine. The understory for the last is blueberry (Leahy 2001). The Natural Area is owned by the Department of Natural Resources (MDNR) and MDC.

Mudlick Mountain Natural Area, in Sam A. Baker State Park, southeastern Missouri (Wayne County)

Old growth variously described as a total of 700 acres of old growth (rank "A") on a long slope (Kurz 1990); 300 acres of grade "A" old growth and 400 acres of grade "B" (Shifley 2001); or 1000 acres of old growth of unspecified rank (Leahy 2001). The 700-acre figure has been divided as follows:

--300 acres of dry igneous forest characterized as "old growth climax White Oak aged more than 200 years. Trees stunted and gnarled due to severe growing conditions and natural disturbance. Described as virgin forest" (Nelson 1985). More recently Leahy writes of 500 acres of old-growth dry igneous woodland (2001).

--400 acres of dry-mesic igneous forest characterized as "old growth and mixed age virgin timber" (MDC 1992). Leahy writes of 500 acres of old-growth dry-mesic igneous forest. In this type of forest the dominant trees are Red Oak, White Oak, Black Oak, hickory, and Shortleaf Pine; and the dominant shrub is Flowering Dogwood (Leahy 2001).

Turkey Pen Hollow Natural Area, in Ha Ha Tonka State Park**,** central Missouri (Camden County)

A 967-acre Natural Area with 700 acres of remnant woodland and scattered glades. Post Oak dominates the woodland as a whole; White Oak grows on north-facing slopes. Prairie grasses and other flora are in the ground layer (McCarty 1993, 1998). MDNR has conducted prescribed burns since 1985 with a good response in the herbaceous layer. By 1993 the area struck visitors as "a 'classic' woodland--widely spaced, gnarled trees amongst a grassy understory" (Dorst 1993).

Peter A. Eck Natural Area, along the Piney River, south-central Missouri (Texas County)

A 316-acre tract with up to 230 acres (93.2 ha) of grade "A/B" old-growth and old second-growth dry-mesic chert forest (MDC 1992, Kurz 1990; Murphy and Nowacki 1997). Leahy describes the old growth as 100 acres in extent (2001). The entire area has had some cutting, but not for a long time. The slopes of ravines and forested ridge tops support White Oak, Northern Red Oak, Black Oak, Shortleaf Pine, Black Hickory, Mockernut Hickory, Black Walnut, Eastern Redbud, and dogwood, including trees more than 200 years old. The MDC owns the area (MDC 1992, Kurz 1990; Murphy and Nowacki 1997).

Hawn State Park,* east-central Missouri (Saint Genevieve County)

Within the 5000-acre State Park, some 220 acres of old growth on sandstone bluffs: dry-mesic sandstone forest (40 acres), dry sandstone woodland (100 acres), and dry-mesic sandstone woodland (80 acres). The dry-mesic sandstone forest is composed of Northern Red Oak, White Oak, Black Oak, hickory, and Shortleaf Pine with Flowering Dogwood. The dry sandstone woodland supports Post Oak, Plackjack Oak, Black Oak, Scarlet Oak, and Shortleaf Pine with blueberry. The dry-mesic sandstone woodland has White Oak, Black Oak, and Shortleaf Pine. MDNR owns the site (Leahy 2001).

Meramec Upland Forest Natural Area, in Meramec State Park, east-central Missouri (Franklin County)

Within the 461-acre Natural Area, 150 acres of dry-mesic chert forest and 80 acres of dry-mesic limestone/dolomite woodland (Leahy 2001). Dry chert forest is "mixed oak-hickory, oak-pine, or pine forest," with White Oak, Black Oak, Scarlet Oak, Shortleaf Pine, and Lowbush Blueberry as the dominant plants (Nelson 1985). The Meramec area suffered "tremendous wind damage in 1980" (Kurz 1990).

Hickory Canyons Natural Area, eastern Missouri (Sainte Genevieve County)

Some 190 acres of old growth of "A" quality in three tracts within the larger Natural Area. The site's sandstone hills are "well-dissected," with outcrops, shelter caves, and box canyons (MDC 1992). The area is owned by the private Leo A. Drey Foundation and leased to MDC for management (Kurz 1990). The three tracts are:

--30 acres of dry sandstone forest. The dominant trees are Shortleaf Pine, White Oak, Black Oak, Scarlet Oak, and Post Oak. Murphy and Nowacki list this site as one of the areas “where representative” xeric pine and pine-oak woodland may occur (1997);

--70 (Leahy 2001) or 80 (MDC 1992; Nelson 1995) acres of mesic sandstone forest. Northern Red Oak, White Oak, and Sugar Maple dominate the canopy. Spicebush is present in the understory. This type of forest is very rare, with only a few high-quality tracts remaining;

--80 acres of dry-mesic sandstone forest. White Oak, Northern Red Oak, Black Oak, Shortleaf Pine, and Shagbark Hickory dominate. Flowering Dogwood grows in the understory. The understory and ground cover are well developed (MDC 1992; Nelson 1985; Leahy 2001).

Bennett Springs Savanna, south-central Missouri (Laclede County)

Unlogged dry-mesic chert woodland, 160 acres in extent, within a 995-acre preserve (Churchwell 2002). Underneath an open canopy of old-growth Black Oak, Post Oak, Blackjack Oak, and Black Hickory, such prairie plants as Rattlesnake Master, Lead Plant, and Switch Grass flourish (Ladd 1993). According to a 1991 study by The Nature Conservancy, the site supports 24 tree species, 20 species of sedges, 243 forb species, and 41 grass species (McCarty 1998). The site has burned frequently over the last fifty years--until "very recently" with wildfire. The balance of the preserve is undergoing long-term restoration to return it to high-grade woodland. The preserve is owned by The Nature Conservancy, which manages it jointly with MDNR, and is the site of research into natural communities. A road passes through the 160-acre area (Ladd 1993; Churchwell 2002).

Big Oak Tree Natural Area, in Big Oak Tree State Park, in the southeastern corner of the state (Mississippi County)

Old-growth wet-mesic bottomland forest, ranked "A-B+," covering 160 acres (MDC 1999) within a 940-acre Natural Area. The structure is even aged (MDC 1992), with a tree canopy averaging 120 feet in height and several trees over 140 feet. An 80-acre portion is uncut (Thom and Iffrig 1985). A driveway divides the old growth, and a boardwalk crosses the north center. The balance of the Natural Area is old second growth. MDNR owns the tract (MDC 1992).

The forest is healthy, but is under stress because of changes in hydrology, loss of fire, and an excessive number of deer (due, presumably at least in part, to lack of large predators), all of which cause concerns about regeneration. The water problem is complex. Big Oak is located in a bowl-shaped depression in the New Madrid Floodway. The state owns most of the depression, but agricultural interests own the rest. To help farmers to drain their land quickly in the spring, drainage canals that radiate from the park in all directions have been constructed. They shorten the duration of the periodic floods in the park.

The US Army Corps of Engineers' St. John's Bayou and New Madrid Floodway project would compound the water problem, as it would prevent the entry of floodwater into the park by breaking the connection between the New Madrid Floodway and the Mississippi River. In November 2002, the MDNR denied the Corps of Engineers water quality certification for the project. If this denial holds, MDNR will address the problem of the drainage ditches by installing a low berm to try to prevent them from siphoning off floodwater (McCarty 2002, USACE 2003).

Stegall Mountain Natural Area,* southeastern Missosuri(Shannon County)

Old growth of uncertain extent within the 5500-acre Natural Area. Leahy lists 100 acres of dry igneous woodland and 100 acres of dry-mesic igneous woodland (Leahy 2001). Kramer told us that the old growth is in scattered five-acre pieces (Kramer 2001). The Nature Conservancy, the National Park Service, and the MDC (which owns the land) are cooperating in restoring the Natural Area (McCarty 1998).

McSpadden Tract, southeastern Missouri (Cape Girardeau County)

Old growth and old second growth on a 172-acre tract: "a large hillslope with E-facing bluffs and 2 SE running draws along the Mississippi with outstanding mesic and dry-mesic forest" (rank "A/B") (MDC 1992). The site includes an example of the unusual mesic forest found in deep coves along the Mississippi. This forest type contains species characteristic of the Appalachian Mountains to the east: American Beech, Tulip Tree, American Holly, and Cucumber Tree (Kurz 1990; Nelson 1985). The tract is privately owned (Gremaud 1992).

Big Spring Pines Natural Area,* in Ozark National Scenic Riverways, southeastern Missouri (Carter County)

Within a 345-acre Missouri Natural Area, a 150 acre (MDC 1992, Murphy and Nowacki 1997) or 160-acre (Shifley 1997, Leahy 2001) dry-mesic chert, pine-oak and oak-pine forest along the ridge tops and the upper half of slopes. The tract was selectively logged in 1915 prior to acquisition by the state and again 20-30 years ago. Nevertheless, trees of 250+ years of age "occur throughout the site," and the site has diverse species in most size classes. Dominant canopy species are Shortleaf Pine and Scarlet Oak. Also in the canopy are Black Oak, White Oak, Post Oak, Mockernut Hickory and Black Hickory. Flowering Dogwood and Sassafras are among the varied species in the understory. The National Park Service owns the unit, which is apparently sometimes referred to as "Big Spring Towering Pines"(Griffiths 1992).

Westport Island Natural Area, on the Mississippi River, half-way up the state (Lincoln County)

At least 100 acres of likely old-growth wet and wet-mesic bottomland forest within a 480-acre Natural Area that occupies the southern half of an island in the Mississippi. Leahy gives the 100-acre figure (2001). Shifley writes

of 153 acres of grade "B" old-growth (2001). Meadows and Nowacki list the Natural Area as a place "where representative old-growth eastern riverfront forests may occur" (1996). Greg Gremaud of MDC believes that the trees on the island are short-lived for natural reasons, and that the age of the trees is not an indication of human disruption. Silver Maple, Eastern Cottonwood, American Sycamore, Pin Oak and Pecan dominate in the bottomland forest (Gremaud 1992). USACE owns the site; MDC manages it (Kramer 2002) Increased siltation and large floods have eliminated many oaks (Leahy 2001).

Engelmann Woods Natural Area, in east-central Missouri (Franklin County)

Old-growth forest on loess and weathered dolomite soils within a 145-acre Natural Area. Shifley lists the site as having 135 acres of grade "B" old growth (2000); Leahy, as having a total of 60 acres of old-growth mesic limestone/dolomite forest (2001). Earlier sources divided the old growth into two types:

--41 acres of "high quality, mixed, undisturbed, and old growth" mesic forest with Northern Red Oak, Sugar Maple, American Basswood, and ash on north-facing slopes and ravine bottoms (grade "A-B");

--68 acres of old growth and recovered dry-mesic forest of Chinquapin Oak and Sugar Maple (grade "B").

MDC owns the area, which also has dry upland and wet-mesic bottomland second-growth sections (MDC 1992; Thom and Iffrig 1985).

Alley Spring Hollow,* in Ozark National Scenic Riverways (Shannon County)

Up to 100 acres of old-growth xeric pine-oak forest. The dominant trees are in some places White Oak and pine; in some, mostly White Oak with dogwood; in others, mostly pine. The site is owned by the National Park Service and is to be combined with MDC land to form a Natural Area (Kramer 2002).

Weldon Spring Conservation Area,* near St. Louis (St. Charles County)

More than 90 acres of old growth within a 7200-acre area that was formerly the site of the Weldon Spring Ordnance Works. Within the 385-acre Weldon Spring Hollow Natural Area is old growth described as 80 acres of mesic loess/glacial till forest (Leahy 2001) or 220 acres of grade "B" forest of unspecified type (Shifley 2000). Dominant trees are Northern Red Oak, Sugar Maple, elm, and basswood; the dominant shrub is Pawpaw (Leahy 2001). Outside the Natural Area are 12 acres of grade "A" old growth of unspecified type (Shifley 2000). The MDC owns the Conservation Area.

Dark Hollow Natural Area,* in the Union Ridge Conservation Area, northern Missouri (Sullivan County)

An old-growth oak-hickory forest approximately 80 acres in extent (Rebertus et al. 1997, Leahy 2001) within a 308-acre Natural Area. The Natural Area is within the Union Ridge Conservation Area (Missouri Web). The old growth occupies "a dissected maze of valleys, with elevation changes up to 61 m and slopes ranging from 20 to 70%." The ridges are dominated by White Oaks grown in the open; the drainages support Northern Red Oak, American Basswood, Sugar Maple, and elms, among other species (Rebertus et al. 1997). MDC ranked the forest as A-C, but primarily B with "old selective logging locally, primarily on ridges" (MDC 1992). The Natural Area is owned by MDC (Leahy 2001).

Schnabel Woods Natural Area, in central Missouri (Boone County)

An 80-acre Natural Area of dry-mesic limestone/dolomite forest with loess soils. The ridge tops are oak-hickory, while Sugar Maple, American Basswood, and associated northern hardwoods grow on the side slopes and in the coves and main drainage. According to the State Natural Area nomination form from 1958, about 50 acres are old growth "of high natural quality" (Dorst 1993). More recently Leahy described the old growth as 40 acres (2001). Shifley characterizes Schnabel Woods and the adjacent Eagle Bluffs Conservation Area as together having 65 acres of class "B" old growth (2000). The University of Missouri owns Schnabel Woods, and has registered it with MDC (Thom and Iffrig 1985, Shifley 2000).

Harry S. Truman State Park,* central Missouri (Benton County)

Old growth of uncertain extent within the 1440-acre state park. Leahy lists 80 acres of dry limestone/dolomite woodland (2001). Shifley listed 160 acres of class "B" old growth (2000). The park, which is owned by the Missouri DNR, has towering limestone bluffs overlooking the Harry S. Truman Reservoir.

Cuivre River State Park,* east-central Missouri (Lincoln County)

Sixty acres of old-growth dry-mesic limestone/dolomite woodland with Chinquapin Oak and White Oak in a 6394-acre state park (Leahy 2001). The park includes scenic limestone bluffs. Missouri DNR is the owner.

Fuson Conservation Area,* southern Missouri (Wright County)

Sixty acres of old-growth Post Oak upland flatwoods within the Conservation Area. MDC owns the area (Leahy 2001).

Allred Lake Natural Area,* southeastern Missouri (Butler County)

Sixty acres of old-growth swamp and wet bottomland forest within a 76-acre Natural Area (Leahy 2001). The swamp, 40 acres in extent, surrounds a natural pond that harbors two state-endangered species of fish. Here are found ancient Baldcypress and tupelo trees with a shrub layer of Swamp Rose. The wet bottomland, twenty acres in extent, supports Red Maple, Overcup Oak, Water Hickory and Swamp-privet, among other species. The site is owned by the MDC (Leahy 2001).

Cochran Woods, in Babler State Park, eastern Missouri (St. Louis County)

Fifty-three acres of dry-mesic forest, dominated by White Oak, Northern Red Oak, and Black Walnut, and 16 acres of mesic forest. Both are described as "A-B" quality and as having undergone "some selective cutting." The larger area is, however, also characterized as "essentially undisturbed." MDNR owns the Woods (MDC 1992).

Roaring River Cove Hardwoods Natural Area, in Roaring River State Park, southwestern Missouri (Barry County)

Within a 120-acre Natural Area, a possible 50 acres of old- growth dry-mesic limestone/dolomite forest. In 1992-93 the Natural Features Inventory gave 50 acres a grade of "B" (Dorst 1993), and described at least 25 of those acres as "old second growth" oak (MDC 1992). Shifley et al. chose the Natural Area as one of five Missouri sites to measure for an old-growth study and listed the old-growth tract as the full 120 acres (Shifley 1992, Shifley et al. 1997). Leahy lists 40 acres of old growth with White Oak, Chinquapin Oak, Northern Red Oak and, as the main shrub, Redbud. MDNR owns the site (Leahy 2001).

Pershing State Park,* northern Missouri (Linn County)

Forty acres of old-growth wet-mesic bottom woodland with cottonwood trees within the 3527-acre state park on the Locust River. MDNR owns the park (Leahy 2001).

Quercus Flatwoods Natural Area, in the George O. White State Forest Nursery in south-central Missouri (Texas County)

Within a 48-acre Natural Area, 40 acres of flatwoods oak forest on fragipan soils. Post Oak, more than 200 years old, dominates (Thom and Iffrig 1985), and is accompanied by Black Oak, Blackjack Oak, Black Hickory, and Eastern Red-cedar. Graded "B," the site has both old growth and old second growth (MDC 1992).

Bradyville Natural Area,* southeastern Missouri (Stoddard County)

Old growth within a 139-acre Natural Area, itself within the Otter Slough Wildlife Area. Leahy lists 40 acres of bottomland flatwoods with Pin Oak, Post Oak, and Cherrybark Oak (2001). Shifley lists 139 acres of class “B” old growth (2000). The Natural Area is owned by the MDC.

August A. Busch Memorial Conservation Area,* west of St. Louis in Missouri (St. Charles County)

On Dardanne Creek, within the 7000-acre Conservation Area, possible old-growth eastern riverfront forest. Among the principal species in eastern riverfront forests are River Birch, American Sycamore, Silver Maple, American Elm, Eastern Cottonwood, Swamp Cottonwood, Sweetgum, and Black Willow (Meadows and Nowacki 1996). The Conservation Area is owned by the state of Missouri, which purchased it from the federal government with the help of a gift from Mrs. August Busch. The MDC manages the site. It is adjacent to the Weldon Spring Conservation Area and, like the Weldon Spring Area, was formerly the site of the Weldon Spring Ordnance Works (Weldon 2003).

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OKLAHOMA

In 1993 David Stahle of the University of Arkansas's Tree-Ring Laboratory described Oklahoma, which was not opened for homesteading until 1901, as probably the least disturbed state in the union; and Malcolm Cleaveland, also of the laboratory, reported that old-growth sites in the state are so numerous that finding trees worth coring to determine age is simply a matter of traveling along country roads with one's eyes open. The Cross Timbers landscape is dominated by Post Oak and Blackjack Oak, which tend to grow to only 15 to 40 feet in height, with trunks 10 to 20 inches in diameter. The trees grow on savannas and in woodlands, which represent a western outpost of the eastern deciduous forest. The twisted, gnarled oaks did not furnish marketable timber; but many of those on level ground were cleared to make way for agriculture and often, if not removed, were subject to livestock grazing. Today they are falling to development. Chip mills are also a threat. Nevertheless, Stahle could say in 1993 that "thousands and thousands of acres" remained largely unaltered from their presettlement condition (1993).

Since 1993, the Tree-Ring Laboratory has added substance to Stahle's assessment. The Laboratory developed a predictive model to identify likely areas of ancient Cross Timbers woodland in southern Osage County, Oklahoma, based on the location of steep slopes with poor soils. The researchers found that 27,931 acres (11,308 ha) fitted this criteria. They then examined randomly chosen sites in the field. Seventy-four percent of the acreage surveyed supported ancient Cross Timbers. They thus calculated that 20,390 acres (8,255 ha) in southern Osage County still support ancient Cross Timbers. This acreage includes contiguous tracts of up to 700 acres (Therrell and Stahle 1998).

Alynne Bayard at the Laboratory then worked out a predictive model for eastern Oklahoma as a whole. David Stahle wrote in December of 2001 that Bayard "estimates that at least 162 square miles of ancient Cross Timbers still survive in eastern Oklahoma. But we now realize the real number is more like 500 square miles! Seriously. Probably the largest old-growth forest type left in the eastern USA." Stahle continued that Mike Mangione of the Laboratory finds that seedlings and saplings are growing within the ancient Cross Timbers of eastern Oklahoma and that about 15% of trees over 10 cm dbh (diameter at breast height) are more than 150 years old. The oldest trees that Mangione has located in his random sampling are more than 300 years old.

Alynne Bayard told us that "Nearly all of the study sites sampled as part of the Ancient Cross Timbers Project were located on private land and often straddled more than one ownership boundary. However, there are several state parks, recreational areas, and refuges that no doubt harbor important areas" that we did not sample. She described for us the first two areas listed below in order to indicate the "expanses" of Cross Timbers that remain. She noted, however, that "Of course, there are smaller parcels . . . within these complexes that are significant and representative gems of ancient Cross Timbers as defined by Kuchler" in 1964 (Bayard 2002).

For the Ouachita National Forest we have only one site, forest along a highway in Le Flore County, to add to those presented in our 1993 survey, which were drawn from a 1986 article by Forrest L. Johnson. Susan Hooks, botanist on the Ouachita, told us that the US Forest Service (USFS) has no new information on old-growth sites (2002). The Ozark-Ouachita Highlands Assessment, published in 2000, states that the Assessment's "Terrestrial Team assessed existing and potential stands" on the Ouachita and two other National Forests. However, the text of the Assessment concentrates on potential stands, ie areas with trees at least 100 years old, and does not describe existing old growth. Furthermore, the Team used databases rather than a field inventory. USFS conducts on-the-ground inventories only when the staff enters stands before an action (Logan 2000).

The Land and Resource Management Plan in force for the Ouachita went into effect in 1986. It was appealed, and in 1990 USFS added amendment 5, as a result of which Special Interest Areas were set up. A letter of intent to revise the current plan was released in May 2002. USFS hopes to have a revised plan in place by October 2005.

South Canadian River* (Pittsburg County)

An area of "relatively contiguous" cover of Cross Timbers that probably exceeds 44,000 acres (77 square miles). The University of Arkansas Tree Ring Laboratory selected at random and sampled three sites within the area. Researchers found that all three are completely old growth, but that each had a different species dominance and composition. Two sites were dominated by Post Oak. Of these sites, one site had only Blackjack Oak as codominant,

whereas the other also had Black Hickory, Winged Elm, and Black Oak. The third site was dominated by Blackjack Oak, followed by Post Oak.

The only surveying carried out for most of the 77 square miles has been the interpretation of topographic maps and satellite imagery. Though the area is very large, roads, division among many owners, and land-use activities break it up to some extent. On the other hand, many of the parcels are very remote with little obvious access. Thus their location offers them a certain degree of protection (Bayard 2002).

Conjada and Concharty Mountains,* near Leonard, along the Arkansas River (Wagoner and Tulsa Counties)

An area of up to 25,000 acres (approximately 40 square miles) with large contiguous tracts of Cross Timbers. The area has multiple private owners and includes no significant public lands. The University of Arkansas Tree Ring Laboratory sampled two sites and found them to be on average 95% old growth. Both sites were dominated by Post Oak, with Blackjack Oak as codominant (Bayard 2002).

McCurtain County Wilderness Area, southeastern Oklahoma (McCurtain County)

A 14,000-acre (5700-ha) area of never-logged Shortleaf Pine-mixed hardwoods. Pines dominate south-facing slopes; hardwoods, mostly oak and hickory, north-facing slopes. Overall, the forest is on average 60% pine and 40% hardwoods by basal area. Although the forest has not been logged, exclusion of fire since 1926, and the foraging of domestic and feral pigs have impacted the forest's structure (Kelly et al. 1993). The only signs of disruption in the upland away from the reservoir are some dirt roads and a couple of abandoned cabins once occupied by caretakers (Stahle et al. 1985). The State of Oklahoma purchased the land in 1917, and the Oklahoma Department of Wildlife Conservation has managed it as a game reserve since 1926. The department protects the old growth, and keeps the area closed to the public (Kelly et al. 1993).

Ouachita National Forest, southeastern Oklahoma (LeFlore County)

--Beech Creek Area. An 8000-acre area, including most of Beech Creek watershed, which, like the three areas below, Forrest Johnson describes as "essentially roadless," "relatively undisturbed," and a "good example of presettlement conditions in the Ouachita Mountains." The valley-bottom-floodplain community within Beech Creek has 24 species of trees, none of them dominant. They include Sugar Maple, Bitternut Hickory, Sweetgum, Eastern Hophornbeam, Shumard's Oak, and White Oak.

--Upper Kiamichi Area. An 8800-acre area that includes most of Pine Mountain and a large part of the southern slope of Rich Mountain. Vegetation on southern slopes here and in the other three areas is oak-pine forest, with Shortleaf Pine, Post Oak, Blackjack Oak, Black Oak, and Black Hickory prominent.

--**Rich Mountain Area**. A 5000-acre area comprised of most of the Oklahoma part of the north slope of Rich Mountain. Vegetation on upper and mid-level north-facing slopes here and in the other three areas is dominated by Mockernut Hickory. Carolina Basswood and White Oak are also prominent. The most important species on lower north-facing slopes is Shumard's Oak.

--Black Fork Area. An area of 4400 acres that includes most of the part of Black Fork Mountain in Oklahoma and a portion of Big Creek Valley. The Black Fork Area is adjacent to the Black Fork Wilderness in Arkansas. Ridge top vegetation found in the Blackfork Area and elsewhere in the three sites listed here is dominated by White Oak. On the highest and narrowest ridges atop Black Fork and Rich Mountains, twisted White Oak, Blackjack Oak, Post Oak, and Black Hickory, little more than 9 feet tall, grow amidst grassy openings and a few boulder fields. Forrest Johnson does not point out specific old-growth sites, but at the very least the stunted ridge top vegetation could be expected to be old growth. Given the number of acres that Johnson describes, the Oklahoma portion of Ouachita National Forest would make a substantial contribution to the East's old-growth inventory, even if only a modest proportion of the vegetation were actually undisrupted (Johnson 1986).

--Forest along Highway 1 Scenic Drive* (Le Flore County). Well over a thousand acres of old-growth hardwoods—"noncommercial" Post Oak, Blackjack Oak, with some Northern Red Oak—scattered on the steeper slopes and higher elevations along Highway 1 Scenic Drive, which runs east-west through a section of the Forest. The Highway crosses Winding Stair Mountain (Seay 1995). The scenic route begins in Mena, Arkansas and is also mentioned under that state.

Keystone Ancient Forest Preserve,* northeastern Oklahoma (Osage County).

A new 1100-acre preserve, representative of the Cross Timbers. The tree species on the preserve include Blackjack Oak, Post Oak, Black Oak, Black Hickory, American Ash, and Winged Elm. Many individuals of each species may be at or above the natural longevity for the species. The Tree Ring Laboratory has documented a Post Oak over four hundred years old, and Eastern Red-cedar over five hundred years in age. The preserve supports nine vegetation associations, including forests of Post Oak, Blackjack Oak, and hickory; Red-cedar and Black Oak in rocky ravines, Post Oak savannas, Blackjack Oak barrens, Black Oak slopes, grassy glade openings, and tallgrass prairie. Much of the tallgrass prairie and some of the Post Oak savanna appear to have been directly disrupted by human activity, which took the form of grazing livestock, building roads, and clearing land in connection with exploration for oil. However, there are no other obvious signs of disturbance.

The Cross Timbers Preserve, which is on land that Stahle and his colleagues "discovered" and worked to put into permanent protected status, is owned by the city of Sand Springs. It was purchased from a private owner with funds from the Oklahoma Department of Transportation. The Nature Conservancy has a management agreement with the city and, in 2002, was developing a management plan. The preserve overlooks Keystone Reservoir and is adjacent to a 108-acre tract purchased by the Tulsa Audubon Society to protect the American Bald Eagle and to land owned by the US Army Corps of Engineers (Hollenbeck 2002, Stahle 1995, Stahle et al. 1996).

Wichita Mountains Wildlife Refuge, southwestern Oklahoma (Comanche County)

Old-growth Cross Timbers woodland, within the 60,000-acre Refuge, which President McKinley withheld from settlement in 1901. Originally oak savanna was the dominant community in the Refuge, and areas of scattered old-growth Post Oak can still be found. Heavy grazing and fire suppression, however, encouraged the formation of woodlands of Post Oak, Blackjack Oak, and Eastern Red-cedar among the Refuge's extensive grasslands (Dooley and Collins 1984). James Smith, Refuge Manager, lists the following "old growth woodlots": Mount Marcy (300 acres), Big Bull Pasture (80 acres), Black Bear Mountain (300 acres), West Research Pasture (150 acres), Hollis Canyon (150 acres), Mt Scott Canyon (80 acres), Pennington Tunnel (100 acres), and Quanah Mountain (80 acres) (1993).

Stahle et al. cored trees on a 100-acre site on the east side of Quanah Mountain, and found the Post Oak on the lower slopes to be 200 to 250 years old. The woodlands at the Quanah Mountain location graded into savanna and into occasional cedar and shrubs growing on granite outcrops. The only obvious sign of disturbance at the site was a browse line in the understory due to the Refuge's large number of herbivores (Stahle et al. 1985). Many eastern forests are suffering from over-browsing by deer, since the top predators, like wolves and cougar, have been eliminated or greatly reduced in numbers.

Stahle describes the forest within the Refuge as a whole, as varying from very open, prairie outlier type communities to densely wooded areas (Stahle 1993, Stahle et al. 1985). The Fish and Wildlife Service's Bureau of Sport Fisheries and Wildlife manages the Refuge, parts of which are closed to the public.

Lake Eufaula, southeastern Oklahoma (Pittsburg County)

Scattered sites dominated by small Post Oak on ridges and hills around the reservoir known as Lake Eufala. Stahle et al. cored a privately-owned, 40-acre site, with Post Oak 200 to 250 years in age and around 30 feet tall. The sampled oak were growing on a rocky, south-facing slope (Stahle et al. 1985).

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TEXAS

Eastern Texas has few sites recognized as virgin or even as only lightly and selectively logged. The approximately 600,000 acres of pure Longleaf Pine savanna once found in southeastern Texas have been for the most part converted to pine plantations. Much of the Longleaf Pine savanna that remains suffers from livestock grazing, wildlife management practices, and disruption of natural fire regimes, as described by Bridges and Orzell (1989). Good relict areas of Post Oak savanna are almost impossible to find, according to Fred Smeims. The remnants of Post Oak savanna described in the scientific literature of earlier decades have pretty much disappeared (1993).

On the other hand, Ike McWhorter, East Texas Land Steward of The Nature Conservancy, points out that Texas has many Longleaf stands that are restorable and that with stewardship could become old growth. At The Nature Conservancy's Roy E. Larsen Sandylands Sanctuary, for instance, Longleaf Pine stands that were mostly or entirely cut in the past are beginning "to act as old growth" and to take on the structure of old growth. In Angelina National Forest, Longleaf Pine undergoing prescribed burns could already be mistaken for virgin Longleaf by someone not well acquainted with old growth. McWhorter hopes that people will see the potential to restore forests as well as to preserve the primary forests that remain (McWhorter 1993).

In addition to the areas described below, old growth sites include 15 or 20 acres of Cross Timbers forest, actually overgrown Post Oak savanna, within a 60-acre site at the **Fort Worth Nature Center** (Tarrant County)(Stahle et al. 1985, Stahle 1993, Clark 1993); some 20 acres of old-growth Blackjack Oak-Post Oak-Black Hickory woodlands on a sandhill in the 1582-acre **Purtis Creek State Park*** (Henderson and Van Zandt Counties) (Singhurst 2001); a 5- or 6-acre **Longleaf Pine roadside park**, owned and managed by the state (Sabine County)(Gidlund 1990); 5 to 10 acres of probably uncut beech-magnolia slope forest grading into floodplain forest, in the **Turkey Creek Unit of Big Thicket Preserve** (McWhorter 1993); and 3 or 4 apparently uncut acres of remnant forest including giant Pecan trees, surrounded by prairie, and protected by the city of **Mesquite** (Dallas County)(Moore 1992).

The US Forest Service (USFS) adopted a Revised Land and Resource Management Plan for the National Forests and Grasslands in Texas in 1996. Prior to the revision process, USFS entered into a cooperative agreement with the Texas Natural Heritage Program that provided for a "systematic assessment of natural diversity in the Texas National Forests." The Natural Heritage Program then conducted a three-year inventory, the results of which are presented in a report by Steve Orzell, the principal investigator (Orzell 1990).

Little Sandy Hunting and Fishing Club, northeastern Texas (Wood County)

Thirty-five hundred to 3900 acres of old-growth bottomland hardwoods. Trees are predominantly Sweetgum, Overcup Oak, Willow Oak, and Water Oak. Club records go back only to the l890s, since which time the area has not been cut. There are no stumps or other obvious signs of earlier logging, and the area is replete with snags and downed trees. The Hunting Club, which owns the land, has given an easement to the US Fish and Wildlife Service (USFWS). The easement prohibits timber harvest unless both parties agree to it. The land was the subject of a suit against FWS, because its preservation prevented construction of a reservoir (Neal 1992, 2003).

Balcones Canyonlands National Wildlife Refuge,* northeast of Austin (Travis County)

One thousand to two thousand acres of old-growth Ashe Juniper woodland within the 80,000-acre acquisition boundary of the Wildlife Refuge. As of February 2003, the Refuge occupied 19,500 acres, of which 10,500 were Ashe Juniper woodland. The staff is protecting all existing old growth, allowing thousands of additional acres to become old growth, and eliminating young Ashe Juniper on hundreds of other acres where it has grown up due to fire suppression and where its elimination will recreate grasslands and specialized habitats like those needed by the Black-capped Vireo. The Golden-cheeked Warbler is dependent on old-growth or old second-growth juniper-oak woodland—-trees at least five meters tall and at least 35-50 years old. Black-capped Vireos, on the other hand, need scrub oak brushland, a fire successional habitat, and do not like young juniper woodland (Sexton 2003).

Gus Engeling Wildlife Management Area, east-central Texas (Anderson County)

About 2200 acres of potential old-growth Post Oak savanna on rolling, sandy hills within the 11,000-acre Wildlife Management Area (Singhurst 2001). The land was "not extensively cleared" (TPWD 2003). The savanna

was grazed from 1901-1942, but the grazing had the positive result of helping to replace the fires that had kept the area open and were by then being suppressed. Prescribed burning every 3 years began in 1950. Savannas were approximately 60% of the site before European settlement. Today about 45% of the site is in sandhill openings. The missing 15% of savanna has been lost to groves of hardwoods, intermixed with the savanna. Tree species in the savanna are Post Oak, Blackjack Oak, Bluejack Oak, and hickories. In the groundlayer are bluestem grasses, forbs, and herbaceous legumes (Singhurst 2001).

Longhorn Army Ammunition Plant, northeastern Texas (Harrison County)

Along Harrison Bayou, 960 acres of "mature hardwood species that were typical of southern bottomland during settlement" (Delk 1993). The water level along the bayou has changed drastically, as the result of flooding caused by a logjam; the subsequent dynamiting of the logjam; and finally the construction of a weir. As a result, the old-growth community, although never logged, is only 100 years old (Neal 2003).

The ammunition plant is no longer operating and the land has been designated as Caddo Lake National Wildlife Refuge. However, the US Fish and Wildlife Service has only secondary jurisdiction over the site at present. Harrison Bayou and other portions of the plant are contaminated from past activities. The Service will not accept primary jurisdiction until the contamination has been cleaned up. Remediation is underway. Meanwhile, the site belongs to the military, and the refuge is an "overlay refuge" (Neal 2003).

Lennox Woods , northeastern Texas (Red River County)

Up to 875 acres of upland and bottomland old growth within a 1400-acre preserve. The preserve is in two tracts: the original 366-acre area and a 1000-acre area on Pecan Bayou. The 366 acres have never been logged, as far as is known. They are comprised of some 140 acres of Shortleaf Pine-oak upland forest and some 226 acres of bottomland hardwoods. The 1000-acre tract has 500 acres of bottomland hardwoods, of which 300 acres are probably old growth. If the 300 acres were cut, they were cut lightly, The Nature Conservancy reports (Eidson 2003). The preserve, which is owned by The Nature Conservancy, is home to Arkansas Meadow Rue, an Endangered species, and to Wildenovi's Sedge, rare in Texas. The Texas Natural Heritage Program ranked the original tract as "A" (Sullivan 1993, TNC 1988, TPWD 2003).

Santa Marie Tract, in the Lower Rio Grande National Wildlife Refuge, southern Texas (Hidalgo County)

Four hundred twenty-two acres of bottomland hardwoods that Michael Bornstein, Wildlife Biologist at the Refuge, is "80-90% confident" have not been disrupted by non-Indians. The tract, which is owned by the US Fish and Wildlife Service, was purchased from the World Wildlife Fund in 1976. It is dominated by Sugarberry and Rio Grande Ash. Cedar Elm and Anacua are among the other species present. The Rio Grande Ash and Anacua cannot be seen elsewhere in southern Texas. The refuge is on the periphery of the ranges of many Central American bird species. Thus many birds rare to the US come through. Also it provides habitat for the Ocelot and Jaguarundi, both Endangered species. The Refuge is closed to the public (Bornstein 1990).

Bull Creek , central Texas (Travis County)

Several hundred acres of Texas Oak-Ashe Juniper woods that may be old growth. The acreage is found near two forks of Bull Creek, between which is a subdivision (Diamond 1993 and 1997, Sullivan 1993). Texas Parks and Wildlife graded the occurrence "B" (TPWD 1998).

SABINE NATIONAL FOREST, in eastern Texas

--Mill Creek Cove Research Natural Area (Sabine County). A 225-acre beech-magnolia forest without evidence of logging. The area is comprised of two peninsulas of old-growth beech-magnolia on the western shore of Toledo Bend Reservoir (USFS 1996a, USFS 1996c).

McWhorter told us of additional ravines with beech-magnolia forest that has never been cut because of the slope. Acreage of each of these forests is much smaller than that of Mill Cove (1993). Rob Evans of the National Forests in Texas mentioned an old-growth slope forest in a drainage. This site has fewer beech and magnolia trees but more rare species in the understory than has Mill Creek (1993).

B. R. MacRoberts and M. H. MacRoberts later studied systematically what they termed beech-hardwood forest (both American Beech-White Oak and American Beech-Southern Magnolia forest) on the Sabine National

Forest. They found that many of the "deepest and steepest ravines" "may never have been logged." The highest quality ravines occur in a band running from the northwest to the southeast of the forest (1997).

--Beech Ravines Scenic Area,* Tenaha District (Sabine County). On 827 acres within a 1020-acre Scenic Area, a series of "deep cut, north and east facing, steep-sided ravines" with "mature hardwood ravine forests (Grade A-B)." Sweetgum, Black Gum, Water Oak, and American Beech dominate the canopy. Chalk Maple predominates in the understory. On the narrow ravine bottoms and slopes is a rich spring-flowering herbaceous layer. The uplands have mature second-growth mixed pine-hardwood forests (Orzell 1990). USFS classifies the Scenic Area as unsuitable for timber management (USFS 1996b).

--Stark Tract Natural Heritage Area,* Yellow Pine District (Newton and Sabine Counties). A 448-acre area composed of diverse communities, some of them Grade A (relatively stable or undisturbed). Longleaf Pine has been logged on some sandhills but "exceptional" stunted hardwood woodlands remain on deep ridge deposits. Bluejack Oak, Post Oak, and Blackjack Oak dominate the woodlands. "Significant undisturbed dry mixed pine-hardwood and dry-mesic hardwood forest" are found on the upper slopes of ravines. The southern end of the tract includes "high quality (grade A) dry upland longleaf pine savannas," which harbor many relic Longleaf Pines (Orzell 1990). Natural Heritage Areas, including the Stark Tract, are outside the timber base (USFS 1996b).

--Matlock Hills Natural Heritage Area,* Tenaha District (Sabine County). A 215-acre area containing "A-B" examples of "mesic ravine forest, sandhill woodland, acid seeps on forested valley slopes, and acid spring branches." The overstory of the mesic forests is dominated by White Oak, Southern Red Oak, White Ash, Black Gum, and Bitternut Hickory. Eastern Hophornbeam and Chalk Maple are common in the understory. Xeric hardwoods dominate the sandy ridgetops and upper slopes as a result of past logging (Orzell 1990).

--Upper Colorow Creek Scenic Area, Tenaha District (Sabine County). Within a 230-acre Scenic Area, 128 acres of "relatively undisturbed mesic slope forests (Grade A-B), mesic ravine forests, and wet rock outcrops." The mesic forests support "an exceptional assemblage of northern and eastern forest flora disjunct to southeastern Texas," including Toothwort (*Dentaria laciniata*), Bloodroot (*Sanguinaria canadensis*), and Perfoliate Bellwort (*Uvularia perfoliata*) (Orzell 1990). Also in the Scenic Area are upland hardwood and pine, apparently not old growth. With the 1996 forest management plan, management was to become that of a Botanical Area rather than of a Scenic Area (USFS 1996b). Like Beech Ravines Scenic Area, Upper Colorow Creek is classified as unsuitable for logging (USFS 1996c). A USFS review team recommended 360 acres at Upper Colorow Creek for RNA status (USFS 1996a).

ANGELINA NATIONAL FOREST, in eastern Texas

--Upland Island Wilderness Area* (Graham Creek Wilderness Area), Angelina District (Angelina and Jasper Counties). A 3172-acre Wilderness Area with extensive park-like stands of Longleaf. "Most of the longleaf pine is second growth, averaging 40-70 years," but there are "remnant older growth stands (90+ years old)" (Orzell 1990, p. 417). The Wilderness Area includes Graham Creek Bottoms (542 acres), "noteworthy for its undisturbed mature hardwood bottomland forest which is of high quality (Grade B)" (Orzell 1990, p. 291)

--Longleaf Ridge Special Area, Angelina District (Angelina and Jasper Counties). Approximately 32,000 acres (Record of Decision, p. 10) between Sam Rayburn Reservoir and the Neches River and adjacent to the Upland Island Wilderness Area. The principal vegetation is Texas Natural Heritage Program's Longleaf Pine-Little Bluestem Series" (USFS 1996a). The area was "established primarily for special enhancement of the westernmost example of longleaf pine communities and species such as the " Red-cockaded Woodpecker. It is subject to prescribed burns, where appropriate, but as a whole is not protected from logging (USFS 1996c).

----*Boykin Spring Longleaf* (Angelina and Jasper Counties). Approximately 90 acres of old-growth Longleaf Pine within a 380-acre area recommended by Texas Parks and Wildlife and a USFS review committee for a Research Natural Area (RNA). The herbaceous layer has "near climax composition," and the 380 acres, which include seepage bogs and pockets of deep sand, support more than 170 herb species (Diamond 1993, Sullivan 1989). According to USFS comments on the proposed RNA, "the area was commercially thinned about 20 years ago. The effects of this are not apparent at this time [1996]" (USFS 1996a). It is not clear whether the entire 380 acres were thinned or just the part not said to be old growth. Diamond spoke of "patches" of old growth in Boykin Spring Longleaf (1995).

According to Evans, Longleaf Pine is in quite good condition on the extensive Longleaf Ridge Special Area. Patches of Slash Pine have been planted, but in the interior are naturally pure stands of Longleaf Pine, including areas of old trees (1993). Orzell recommended that the 233 acres immediately around Boykin Spring, called Boykin Annex, be evaluated for inclusion with Boykin Spring Longleaf as an RNA (Orzell 1990).

----*McGee Bend**** (Jasper County). "Old-growth bottomland hardwoods, with areas of pine and hardwood mixtures; several bald cypress sloughs" within a 400-acre area (USFS 1996a). Orzell wrote of 60 acres of mature to old-growth mesic hardwood slope forest and an abandoned slough with a canopy of old-growth bald cypress (1990 p. 319). A USFS review team recommended that the hardwoods become an RNA. McGee Bend is on the Angelina River (USFS 1996a).

----*Shearwood Creek Natural Heritage Area** (Angelina and Jasper Counties). A 1442-acre area with diverse communities, some of them apparently old growth. The area includes extensive dry upland Longleaf Pine savanna (Grade B) in which some of the "old-growth stands" are comparable to those at Boykin Spring Longleaf site. One of the xeric sandhills (Grade A-B) is the largest Longleaf-Bluejack Oak sandhill "with old-growth relic trees" in the Angelina and supports more than 50 native sandhill forbs. An "outstanding (Grade A), old-growth, 22 acre, possibly virgin baygall community" is located along Shearwood Creek (Orzell 1990).

----*Rocky Branch Barrens*,* Angelina District (Jasper County). A 73-acre "high quality (Grade A) example of a Catahoula Formation barrens-woodland community type." Post Oak dominates woodlands that surround a prairie-like barrens. In the understory of the woodlands are Farkleberry, Yaupon, and Parsley Hawthorn. Long-leaf Spikegrass (*Chasmanthium sessiliflorum*) is the main herb in the woodlands (Orzell 1990, p. 356). The barrens is within the Catahoula Barrens. Two other barrens within Catahoula Barrens, Black Branch and Buck Branch, were graded "B" by Orzell (Orzell 1990); (USFS 1996a).

Emmaus Retreat, central Texas (Travis County)

One hundred to two hundred acres of low, dense, Ashe Juniper-oak forest that may be old growth. The woodland lies on the steep slopes and uplands of a single canyon on the south side of the Colorado River (Diamond 1993 and 1997, Sullivan 1993).k

Davis Hill State Park,* eastern Texas (Liberty County)

A 3000-acre State Park with possible old growth of undetermined acreage. The old growth would be a stream bottom community associated with a salt dome (Neal 2003).

The Deep Bottom,* northeastern Texas (Denton County)

A 230-acre forest described as "transitional old growth." Some stands within the forest are classic old growth; the rest are old, but lack large trees as a result of high grading, the only logging since the arrival of Europeans. Hackberry, Cedar Elm, and Green Ash predominate in respect to basal area, density, and frequency. Many trees are 150-200 years in age and more than 3 feet across. Unfortunately the creation of "Lake" Ray Roberts upstream in 1987 put an end to cyclical flooding. The Hackberry, elm, and ash are still replacing themselves, but the presence of Bur Oak and Black Walnut in the forest suggest that the water table is changing and that eventually the composition of the forest may change. The forest is owned by the US Army Corps of Engineers, which bought the land as a flood easement. The Corps has given the City of Denton a long-term lease on the property; Texas Parks and Wildlife manages it for recreational use only (Barry and Kroll 1999).

Garner State Park,* south-central Texas (Uvalde County)

Extensive old-growth Ashe Juniper-oak woodland within the 1420-acre State Park. Ranked "AB" (TPWD 1998), the old growth covers both sides of a big ridge. The Frio River, with Baldcypress and sycamore trees alongside it, flows through the park (Carr 2001).

Lost Maples State Natural Area,* northwest of San Antonio (Bandera and Real Counties)

Old-growth Ashe Juniper woodlands (Diamond 1997, Carr 1998) and little logged hardwoods (Carr 1998, Heideman 2003) within the 2174-acre Natural Area. The Ashe Juniper is on the dryer uplands, of which a major portion has been logged. The hardwoods, Uvalde Bigtooth Maple, Live Oak, other oaks, and cherry are mostly along the bottom and lower slopes of the Natural Area's canyons, where only patches of forest may have been logged. The park is very rugged with steep canyon slopes, and hills, and cliffs (Heideman 2003).

Coleto Creek, southeastern Texas (Goliad County)

As of 1983, 120 acres of "relatively undisturbed" Post Oak savanna on property owned by the Central Power and Light Company of Corpus Christi. Along with Post Oak and native grasses were Blackjack Oak, Yaupon, Live

Oak, and mesquite, among other species. The mature and old Post Oak on 70 acres of the tract were 250 to 300 years old and 18 to 30 feet tall. A powerline corridor cut through the site, and a reservoir and dirt roads bounded it on the east and west sides. Nevertheless, the University of Arkansas Tree-Ring Laboratory, which determined the age of the trees, believed that there were probably additional old-growth stands in the vicinity. (Stahle et al. 1985, Stahle 1993, Sullivan 1993, Allen 1993).

Texas has many additional Post Oak savanna sites in varying condition. Most of those in which the University of Arkansas Tree-Ring Laboratory has dated trees are less than 40 acres in size (Stahle 1993).

Cedar Creek Islands Wildlife Management Area,* northeastern Texas (Henderson County and Kaufman County)

One hundred and ten acres of likely old growth on the 144-acre Big Island (Kaufman County) within the Wildlife Management Area. Shumard Oak, Post Oak, and Blackjack Oak are among the trees. May Apple (*Podophyllum peltatum*) and Trout Lily (*Erythronium albidum*) bloom in the herbaceous layer. No exotics are present. Singhurst does not believe that the 110 acres have experienced any logging (2001). Big Island is the largest of three islands in Cedar Creek Reservoir/Lake, which comprise the Management Area. At one time Big Island was a terrace on a river.

Pedernales Falls State Park,* west of Austin (Blanco County)

Old-growth Ashe Juniper-oak woodland and possible old-growth Texas Oak-Chinquapin Oak woodland within the 5212-acre park. The Ashe-Juniper-oak woodland, located on upland terraces with sinkholes, is about 100 acres in extent (Carr 1998, Singhurst 2001). Diamond describes it as a representative Ashe Juniper old-growth site (1997), but the Texas Parks and Wildlife Department gives it a "B" grade (TPWD 1998). On the other hand, the Texas Parks and Wildlife Department gives an "A" grade to the band of Texas Oak series vegetation, on slopes along the Pedernales River (TPWD 1998). The band is some 100 to 120 feet wide and perhaps half a mile long and includes an endemic mock-orange (Singhurst 2001).

Fort Parker State Park,* east-central Texas (Limestone County)

On a bluff within the 1458-acre park, possible old growth with Shumard Oak, and Bur Oak. As far as Singhurst can determine, the forest has never been disturbed. The land is in a location that could never have been plowed, and the trees are very mature (Singhurst 2001). The park manager agrees that plowing could not have taken place, but he thinks that there is no way to know whether the site is actually old growth. He puts the acreage at between 20 and 110 acres (Fisher 2003).

Atlanta State Park,* northeastern Texas (Cass County)

About 80 acres of unlogged pine-oak forest on bluffs overlooking Wright Patman "Lake," formed by Wright Patman Dam. Within a matrix of Shortleaf Pine and White Oak are Sugar Maple, Red Maple, and Paw Paw, among other species. A significant herbaceous layer includes lady slippers, orchids, and Solomon's Seal. Atlanta State Park is 1475 acres in size (Singhurst 2001, Berry 2003).

Cooper Lake State Park's South Sulphur Unit,* northeastern Texas (Hopkins County)

Within the 3210-acre South Sulphur Unit of the State Park, possible old growth as a Shagbark Hickory-Shumard Oak slope community and also bluff terrace (Singhurst 2001). The park is at the juncture of tall grass prairie and Post Oak savanna.

Guadalupe River State Park and **Honey Creek Ranch State Natural Area**,* just north of San Antonio (Comal County)

Old-growth Ashe Juniper woodland within the 1940-acre State Park and the adjacent Natural Area (Diamond 1997). A stand with 45 acres in the Park but extending from the Park onto private property is "B" grade. It is on a gentle, dry rocky limestone slope (TPWD 1998). Approximately another 5 acres of old growth Ashe Juniper woodland is in small scattered stands (Singhurst 2001). Much of the Park has been cleared of juniper in order to restore savanna (Carr 1998).

Spring Creek Forest Preserve, northeastern Texas
(Dallas County)

Three 8- to 10-acre little-disturbed areas of prime oak-hickory bottomland within a 185-acre preserve. The balance of the tract, which extends some 2 miles along Spring Creek, is regenerating. All of the prime areas have had "very little cutting." One was only grazed by livestock in the hottest and driest time of the year. The others were grazed a little more, and had some open gravel pits. The dominant trees in the preserve are ash, elm, Pecan, Sugarberry, Shumard Oak, and Chinquapin Oak. The regenerating areas have the same species as the prime areas, but elm and ash are more prominent outside the prime areas. The city owns part of the preserve; Dallas County, part. They have acquired the preserve little by little since 1980 and now have 30 acres left to buy to make the whole contiguous (Frey 1993 and 2003, Nixon 1991).

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Northern Midwest

ILLINOIS

D. W. Larson et al. have identified ancient cliff forests on at least two sites in Illinois: **Mississippi Palisades State Park*** (Carroll County): cliffs along the Mississippi River in a 2500-acre park; **Apple River Canyon State Park*** (Jo Daviess County): cliffs above the Apple River in a 297-acre park (2000).

In addition to the areas described below, old-growth or virtual old-growth sites include **Julius J. Knobeloch Woods Nature Preserve** , formerly Hazel Creek Woods (St. Clair County): 25 acres of dry mesic upland and 9.5 acres of wet floodplain, lightly logged and grazed, owned by IDOC (Hutchison 1993, IDOC 1991); **Myer Woods State Nature Preserve** (Bureau County): 20 acres of dry-mesic old growth owned by Princeton Park District (IDOC 1991); **Elburn Forest Preserve*** (Kane County): 34 acres of old- and mature second-growth dry mesic forest within a 57-acre Preserve (Kirk 2003); **Kane Kaskasia Woods Ecological Area** (Hardin County): 24 acres of mesic/dry-mesic upland forest within a US Forest Service experimental forest (Stritch 1993); and **Nettie Hart Memorial Forest** (Champaign County): 16 acres of woodland grading from floodplain bottomland to dry upland, owned by the University of Illinois (Edgington 1993).

Barton-Sommer's Woodland* (Mason County), a dedicated State Nature Preserve, supports huge Bur Oaks and sycamores, plus old Black Walnut and Swamp White Oak. It has several old-growth characteristics; but it cannot be considered to be true old growth, because fire suppression has transformed it from a savanna into a woodland. In this way, it is similar to many other sites in the Midwest. At Barton-Sommer's, biologists from the Illinois Department of Natural Resources are reintroducing fire (Lerczak 1998).

Another example of an area changed by fire suppression is **Baber Woods State Nature Preserve**s (Edgar County), a 59-acre preserve owned by The Nature Conservancy. The Baber family began to purchase the woods in 1835 and had bought the area by 1894. They did not graze it, but cut wood for their own use, and cleared three acres for two cabins in a corner. The Conservancy leases the preserve to Eastern Illinois University, which conducts research there. Since fire suppression began in the mid-nineteenth century the composition of the area has changed. It was probably a closed savanna dominated by large White Oak. Today it is a closed mesic forest, in which Sugar Maple is becoming dominant (Ebinger 1992, IDOC 1991).

The US Forest Service (USFS) issued the notice of intent to revise the management plan of Shawnee National Forest in March 2002 (Johnson 2002).

Cache River Project, in southern Illinois (Johnson, Massac, Union, Alexander, and Pulaski Counties)

Selectively cut old forest stands in a protected area projected to encompass 60,000 acres. As of 2002, the project was 32,000 acres in size. The acres owned are in three sections: the 3200-acre Lower Cache River State Natural Area of which approximately half is mature to old growth; Little Black Slough with approximately 4000 acres of mature to old-growth forest; and the Cypress Creek National Wildlife Refuge with 500 acres of old-growth forest. In the contiguous bottomland forests and swamps of the Lower Cache are "stands of huge old bald cypress and tupelo trees." Locally dominant and important members of plant communities include Black Willow, Overcup Oak, Pin Oak, River Birch, Swamp Cottonwood, Sugar Maple, and Red Maple. Vegetation in the Little Black Slough, which includes the 1861-acre Heron Pond-Little Black Slough State Nature Preserve, is similar to that of the Lower Cache. Of the 32,000 acres, 14,000 are owned by the Illinois Department of Natural Resources, 15,000 by the US Fish and Wildlife Service, and 3000 by The Nature Conservancy (Hutchison 1989, 1993; Jones 2002).

Sielbeck State Land and Water Reserve*, southern Illinois (Massac County)

A 385-acre tract with 125 acres of high-quality old growth, which constitutes a state Natural Area (Guetersloh 2002). At the north end of the Natural Area is a cypress-tupelo swamp. However, most of the old growth is oak and hickory, wet, floodplain forest with a lot of Cherrybark Oak and Shellbark Hickory, some Pin Oak, and a mixture of other species. At the south end, where the land is slightly drier, ashes and maples grow. The Sielbeck family, who owned the old growth for more than a hundred years as part of a 418-acre tract, cut a few trees; but essentially the forest is undisturbed (Hutchison 1998, Nature Conservancy 1998). The status of Land and Water Reserve offers almost the same protection as that of state Nature Reserve, but some uses like hunting are allowed (Guetersloh 2002).

The Nature Conservancy bought what is now the reserve in a sealed-bid auction after the death of its previous owner. The Conservancy bid unsuccessfully on an old-growth tract a mile distant, the 40-acre Sielbeck Q Ditch, which has since been logged. The Conservancy turned over the land that it acquired to the Illinois Department of Natural Resources.

The Sielbeck lands are on the edge of what was once known as the Big Black Slough. Almost all of the slough has now been drained and cleared for farmland (Hutchison 1998, Nature Conservancy 1998).

Shawnee National Forest, southeastern and southwestern Illinois (Jackson, Union, Pulaski, Johnson, Pope, Hardin, Massac, Williamson, Saline, and Gallatin Counties)

--**Post Oak/Blackjack Oak**. An estimated 2800 unlogged acres of Post Oak/Blackjack Oak on very dry, upland sites throughout the forest. The trees, which usually occur in bands on ridge tops and in association with glades, have been cored at 400 to 450 years in age. Many of the oaks are gnarled and stunted. Eastern Red-cedar may be mixed with the Post Oak/Blackjack Oak. Eastern Red-cedar is more often alone, on escarpments and in glades, but the total acreage of Red-cedar sites is "negligible." The Forest Service does not cut its Post Oak/Blackjack Oak or Red-cedar. but private landholders may have taken Red-cedar for fence posts, because of its strength. Three sites that include Post Oak/Blackjack Oak are among those described below (Shimp 1993, Stritch 1993). No logging of hardwoods has taken place in the Shawnee in more than ten years (Moore 2003).

--**Cave Hill Research Natural Area** (Saline County). A 465-acre RNA composed of old-growth and old second-growth stands. These include Post Oak/Blackjack Oak stands and Chestnut Oak stands. The state of Illinois lists Chestnut Oak as a threatened species, and the US Forest Service, under the Shawnee Forest Plan, considers it a "forest-listed species." In Illinois this oak is at the western extent of its range.

--**Dennison Hollow Research Natural Area** (Saline County). A 205-acre RNA similar to Cave Hill in respect to old growth. Together, Cave Hill and Dennison Hollow support the finest examples in Illinois of old-growth Chestnut Oak.

--**Big Brushy Ridge Ecological Area** (Alexander County). A 150-acre area with "excellent old-growth dry-upland forest" dominated by Chestnut Oak, White Oak, Black Oak, and Pignut Hickory.

--**Provo Cemetery Ecological Area** (Alexander County). A 50-acre area with old-growth dry-upland forest, similar to that at Big Brushy Ridge.

--**LaRue Pine Hills/Otter Pond Research Natural Area** (Union County). A 2811-acre RNA that includes small hollows with old growth, which may have experienced minor selective logging a long time ago. Tulip Tree and Schumard's Oak are nearly three feet in dbh and are 100 feet tall. McCann Springs is an example of such a hollow at LaRue (Stritch 1993).

--**Crow Knob** (Pope County). A 15-acre Eastern Red-cedar-Post Oak-Blackjack Oak community (Shimp 1993).

--**Martha's Woods State Ecological Area**, Lusk Creek Wilderness (Pope County). A Natural Area containing 6 to 10 acres of lowland and mesic upland forest believed never to have been logged, although the forest has experienced wind damage. The area includes huge American Beech, Sugar Maple, and Red Oak (Shimp 1993, Widowski 1993, Johnson 2002).

Allerton Park, in central Illinois (Piatt County)

Within a 1500-acre park, 470 acres of old growth and old second growth, including a 34-acre, essentially virgin natural area. The old growth is comprised of oak-hickory upland, and of bottomland with American Sycamore, Silver Maple, Bur Oak, cottonwood, and a few American Elm, among other species. The 470 acres have been only lightly and selectively logged. The park, which the University of Illinois acquired in 1946, contains additional forest that has been more heavily cut (Szafoni 1992 and 1993, Boggess and Geiss 1967).

The essentially virgin Allerton Park Natural Area, established in 1963, is in the oak-hickory upland and represents upland forest along a stream. The climax oak-hickory community is reproducing and maintaining itself quite well (Edgington 1993).

Beall Woods Nature Preserve and State Park, in southeastern Illinois (Wabash County)

Two hundred and seventy acres of little disturbed old growth, part of a 329-acre tract owned by the Illinois Department of Natural Resources. The forest occupies a variety of land types, from well drained, rolling uplands to low areas subject to frequent flooding and standing water. Trees include six species of hickory and eleven of oak. Trails wind through the tract. The Illinois Department of Natural Resources has planted native hardwood species on former farmland around the forest to provide a buffer (IDOC 1991, IDOC 1989). An overabundance of deer is preventing regeneration. Such steps as controlled hunting are being used to try to solve this problem (Lindsay 2002).

Funk's Grove, central Illinois (McLean County)

An 845-acre site with a mosaic of different forest types. Three hundred and forty acres are "very high quality, almost undisturbed" forest. Some of the remaining acres have been logged; some disturbed by Dutch elm disease, some by natural causes (Szafoni 1993). All wooded, the acreage represents a classic prairie grove. The Funk family owned the grove for more than 150 years. Today it has a variety of owners, including the Funk family, the Illinois Department of Natural Resources, the University of Illinois, and The Parklands Foundation.

In the hands of the Department of Natural Resources are 18.6 acres of mesic upland and floodplain forest, which constitute the Funk's Grove Nature Preserve (Lerczak 2002). The dominant trees of the preserve are White Oak and Sugar Maple in the upland acres and Sugar Maple, American Basswood, and Hackberry in the floodplain. Sugar Maple is increasing in importance, as American Elm and old oaks die (McClain 1990, IDOC 1991).

The University of Illinois has owned 60-acre Funk Forest, on the edge of the Grove, since 1950. Funk Forest is transitional, with characteristics of the prairie grove and of upland stream-side forest (Edgington 1993).

Jackson Slough Woods, southeastern Illinois (St. Clair County)

Wet bottomland forest, wet-mesic bottomland forest, and southern flatwoods composing a 181-acre old-growth tract, part of which is owned by the Illinois Department of Conservation (IDOC) and part by The Nature Conservancy. A perennial stream crosses the area. Trees and shrubs include American Sycamore, White Oak, Shingle Oak, Swamp White Oak, Black Cherry, Post Oak, Pawpaw, Eastern Redbud, and Hackberry (Hutchison 1993). Jackson Slough Woods is part of Kaskaskia Forest, which lies along the Kaskaskia River. It is the largest contiguous bottomland forest in Illinois; but most of it was logged, a small road dissects it, and only small areas of old-growth remain (Schwegman 1993).

Spitler Woods State Natural Area, in central Illinois (Macon County)

A 220-acre Natural Area with 164 acres of oak-walnut-hickory forest that has experienced virtually no logging. McFall described the site as one of the largest areas of old-growth forest remaining in central Illinois (1991). Roads and houses (but also some wooded ravines) surround the area. Two small waterfed ravines traverse moderately hilly terrain (Hamilton 1993, Lovaas 1992). Dry mesic upland supports Northern Red Oak, Sugar Maple, Black Walnut, and American Basswood; mesic upland, White Oak, Black Oak, and Shagbark Hickory. Wet mesic floodplain forest harbors American Sycamore, Ohio Buckeye, and Hackberry. Oaks seem to be decreasing in dominance; Sugar Maple, to be increasing. Prescribed burns are being used in parts of the woods to limit the invasion of Sugar Maple and increase the regeneration of oak (Roovers and Shifley 1997). The woods were originally owned by Ida B. Spitler, who protected the property from trespass and logging. She donated the land to the state in 1937. The Illinois Department of Natural Resources now owns and manages it (Spetich 1999).

Long Island, in the Mississippi River, Mark Twain National Wildlife Refuge (Adams County)

An island, recommended for inclusion in this report as old-growth by Strole (1992). The refuge management doubts the forest is virgin, but says it includes "many old growth trees" and has "little evidence of any logging activity" (Adams 1992). Any old growth is believed to be located at the southern end of the island, but biologists have not visited the area since a major flood in 1993 and do not know if the old growth still exists (Corgait 2003).

Piney Creek Ravine State Nature Preserve , in southeastern Illinois (Randolph and Jackson Counties)

A 111-acre preserve containing largely undisturbed "dry upland forest on rocky slopes and canyon bluff tops." The Post Oak-Black Oak forest is punctuated by scattered xeric forest/sandstone glades. The Illinois Department of Natural Resources owns the site (IDOC 1991).

Stemler Cave Woods State Nature Preserve , southeastern Illinois (St. Clair County)

A 105-acre old-growth forest on a plain dotted by sinkholes. In the dry upland community are White Oak, Post Oak, Red Oak, Pignut Hickory, and White Ash. Forest composition changes near the sinkholes. The upper two thirds of the sinkholes are dominated by White Oak and Black Oak; Red Oak dominates the lower one third. The Illinois Department of Natural Resources is the owner (IDOC 1991).

Horseshoe Lake State Nature Preserve , southeastern Illinois (Alexander County)

On the southern end of Horeshoe Island, within the 492-acre Horseshoe Lake Nature Preserve, an 86-acre stand of old-growth bottomland and upland forest. Researchers regard it as relatively undisturbed, but the site superintendent says that like "all the timber in Southern Illinois" it "has been cut over" (Garrison 1992). No evidence of any logging appears now (Robertson et. al. 1984); but impacts of hydrological changes can be traced (Brown 1985). Horseshoe Island is located in Horseshoe Lake, which is formed out of channels that once carried the Mississippi River. In 1929, long after the Mississippi had abandoned the channels, they were dammed. The dominant canopy species in the bottomland forest is Sweetgum, which is accompanied by American Elm, Red Maple, Green Ash, Black Gum, and American Sycamore, among other trees. This forest represents the northern terminus of the southern floodplain forest. The upland forest includes White Oak, Sweetgum, Sugar Maple, and Black Walnut. The old-growth forest is contiguous with a forest of similar composition that is recovering from disturbance. (Robertson et. al. 1978, Robertson 1984, Brown 1985). In 1993, the old growth itself experienced disturbance as a major flood killed most of the American Beech that were growing on swales (Lindsay 2002). The Illinois Department of Natural Resources owns the Nature Preserve.

Messenger Woods Forest Preserve , northeastern Illinois (Will County)

A 180-acre dedicated State Nature Preserve within a 407-acre preserve. Within the 180 acres are an estimated 80 or more acres of old growth. The old growth is found in a dry-mesic tract recently added to the preserve and in the forest north of Spring Creek, which flows through the preserve. In the latter, dry ridge tops support Black Cherry, Shagbark Hickory, White Oak, and Bur Oak. On mesic uplands are White Oak and Red Oak, associated with American Basswood, Sugar Maple, White Ash, and Slippery Elm. Sugar Maple dominates the ravine bottoms and the terrace along Spring Creek; Pawpaw is in the understory. The rich herbaceous layer includes Squirrel Corn (*Dicentra canadensis*), Large-flowered Trillium (*Trillium grandiflora*), and Blue-eyed Mary (*Collinsia verna*). The rare Heart-leaved Plantain (*Plantago cordata*) is found in a ravine (Mauger 1991 and 1993, IDOC 1991).

American Bottoms Ecologic Area, western Illinois (Madison County)

A wet floodplain, possibly old-growth, forest of approximately 80 acres. The forest is in the Ridge and Swale region of the American Bottoms, a 30-mile stretch of alluvial plain along the Mississippi. Pin Oak and Swamp White Oak dominate the area. The US Army Corps of Engineers, which controls the area, reports that it "includes one of the best known pre-settlement remnant forest communities of the historic American Bottoms." *Audubon* magazine in 1990 described the floodplain hardwood forest as "a relict stand"(Madison 1990). "Management plans call for limiting future development to protect the existing hydrology," which is actually the result of alteration of the natural hydrology. The Ecological Area is to the east of the Corps's American Bottoms Restoration Area, where the Corps is working to restore permanent vegetative cover (Cannon 2003).

Trelease Woods , in eastern Illinois (Champaign County)

A 60-acre remnant of a prairie grove called the "Big Grove" that covered 10 square miles north and east of Urbana. Trelease Woods, which is on a mesic, upland site, is categorized as mixed mesophytic, but is shifting in composition "from the more mesophytic species (dominated by oak, hickory, and elm) toward an Oak-Maple sub-climax." Sugar Maple has replaced American Elm, eliminated by Dutch elm disease. American Basswood, Ohio Buckeye, and Sugar Maple are expected eventually to replace the oak. Trelease Woods was selectively logged before 1900, but has since remained "essentially undisturbed." The University of Illinois acquired it in 1917. It is used for research and is closed to the public. Fields and a road surround the woods.

The 60-acre Brownfield Woods, another remnant of the Big Grove and in Champaign County, is similar to Trelease Woods in species composition, but has undergone more disturbance. The University of Illinois did not acquire it until 1939 (Edgington 1993, Boggess 1964, Szafoni 1992, Gehlhausen et al. 2000).

Miller Anderson Woods State Nature Preserve , in north-central Illinois (Bureau and Putnam Counties)

A 269-acre preserve, which includes a mixture of second-growth and old-growth forest. One hundred and sixty acres of "essentially undisturbed" mixed deciduous forest constitute most of the valley of an intermittent stream. The 160 acres have had light or brief grazing. The Illinois Department of Natural Resources owns the site and a 71-acre buffer around it (IDOC 1991; Anderson 1993).

Starved Rock State Park*, north-central Illinois (La Salle County)

Three types of old growth totaling more than 70 acres in a park that runs for four miles along the south side of the Illinois River. At the park, 18 canyons, created by glacial meltwater and stream erosion, cut through sandstone bluffs. On the bluffs are communities with very old stands of Eastern Red-cedar and Northern White-cedar. Also in the park are 34 never-logged acres of mesic upland forest with Northern Red Oak and White Oak, and 34 acres of old-growth dry mesic upland forest characterized by White Oak (Bitner 2003, Spetich 1999).

Norris State Nature Preserve , in northeastern Illinois (Kane County)

An 81-acre preserve, with 48 acres of old-growth forest that "probably had some timbering at the time of settlement." The dry mesic upland is dominated by Northern Red Oak and White Oak up to 150 years in age. Sugar Maple dominates small mesic communities along the Fox River. Willow and Silver Maple are found in the floodplain. A portion of the area that was once cleared for a beach and picnic area has grown up in Sugar Maple. Unfortunately the preserve has a problem with Garlic Mustard, an exotic species. St. Charles Park District owns it (Ochsenschlager 1992, IDOC 1991,vb 2003).

Posen Woods State Nature Preserve , southeastern Illinois (Washington County)

"Essentially undisturbed," southern flatwoods, intermittent stream, and dry-mesic upland forest communities in a 40-acre preserve. Stunted Post Oak predominate in the flatwoods, which are on relatively impermeable soils (McClain 1993, Ballard 1993, Fralish 1993, IDOC 1991).

Hartley Memorial Woods State Nature Preserve , in northern Illinois (Winnebago County)

A 40-acre dry-mesic upland forest, dominated by American Basswood and White Oak (IDOC 1991). A past director suggested that the forest may have been grazed in the 1910s and 1930s, as most tracts were; but no evidence of grazing is present. "The prevernal flora is exceptional." A nature trail, now grown over, was cut, but otherwise the forest is regarded as "nearly virgin." Sugar Maple are encroaching, mostly on the southern end. Emily Hartley donated the forest to the Winnebago County Forest Preserve District (Branhagen 1992, Groves 2003).

Harper's Woods State Nature Preserve , near Peoria (Stark County)

A 40-acre old-growth forest above the flood plain of Spoon River. White Oak dominates; Sugar Maple appears in the diverse understory. The mesic and dry-mesic site was purchased in 1865 by John Hall and resold to family members with the request that they not cut or graze it. Still in private hands, it can be entered only by permission (IDOC 1991).

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IOWA

John Fleckenstein of the Iowa Bureau of Preserves and Ecological Services wrote in 1990 that, to his knowledge, there has been no inventory of uncut woodlands in Iowa. Because of the extent to which wood has been used in the state, from white settlement down to the present, and because of the fact that wooded areas in this prairie region were relatively small when Euro-Americans arrived, the state has "little if any acreage" that has not been subjected to selective cutting "at least once."

Fleckenstein pointed out also that in Iowa an uncut woodland is not necessarily a good woodland. Much of the wooded area is grazed by livestock, some of it very heavily. Some of these tracts with "big, old oaks" and that apparently have been cut very little have thick undergrowth comprised mostly of "weedy species."

Furthermore, he reported that Iowa has much uncut forest that is only 100-150 years old. It is the result of trees having taken over prairie or savanna. Very little good savanna remains, although it was quite an abundant community prior to white settlement. John Pearson, plant ecologist for the Iowa Department of Natural Resources, confirmed Fleckenstein's views (Pearson 1992).

Recently researchers have documented the fact that Iowa has uncut woodland on cliffs similar to the well-known ancient woodlands on the Niagara Escarpment in southern Ontario. The dominant tree species in these Iowa woodlands is the Eastern Red-cedar. Like the Northern White-cedars in Ontario, the trees are generally "small, slow-growing, and widely spaced."

`D. W. Larson et al. characterized "ancient" woodland on eight cliff sites in Iowa (2000). Pearson indicates that of the eight sites, those with the longest stretches of ancient cliff woodland are **Turkey River Mounds Preserve** (Clayton County), a 62-acre preserve above the Mississippi and Turkey Rivers, owned by the State of Iowa; **Palisades-Kepler State Park** (Linn County), an 840-acre park along the Cedar River; and **Palisades-Dows Preserve** (Linn County), a 330-acre preserve across the Cedar River from Palisades-Kepler, and owned by the State of Iowa and the Linn County Conservation Board. **Backbone State Park** (Delaware County), a 1780-acre park on the Maquoketa River, has ancient woodland on scattered outcrops. Turkey River and Backbone State Park (see below also) are part of the Niagara Escarpment; Palisades-Kepler and Palisades-Dows are on an outlier of the Niagara Escarpment (Pearson 2002; Iowa 2002).

Dendrochronologists have determined that certain White Oak at a number of Iowa sites date back to the sixteenth and seventeenth centuries (Stahle 1996). At several sites the old White Oak are scattered or very scattered. Each of three sites, however, supports a cluster of about ten acres of ancient White Oak intermingled with younger trees. The three sites are Backbone State Park (see above); **Pammel Park** (Madison County), a 350-acre park formally part of the state park system but managed by the Madison County Conservation Board since 1989 (Madison 2002); and White Pine Hollow (see below). Younger trees, mostly maple, basswood, Hackberry, and elm, are mixed in with the White Oak, which appear to have grown in a more open forest than the forest in these areas today (Pearson 2002). At Backbone State Park, trees less than six inches in diameter have been removed and the site burned (Pearson 1995). At Pammel the oak grow on the park's backbone, a limestone ridge that is more than one hundred feet high (Madison 2002).

Other sites with small areas of uncut woodland include **Merritt Forest State Preserve** (Clayton County), 20 acres in which Northern Red Oak and White Oak, some of them "ancient," dominate, surrounded by roads and fields (Stahle 1996, Blair 2002); an **unnamed 15-acre site** adjacent to the Mississippi River (Clayton County), probably never logged or grazed by livestock, dominated by Northern Red Oak, accessible only through private land or by boat, and owned by the State of Iowa (Blair 2002, Farlinger 2002); **Brushy Creek Preserve** (Webster County), 6 acres of maple/basswood amidst a 260-acre tract dominated by second-growth oak/hickory (Fleckenstein 1990).

The following two more extensive sites of uncut woodland have probably (like Merritt Forest and Brushy Creek) undergone some grazing by livestock but do not have thick, weedy undergrowth.

White Pine Hollow (Dubuque County)

A 712-acre site of which "Much . . . has not been cut" (Fleckenstein 1990). Blair reports that the 400 acres that initially comprised the preserve are all old growth, but that only about half of those acres are considered high quality, with big trees (Blair 2002). Spetich et al. describe the site as "the only existing old-growth site of substantial size in Iowa" (1999). Oak/hickory is the dominant vegetation with "some areas of maple/basswood," plus "small

areas" of Eastern White Pine (Fleckenstein 1990). The preserve includes about ten acres of ancient White Oak. White Pine Hollow is owned by the Iowa Department of Natural Resources and managed by the Parks Department.

Bluffton Fir Stand Preserve (Winneshiek County)

A 94-acre preserve dominated by a disjunct population of Balsam Fir. The half of the fir that grows on a steep bluff has probably never been logged, although the trees now on the bluff are young. Widely scattered Eastern Red-cedar among the fir on the bluff are likely to be very old. The preserve is owned the State of Iowa and managed by the Parks Department (Pearson 2002).

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MICHIGAN

Combining information from many sources, Lee Frelich has calculated that as of 1992, Michigan had 82,058 hectares (roughly 205,000 acres) of primary forest. The breakdown by type is as follows: Northern White-cedar 50,587 ha, northern hardwoods 24,399 ha, Black Spruce-Tamarack 6070 ha, Jack Pine less than 400 ha, White Pine-Red Pine 344 ha, spruce-fir 161 ha, oak-hickory, 68 ha, riverbottom 29 ha. The percentage of primary forest that is old growth is unknown ("old growth" for the purposes of his study was forests composed of long-lived species that are more than 120 years in age). Frelich calculated that presettlement forest in Michigan covered 12,735,300 ha (31,456,191 acres). Thus, in Michigan current primary forest is 0.64% of the presettlement forest.

Frelich further noted that, with the exception of swamp conifers, "nearly all" the primary forest in Michigan, as in the two other Great Lakes states, is in well known wilderness areas and parks. Two Michigan sites are of particular importance. The Porcupine Mountains State Park and Sylvania Wilderness are the largest remaining areas of primary northern hardwood forest in the Lake States. Furthermore, within the Great Lakes states, these areas are the only remaining "presettlement-like upland forest landscapes, on which the species composition, spatial patterns, and disturbance dynamics have changed little" (Frelich 1995).

The US Forest Service (USFS) has begun working on the revision of the forest management plans for the three National Forests in Michigan: the Hiawatha, the Huron-Manistee, and the Ottawa. Each Forest will have its own plan and Environmental Impact Statement, but the three will follow approximately the same timetable. As of early 2003, meetings to involve the public were already taking place. Notices of Intent are scheduled to be is sued in September, 2003. USFS hopes to adopt revised plans two years later (Roycraft 2003).

Locations of small old-growth sites include **Tourist Park** in Marquette (Marquette County): some 10 acres of old-growth Red Pine at the entrance to the 40-acre, wooded park (Cornett 2002; Marquette 2002); **Consumers Power Co.** (St. Clair County): 7-20 acres of old-growth oak-hickory on a low ridge within a 69-acre tract owned by Consumer Power Co., but managed by the Michigan Nature Association (Donaldson 2001); **Crawford Red Pines/Dyer Road Pines,** T27N/R1W/30-31, Au Sable State Forest (Crawford County), 17 acres of old-growth Red Pine within a 40-acre oak-pine forest, salvage logged on the edge after a fire (Cornett 2002, Eagle 2001); **Bismarck Creek,** T49N R25W, section 31 (Marquette County) small, scattered stands of virgin Northern White-cedar and hemlock-hardwoods, probably not more than 30 acres in total.

Isle Royale National Park, in Lake Superior

An estimated 50 to 75% of the Park's 133,782 land-based acres, or 66,900 to 100,336 acres, is old growth. The forests have suffered little or no human disturbance since the 1930s, and that disturbance was focused in one corner of the island. Euro-Americans arrived on the island in the 1830s. In the mid- to late-1880s mining prospectors burned portions of the forest. In 1936 lightning and human activities caused a fire that may have burned as much as 20% of the island. Small-scale logging took place in the mid-1870s, 1890s, and again in the 1930s to support the small settlements, for buildings, or as commercial logging efforts. The acreage impacted by the human-ignited fires and by the logging is not known. Jack Oelfke, Resource Specialist at the Park, thinks it is safe to say that these operations covered less than 25% of the land base, but he is still studying the question.

The National Park Service (NPS) completed a new vegetation map of the Park in the late 1990s. The map includes 52 community types. Those with the greatest acreage (by percent coverage) include: aspen-birch/boreal conifer forest—18.6%; spruce-fir-aspen forest—14.5%; spruce-fir feathermoss forest—13%; Northern White-cedar (mixed conifer)/alder swamp —11.6%; maple-Yellow Birch, northern hardwoods forest—6%; and White Spruce woodland alliance--5.6%

The National Park Service is inventorying developed [sic] portions of the island and rockshore communities for rare species. At present, known federally listed animal species on Isle Royale are the Eastern Timber Wolf and Bald Eagle. Among state-listed animals are the Osprey, Moose, Merlin, and Common Loon. More than 60 plants on the island are state listed or otherwise recognized as rare (Oelfke 2003).

Porcupine Mountain Wilderness State Park, northwest shore of the Upper Peninsula (Ontonagon and Gogebic Counties)

More than 30,000 acres of unlogged forest, mostly or entirely within Porcupine Mountain Wilderness State Park. Frelich and Lorimer describe approximately 36,000 acres (14,500 ha) of "primary, or virgin forest, mostly in one large contiguous block" within the state park (1991). The Michigan Natural Heritage Inventory database refers to 31,000 acres of unlogged northern hardwoods, intermixed with logged forest, balds and cliffs, shrub and conifer swamps, lakes, and wet meadows, a little of the acreage outside the park (1990). The site is considered to be "the most extensive virgin hardwood forest in North America, west of the Adirondacks" (Rob 1993). Sugar Maple, American Basswood, Eastern Hemlock, and Yellow Birch dominate. Burton Barnes states that "most northern hardwood forests, except Porcupine Mountain Wilderness State Park, were culled for eastern white pine" (1989), although Frelich and Lorimer speak of a light culling for White Pine (1991). Excessive deer browsing is hindering the reproduction of Northern White-cedar, Eastern Hemlock, Canada Yew, and Common Juniper (Cornett 1993).

OTTAWA NATIONAL FOREST, in the southwestern Upper Peninsula (Ontonagon, Gogebic, Iron, and Baraga Counties)

--**Sylvania Wilderness Area**, formerly Sylvania National Recreation Area (Gogebic County)

About 15,000 acres (6000 ha) of essentially unlogged forest within a 17,950-acre tract (Frelich and Lorimer 1991). The area is dominated by Sugar Maple, hemlock, and Yellow Birch. When the hemlock dies, Sugar Maple usually replaces it. Other tree species include White Pine, Red Pine, Jack Pine, White Spruce, Red Maple, and Paper Birch (Evans 1990). Balsam Fir is in the understory throughout (MNFI 1990). Evidence of human impact is present primarily as old roads, openings at former building sites, and campsites and portage trails built by the Forest Service. The 5000-acre Sylvania National Recreation Area Botanical Area occupies part of the tract (USFS [n.d.]).

--**McCormick Tract**, Upper Peninsula (Marquette County). Two hundred thirty acres of mostly old-growth dry-mesic northern forest, in which about 46 acres of White Pine were heavily cut. Also in the McCormick Tract are 2590 acres of old-growth mesic northern hardwoods throughout which White Pine has been cut (MNFI 1990). The McCormick Tract is owned by the US Forest Service and managed by Ottawa National Forest officials but is outside proclamation boundaries. The Bentley Trail connects the Huron Mountains and the McCormick Tract, which are near each other but separated by private land (Rooks 1993). Heavy logging has taken place around the McCormick tract and around the Huron Mountain Club, which has further diminished the connectivity between the two tracts (Cornett 2002).

--**Sturgeon River Gorge Wilderness** (Houghton County). A 50-acre unlogged stand dominated by Eastern Hemlock (Cornett 1993, Palmer 2000).

--**Compartment 67, stand 22**, Ontonagon Ranger District (Ontonagon County). Three hundred and thirty-eight acres of mixed swamp conifer forest in which, according to the US Forest Service (USFS), the trees date back to 1800. Northern White-cedar, Balsam Fir, Eastern Hemlock, Black Spruce, and Tamarack comprise 60% or more of the basal area (Klungness 1992).

--**Compartment 146, stand 19**, Ontonagon Ranger District (Ontanagon County). Seventy-five acres of hemlock-dominated forest with a birth date of 1846.

--**Compartment 97, stand 17**, Ontonagon Ranger District (Houghton County). Fifty-six acres of hemlock-hardwoods with a birth date of 1871. Hemlock comprise 20 to 50% of the basal area; average diameter of stems is 12 inches (Klungness 1992).

--**Trap Hills**,* adjacent to Porcupine Wilderness State Park (Ontonagon County). A 4400-acre area with at least 200 acres of old growth. The Trap Hills host numerous endangered, threatened, and rare species including the Eastern Timber Wolf, Northern Goshawk, Red-Shouldered Hawk, Wood Turtle, and Fairy Bells (*Disporum hookeri*). The North Country Trail traverses the Hills. After a three-year campaign, conservationists succeeded in persuading USFS to withdraw the M-64 Hardwooods timber sale that would have thinned the area's hardwoods. As of 2003, they are campaigning to have the Trap Hills set aside as Wilderness in order to secure its permanent protection (Cornett 1997, 2002; NWR 2003).

Sleeping Bear Dunes National Lakeshore, on the shore of Lake Michigan

Seventy-one thousand acres (57,000 owned by the federal government) within which are two types of old growth. (The Lakeshore is composed of North and South Manitou Islands and a 35-mile strip along the east coast of Lake Michigan.)

--A possible 12,000 acres of old-growth beech-maple forest with some hemlock and White Pine within the 71,000-acre area. Tree ages, based on coring and estimates, range from 80 to 500 years. These statistics appear in

Lucy Tyrrell's report on National Park Service lands (1991). The only standard for determining old growth that the respondent, Max Holden, Resource Management Ranger with the National Park Service, reported to Tyrrell was a minimum age of 100 years. Max Holden, Park Biologist, has verified the 12,000-acre estimate. The forest was probably selectively logged over 100 years ago, he states.

--A never-logged stand of Northern White-cedar* in the southwest corner of South Manitou Island. The stand is some 25 to 40 acres in size (Holden 2003).

Mulligan Creek Area (Marquette County)

As of 1993, some 20,000 roadless acres, an estimated 2000 to 3000 acres of which were believed to be old growth. Northern hardwood communities predominate, but hemlock stands are scattered throughout. Communities of White Spruce and Balsam Fir with some White Pine also occur (Cornett 1993). However, most of the acreage was selectively logged for White Pine around 1980 (Knoop 2002). The area is privately owned, with Mead Paper Company, in 1993, in possession of 10,000 acres. Since 1993, Mead has done some logging, but has left part of its land alone and has also sold part of it. The area has a greater number of ownerships, with many of the tracts that are 10 to 250 acres owned by people who want to preserve the land (Cornett 2002). Specific areas of old growth include these:

--**Mulligan Escarpment*** on which old growth includes 600-800 acres that may be preserved under a conservation easement and 2000 acres divided among scattered tracts that, as of 2002, were for sale. The acreage for sale included 1000 acres of a mix of Red Pine and White Pine, particularly valuable as habitat for birds. Some White Pine may have been removed from the Red Pine/White Pine areas, but no stumps can be seen (Knoop 2002).

--**Clark Creek Pines,** T49N R27W, sections 1, 2, and 7; T49N R28W, section 12. Includes a 200-acre virgin White Pine stand, owned by a private individual as the result of a trade by Mead.

--**Stag Lake-Pinnacle Falls,*** T50N R28W, sections 27, 28, 29, 32, 33. Approximately 500 to 600 acres of virgin hardwoods, dominated by "birdseye" Sugar Maple (Cornett 1993, 2002). The ridges support large Northern Red Oak. The Nature Conservancy holds a conservation easement on 2000 acres, including old-growth hardwoods (Pryor 2002).

--**Island Lake-Rocking Chair Lakes**, T49N R28W, sections 3, 10, and 11. Approximately 500 to 600 acres of old-growth, most of which are northern hardwoods, dominated by Eastern Hemlock. Scattered through the hemlock are stands of huge White Pine. In some of the valleys, Sugar Maple dominates. A 240-acre Rocking Chair Lakes Natural Area includes “some old growth” dry mesic northern hardwoods forest (MDNR [2002]). As of mid-2002, Redstone Lumber Co. was seeking a buyer for 1700 acres around Island Lake (Cornett 1993, 2002).

Huron Mountains, northwest of Marquette in the UP (Marquette County)

Some 6500 acres (2600 ha) of minimally disrupted old-growth forest constituting the non-lake portion of the 8000-acre Huron Mountain Reserve Area set aside for preservation by its owner, the Huron Mountain Club. The Club also owns an additional 10,000 acres, most of which were clearcut in the 1930s, 40s, and 50s, before the Club had acquired them. In the 1890s some 20% of the land now in the Reserve was selectively cut for White Pine, but White Pine was common on only 100 of these acres. The Reserve has also experienced fire and some road building.

The Reserve is a mosaic of forest communities, chief among them several hemlock-northern hardwood types (49.6%). Within this hemlock-northern hardwoods group, forest dominated by Eastern Hemlock is most widespread (24.2% of the Reserve). Here Sugar Maple, Yellow Birch, and American Basswood are also in the overstory. The next most prominent group consists of lichen-juniper, pine-oak, and White Pine-hemlock-hardwood (30%). The pine-oak forest, on ridges and steep slopes, grades into and is interrupted by scattered patches of open lichen-juniper community with clumps of Common Juniper providing the sparse tree cover. Pine forests cover 7.3% of the reserve: Jack Pine (5.5%), Red Pine (0.7%), and Red and White Pine (1.1%). Other groups of communities include birch-aspen (2.9%), wet site conifer and conifer-hardwood (2.4%), White Ash and American Elm-Sugar Maple-Basswood (0.2%). The White Ash forest is found in only two locations in the Reserve. White Ash is at the northwestern limit of its range here, but the species forms an almost pure overstory with trees of 10 to 16 inches dbh (diameter at breast height) (Simpson et. al. 1990).

Craig Lake Wilderness State Park (Marquette and Baraga Counties)

A 7600-acre state park, with "a lot of old growth." The forest is hemlock-hardwoods, dominated by hemlock. Virgin stands are scattered through the park, thanks to the park's isolation and rocky terrain; but paper companies own inholdings, which they have cut hard, sometimes by clearcutting (Cornett 1993, Cornett 2002).

North Fox Island, off the northern Lower Peninsula (Leelanau County)

Five hundred thirty-six acres of either "a virgin-overmature or a mixed old-growth/old second-growth hardwood forest, occupying glacial lakeplains and dunes." If the forest was ever logged, it has "essentially recovered." Trees present include Red Maple, Sugar Maple, American Beech, Eastern Hophornbeam, and Mountain Maple. Also on the island, almost all of which is occupied by old growth, are 170 acres of uncut boreal forest and 88 acres of uncut northern swamp. The island is privately owned (MNFI 1990).

Tahquamenon Falls State Park, eastern Upper Peninsula (Chippewa County)

Old-growth hemlock throughout the 36,563-acre State Park, but probably not virgin. Gary Reese believes that the Tahquamenon River area, though sometimes ranked with the huge forests of the western UP as a "large virgin" tract, was extensively logged for White Pine (1990). Included in the old growth from which White Pine was probably removed are about 200 acres of intermingled hemlock and maple around the upper falls (Knoop 2002).

Little Presque Isle, in Escanaba River State Forest, north of Marquette (Marquette County)

Some 3000 acres of state land, with probably 300 to 400 unlogged acres, primarily hemlock-hardwoods. Perhaps one-third of the entire area could be considered old growth, Cornett reports (1993). Knoop says that only a small portion of the area is old growth (Knoop 2002). Cornett named as old growth the following sites within or adjacent to the Little Presque Isle tract. Unless otherwise specified, they are owned by the state (Cornett 1993).

--**Hogback Mountain.** Approximately 245 acres of old growth dominated by stands of Eastern Hemlock and Sugar Maple. Many Yellow Birch are more than 30 inches dbh. White Pine were selectively cut, probably around 1900 (Cornett 1993).

--**Harlow Lake.** A 164-acre site with 124 to 134 acres of virgin forest. Some White Pine and Eastern Hemlock have been removed from the balance of the site, which is along the east side of Harlow Lake. The stand is Eastern Hemlock-Paper Birch-Sugar Maple. Second-growth hardwoods surround it (MNFI 1990, Reese 1990, Cornett 1993).

--**Sugarloaf Mountain**. A 154-acre site, of which approximately 100 acres are virgin. It is dominated by stands of Sugar Maple and Eastern Hemlock (Cornett 1993, Wells 1993). In a damaged area of approximately 10 acres, only a few hardwood trees survive and virtually all the hemlock and White Pine have died, Cornett reported in 2002. He speculated that acid rain and fog may be the cause (Cornett 2002). The County Road Commission owns the site (Cornett 1993, Wells 1993).

--**Eagle's Nest**. 20 acres of privately owned virgin White Pine just north of the Little Presque Isle tract. A wind storm in 1988 blew down the biggest trees.

--**Harlow Creek**. A 16-acre virgin stand with an upland portion dominated by Red Pine, White Pine, and Eastern Hemlock and a lowland portion dominated by White Pine and Black Ash. The stand has several large White Pine with dbhs to 52 inches.

--**Wetmore Pond.** A 13-acre old-growth stand owned by Mead Paper Company, and adjoining the Little Presque Isle tract. The stand is dominated by hemlock and includes scattered large Red and White Pine (Cornett 1993). Mead developed a parking area in a second-growth stand next to the old growth, but they say that they will leave the old growth alone (Cornett 1993, 2002).

HIAWATHA NATIONAL FOREST, central Upper Peninsula

--**Dukes Experimental Forest** (Marquette and Alger Counties). A 7000- to 8000-acre tract devoted to research on northern hardwoods. The bulk of the tract shows old-growth characteristics (Cornett 1993). Hardwoods dominate most of a 280- (Schultz 1993) or 320-acre unlogged control plot, within which Eastern Hemlock and Northern White-cedar dominate small stands (Cornett 1993). Mroz et al. describe the Upper Peninsula Experimental natural area as containing approximately 232 acres of hardwoods, from which American Elm and American Basswood were selectively cut in the early 1900s (1985).

--**A candidate Research Natural Area** (RNA). Eighty acres of uncut, mixed northern hardwoods and Northern White-cedar in an upland site on a slope along sandstone cliffs. The site is very wet and extremely fragile (Schultz 1993).

--**Squaw Creek,** Rapid River Ranger District. A 65-acre stand of Eastern Hemlock (10%), Red Pine (35%), White Pine (10%), other softwoods, aspen, and other hardwoods. According to the US Forest Service (USFS), the stand was logged to some extent during the early 1900s, but contains older trees. The official age is 132 years (Lanasa 1992).

--Grand Island, in Lake Superior (Alger County). At the north end of the island, a 59-acre parcel of old-growth hemlock-northern hardwoods. The remainder of the island was logged in the 1960s, except for two small areas of old-growth pine: one predominantly White Pine with some Red Pine and the other, Red Pine. The island is within a National Recreation Area; and the 59 acres are a Research Natural Area (Schultz 1993, Henson 1993).

--**Coalwood**, Munising Ranger Dis trict. A 40-acre stand of Eastern Hemlock (75%), American Beech (15%), other hardwoods (8%), and White Pine (2%) with an official age of 110 years. The Forest Service reports that the area was cut selectively in the early 1900s (Lanasa 1992).

--**Murphy Pines** (Schoolcraft County). Thirty-eight acres of Red Pine (30%) and White Pine (60%) (Lanasa 1992). According to stand records, they originated in 1824 (Tyrrell 1998). Other trees present are Black Spruce (5%) and Balsam Fir (5%). The Forest Service says that the area was selectively logged in the early 1900s (Lanasa 1992); and Cornett reports that some trees have been removed in recent years (Cornett 1993). Don Henson describes Murphy Pines as 10 or 12 uncut acres with a buffer (1993).

Pictured Rocks National Lakeshore, on Lake Superior

A reported 1000 acres of old-growth Yellow Birch-Eastern Hemlock within the 73,000-acre Lakeshore. Coring indicates the trees are 150 to 250 years in age. The criteria used in determining the extent of the old growth was a minimum age of 100 years, according to Walter Loope, Park Ecologist (Tyrrell 1991). The old growth was selectively logged in the early 1900s. Approximately half of the acreage in the Lakeshore, including the old growth, is owned by the National Park Service. Up to 80% of the remainder is in the hands of timber companies or the State of Michigan, who log it (Leutscher 2003).

Hog Island Natural Area,* in northern Lake Michigan (off the shore of Emmet County)

Old growth of undetermined extent on a 2075-acre island. The area was nominated in 1995 to become a State Wilderness. The nomination documents describe the island as "largely forested with the higher ground of the north and south separated by areas of swamp, interdunal wetland and submergent and emergent marsh." The island has no roads, trails, or buildings. Indians may have made limited use of the island for agriculture. Settlers from adjacent islands and Indians also used it for producing maple syrup, fishing, and possibly, in the early 1900s, livestock grazing. Portions may have been logged in the late 19th or early 20th centuries, but they are now mature forest. "Pockets of old-growth northern forest and uncut conifer swamp occur amidst the more disturbed or intolerant forest types" (Eagle 2001). The island/Natural Area is managed by the Beaver Island State Wildlife Research Area (MDNR 2003).

Besser Natural Area,* T33N/R8E/13,24, Mackinaw State Forest, northeastern Michigan (Presque Isle County)

A 134-acre Natural Area, which includes a stand of mature, "virgin" Red and White Pine with cedar, spruce, Balsam Fir, and Paper Birch. It also has more than 4000 feet of undeveloped Lake Huron shoreline. Like other State Natural Areas, the area is protected under Michigan's Wilderness and Natural Areas legislation (Eagle 2001, MDNR 2003).

Northshore Natural Area,* Mackinaw State Forest (Mackinac County)

Two hundred acres of old-growth, mixed mesic forest bordered by boreal forest along the lake shore within an 817-acre State Natural Area. The site occupies the peninsula on the north side of Bois Blanc Island. Paper Birch dominates toward the point. Sugar Maple and Northern White-cedar are also important. Two inconspicuous roads run through the tract (MNFI 1990, MDNR 2003).

Allegan State Game Area, in southwestern Michigan (Allegan County)

Within the Game Area, some 3000 acres of savanna-related communities, ranging from near oak forest to dry sand prairie, that include small areas that have had minimal disturbance. Most of the oak barrens have been lightly logged. The area first identified as representative of the natural vegetation is a 100-acre dry oak barrens that did not become overgrown because of such factors as droughty soil and frequent natural fires. Black Oak, White Oak, a diverse herbaceous flora, and patches of lichen are found on the 100 acres (Lerg 1993, Nuzzo 1986). A 160-acre area has become a State Natural Area (MDNR 2003). On the 3000 acres as a whole, White Oak used to be the dominant tree, but Black Oak dominates more of the Game Area now. Much of the savanna became overgrown because of fire supression from the late 1930s to the present. Burning was reintroduced in 1989. The Game Area is under a mix of private and public ownership. The public land is all administered by the Wildlife Division of the Michigan Department of Natural Resources (Lerg 1993, Nuzzo 1986).

Patterned Peatlands, eastern Upper Peninsula

Selectively logged peatlands in which are embedded islands, some of them unlogged. The eastern UP has approximately a dozen patterned peatlands ranging in size from 150 feet by 300 feet to many square miles. Not all have trees, and, as a general rule, any trees are scattered--Tamarack, Northern White-cedar, and "an occasional unhappy White Pine" (Madsen 1990). Much of the Tamarack have been removed from the peatlands themselves, but several of the islands escaped harvesting (Rooks 1993). The entire two-thirds of the 95,455-acre Seney National Wildlife Refuge that has organic (peat) soils has been cut, but some areas "appear quite natural with large trees and few if any stumps" (Tansy 1993).

--**McMahon Lake are**a (Luce County). The Nature Conservancy owns more than 3000 acres with peatland as part of a 15,000-acre wetland complex near McMahon Lake. Black Spruce, Tamarack, and Northern White-cedar grow in saturated peat. Some of the islands embedded in the peatland have never been logged. They bear White Pine, White Pine-Eastern Hemlock, or mixed northern hardwoods (Ewert 1990 and 1993). The 1770-acre McMahon Lake Strangmoor [State] Natural Area in Luce County is presumably within The Nature Conservancy's holding, since it is on The Nature Conservancy Natural Areas Registry (MDNR 2003).

Little Brevort Lake Scenic Site,* T42N/R6W/23-25, in Lake Superior State Forest (Mackinac County)

A 542-acre Natural Area with possible old growth. It was described by the Area Forester in 1974: "Except for the two State Forest Campground Units, the partially developed foot trail and some very light cutting done in Sec. 24, the area is quite wild and unspoiled. It includes nearly every timber type and tree species common to northern Michigan." He noted in particular several stands of large and small hemlock and two hemlock estimated to be over 400 years in age. The area is protected under the State's Wilderness and Natural Areas legislation (Eagle 2001).

Laughing Whitefish Falls Scenic Site (Alger County)

A 360-acre area, much of which is old-growth forest. The old-growth forest includes White Pine stands and hardwood stands. The Michigan Department of Natural Resources State Parks Division oversees the area (Cornett 1993, Knoop 2002). The site is a State Natural Area.

Estivant Pines, the northwestern Upper Peninsula (Keweenaw County)

A 440-acre area centering in 200 acres of near-virgin, dry-mesic to mesic northern hardwoods overtopped in places by White Pine. The hardwoods are Sugar Maple, Yellow Birch, and Northern Red Oak. In the early 1900s the 440 acres were selectively logged in places for White Pine. Today pine is reproducing only in several small areas. The Michigan Nature Association owns the Estivant Pines (Rooks 1993, MNFI 1990, Reese 1990).

Wild Fowl Bay Islands , in Saginaw Bay, in Wild Fowl Bay State Wildlife Area, east-central Lower Peninsula (Huron County)

Three hundred acres of good-quality lowland savanna with Bur Oak, Black Oak, and White Oak (Albert 1993, Selecki 1993). We were unable to learn whether this site or the savanna at Algonac State Park and Crow Island, described below, has been logged (Albert 1993, Selecki 1993).

Two-Hearted River Backus Tract (Swamp Lakes), in the eastern Upper Peninsula (Luce County)

Two hundred acres of steep sandy ridges dominated by old-growth dry-mesic northern forest, in the midst of shallow intermittent wetlands. White Pine and Red Pine dominate the forest. The understory is Northern Red Oak, a tree not common in this part of the UP. The Nature Conservancy has recently acquired the tract.

Most of the forests in the area were logged off around 1900. The Backus tract was spared, perhaps because the pines were too small to be worth cutting, given the terrain. The fires that followed the cutting of areas adjacent to the tract burned through it, opened up the canopy, and allowed the Northern Red Oak, now 80 to 90 years old, to become established (Comer 1992, Clark 1993).

Waterman Preserve,* western Upper Peninsula (Baraga County)

A 920-acre preserve with approximately 400 acres of old-growth Eastern Hemlock-White Pine mix with some oak and maple. The Nature Conservancy purchased the land in 2003 from a lumber company, which had already logged the balance. The preserve is adjacent to the western boundary of the Huron Mountain Club property (Knoop 2003).

Van Riper State Park, Upper Peninsula (Marquette County)

Possibly a couple of hundred acres of old growth within the 1124-acre State Park. The old growth is mainly hardwoods. Next to Lake Michigamme, much of the park is devoted to industrial tourism (Cornett 1993).

Warren Woods Natural Area,* southwestern Michigan (Berrien County)

A 179-acre Natural Area composed of beech-maple forest, which, is described for the National Registry of Natural Landmarks as "virgin," but according to a local resident was selectively logged between 1882 and 1892. The forest includes trees more than 5 feet in diameter and 125 feet in height. The Natural Area is managed by managers of the 1950-acre Warren Dunes State Park, which is not contiguous to it (Coward 2002, Eagle 2001).

Lake Gogebic State Park, on the southwest shore of Lake Gogebic in the western part of the Upper Peninsula (Gogebic County)

A 170-acre near-virgin mesic northern forest. Windthrows were removed in the past (MNFI 1990, Reese 1990).

Roscommon Red Pines, toward the north of the Lower Peninsula (Roscommon County)

One hundred sixty acres of old-growth Red Pine, the largest known old-growth Red Pine tract in the Lower Peninsula. The Red Pine is mingled with White Pine and is on a sandy outwash plain of secondary Jack Pine. Some of the Red Pine bear fire scars. Many have a dbh of over 70 cm. The tract is partially within the Roscommon Red Pine Nature Study Area (MNFI 1990, Reese 1990)

Algonac State Park, east-central Lower Peninsula (St. Clair County)

A 160-acre good-quality savanna within the State Park. In a wet oak opening grow Pin Oak, Bur Oak, and Swamp White Oak; on the uplands are White Oak, Northern Red Oak, and Black Oak. Prescribed burning is conducted on the prairie and oak opening at the park (Albert 1993, Kafcas 1993, Selecki 1993). A 200-acre area within the State Park with lakeplain prairie and savanna has been nominated for dedication as a State Natural Area (MDNR 2003).

Leelanau State Park* (Leelanau County)

At least 100 acres of mature/old-growth beech-maple forest with scattered large hemlock and White Pine. Other species include red and white oaks and Paper Birch. The old growth borders Lake Michigan, and the northern edge quickly transitions into sand dunes with grasses and scattered Eastern Cottonwood trees. Trails cross the old growth (Ostuno 2000).

Crow Island, east-central Lower Peninsula (Bay County)

Good-quality oak openings covering some 80 to 100 acres of lowland. The vegetation is primarily Bur Oak with some prairie grasses (Albert 1993, Selecki 1993).

Third Bass Lake, T50N R27W, section 35, central Upper Peninsula (Marquette County)

A section with an 80-acre virgin hemlock stand in the north. In the middle are four small, hanging valleys with old-growth hemlock, some virgin and some from which White Pine has been removed. The section is owned by a private company. It is "pretty much all old growth" but the southern two-thirds has been selectively logged (Cornett 1993). There has been logging all around this stand and Little Garlic River below (Cornett 2002).

Deer Lake Trust Property,* north-central Upper Peninsula (Alger County)

Within the 92-acre tract, old-growth northern hardwoods on a steep, rocky, xeric site. Ten acres of forest, on the steepest land, have never been logged. Ten acres are wetlands. Most of the remainder of the site is forest selectively logged for large White Pine by trespassers in the 1970s. It can be considered to be old growth, if one accepts the loss of the pine. Three camps have been built on the site. The land is owned by members of one family (Cornett 2002, NWR 1997).

Little Garlic River, central Upper Peninsula (Marquette County)

A thin strip of land along the river, with approximately 60 acres of old-growth hardwoods and 15 to 20 acres of old-growth White Pine. The state owns this land and has clearcut on both sides of the strip. As of 2002, the site had a lot of dying hemlock and White Pine, perhaps from acid rain (Cornett 2002).

Lower Huron River Metropark* in southeastern Michigan(Wayne County)

Some 60 acres of floodplain forest bordered by 40 acres of upland forest in the northwest corner of the Lower Huron Metropark. The old growth is in a strip along the Huron River. Selective logging may have taken place, but the forest has never been completely cut. The floodplain forest provides habitat for more than 150 species of vascular plants including 55 species of woody plants. As of 1998, it was remarkably free of exotic species. The trees included giant Tulip Trees, Black Maple, Black Walnut 10 to 12 feet in circumference, and a Bur Oak almost 4 feet in diameter. In 1986 the Huron-Clinton Metropolitan Park Authority, which owns the land, decided to make the land part of a golf course. A coalition formed to prevent the destruction of the site, and the golf course was not built (Bogaard 1995, Grese 1998).

Indian Bowl, in the extreme southeast of the state (Berrien County)

A 67-acre relict conifer swamp, with Tamarack and many southern species, in the floodplain of the Saint Joseph River. The area has apparently not been subject to fire or to cutting. The site is "succeeding to southern swamp forest" (Reese 1990).

Hartwick Pines, in Hartwick Pines State Park, north-central Lower Peninsula (Crawford County)

A 59-acre tract, described by the Michigan Natural Features Inventory as the "state's best remaining virgin stand" of White Pine and as having "one of the greatest biomasses of any forest in the world." Nevertheless, there are trails throughout the area, and in the 1930s some understory trees were removed. With the White Pine are a few big Red Pine and hemlocks, also Sugar Maple, Red Maple, and American Beech (MNFI 1990, Reese 1990).

Wells State Park, in the southern Upper Peninsula, close to Wisconsin (Menominee County)

A 55-acre area with a virgin tract of mesic northern hardwoods on a former offshore sand bar, surrounded by a virgin conifer-hardwood stand. The dominant trees are Sugar Maple, American Basswood, and American Beech (MNFI 1990). The state put in a road and built cabins; the change in the hydrogeology caused the cedars in the area to die. Furthermore, the Department of Natural Resources logs the edges of the forest to get wood for projects in the park, further diminishing natural values (Cornett 1997).

Willow Creek, T49N R27W, sections 27, 35, and 36 (Marquette County)

About 20 acres of large Northern White-cedar, logged around the edges and a 10- to 20-acre virgin White Pine stand. The White Pine stand occurs on an escarpment above a creek, and some of the drainages entering the creek from the escarpment support patches of white-cedar. The sites are privately owned, the White Pine by Mead Paper Company (Cornett 1993). Logging has recently taken place in section 36 (Cornett 2002).

Keweenaw Peninsula* (Keweenaw County)

Pockets of never-logged Northern White-cedar embedded in second-growth forest. The scattered pockets have not been inventoried, and the total old-growth cedar is unknown (Knoop 2002). However, the Michigan Natural Features Inventory surveyed bedrock portions of the shoreline. An example of their findings is a 5-acre old-growth cedar swamp in the bedrock segment known as Portage Lake Ship Canal West. The old growth is "on seepage rich slopes" above 20-40-foot-high cliffs (Albert 1994, Klungness 1998). The portion of the cliffs with the old growth is privately owned and under conservation easement.

The Nature Conservancy (TNC) has purchased 6275 acres at the tip of the Keweenaw Peninsula from International Paper's Lake Superior Land Company. The state of Michigan is reimbursing The Nature Conservancy for the purchase price and taking ownership of the land, half in 2002 and half in 2003. The purchase connects 2500 acres already owned by the Michigan Department of Natural Resources and 1500 acres owned by TNC (TNC 2002).

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MINNESOTA

Lee Frelich has calculated that as of 1992 Minnesota had 264,023 ha (652,137 acres) of primary forest. The types in order of decreasing prominence were as follows: Northern White-cedar 66,653 ha, spruce-fir 47,471 ha, Black Spruce-Tamarack 44,516 ha, Jack Pine 39,984 ha; aspen-birch 35,370 ha, Red Pine and White Pine 22,339 ha, northern hardwood 4549 ha, riverbottom 2684 ha, oak-hickory 456 ha. The percentage of primary forest that is composed of long-lived species that are more than 120 years in age, ie old growth according to the definition in Minnesota, was not known. Presettlement forest covered 10,964,800 ha (27,083,056 acres) in Minnesota, Frelich estimated. The state's primary forest in 1992 was therefore 2.4% of the presettlement forest (Frelich 1995).

Minnesota's largest areas of virgin landscape are the Boundary Waters Canoe Area Wilderness (BWCAW) in Superior National Forest in the northeast and the peatlands scattered across the north-central and northeastern portions of the state. The aspen parklands in the northwest are also extensive and are relatively little disturbed.

In 1991 Minnesota protected 146,000 acres of peatland in Peatland Scientific and Natural Areas, comprising the state-owned land in the core areas of l6 ecologically significant peatlands. Not protected by the state in the cores are 6641 acres of county-owned land and 2312 acres of privately owned land. The state wants to acquire the latter. Also left out of the Natural Areas are 323,000 acres of watersheds that surround the cores. Scientists deem protection of these watersheds essential to the survival of the peatlands. Nevertheless, the watersheds were omitted in order to obtain concensus for the protection of the core areas. A state law incorporating a no-net-loss-of-wetlands policy will be used to protect the hydrological systems of the watersheds.

The small amount of commercial timber associated with the peatlands is mostly in the areas characterized as watersheds rather than within the Scientific and Natural Areas. Each core area has some forest (almost all non-commercial), but the dominant cover of most is not forest. Exceptions are spring fens, i.e. fen tracks emanating from forested tracts. The core area of Red Lake Peatland, for example, is 83,000 acres in size, with probably only some 2% forested (Djupstrom 1993). The peatlands are composed of fens, swamps, and bogs. The fens resemble meadows. The swamps are dominated by Black Spruce, Northern White-cedar, or Tamarack. The bogs are usually dominated by mosses, ericaceous shrubs, and some sedges; but they may be either unforested, or forested with Black Spruce or Tamarack.

The core areas of the peatlands are generally little disturbed except for unsuccessful attempts at drainage in certain areas (Rusterholz 1989) and the harvesting of stunted Black Spruce for Christmas decorations. Most of the timber activities in watershed areas involve crossing sensitive lands to reach timber elsewhere. The crossing is done only in winter, when the peatland is frozen, but can cause damage unless done under special guidelines (Djupstrom 1993). Two of the 16 protected peatlands are described below.

The BWCAW contains an estimated 400,154 acres of unlogged forest, according to Lee Frelich (348,644 acres of standing forest and 51,510 acres that were blown down in 1999). Frelich bases the figures largely on data from Heinselman (1996) and on his own work on the Environmental Impact Statement for proposed prescribed burns in the area of the blowdown (Frelich 2001 and 2002). (See below for more details.)

The aspen parklands in Minnesota comprise some 200,000 acres of "more or less natural land" concentrated in about six core areas spread out across eastern Kittson County and northwestern Roseau County. (An additional, adjacent 50,000 acres of "more or less natural" aspen parklands are found in Manitoba, Canada, where they extend 20 miles from the US-Canada border. The 50,000 acres are managed by The Nature Conservancy of Canada.) The parklands are a mosaic of aspen patches, prairie patches, wetlands, and brush prairie with scattered to dense shrubs. Bur Oak appears sparingly amidst the Quaking Aspen groves in the uplands. In the wetlands are Balsam Poplar, Quaking Aspen, and, along the rivers, American Elm, Green Ash, and Peachleaf Willow. Also present are oak brush and dogwood brush. Roads, ditches, and agricultural land separate the core areas. The parklands are subject to episodes of severe drought, and wildfires have been frequent for 5000-8000 years. Fragmentation brought about by agricultural development has decreased the frequency of fires, yet the parklands may still be the most functional of tallgrass prairie and savanna landscapes (Chapman 1993, Reisz 2001).

Three high-quality areas of aspen parkland are in Wildlife Management Areas in Kittson County: Skull Lake, Beaches, and Caribou. Skull Lake Wildlife Management Area (6360 acres) contains savanna and dune prairie; Beaches Lake (18,426 acres), aspen/oak forest and wet prairie; Caribou (7861 acres), open wet prairie with aspen

clones. Reisz describes these areas as "some of the best examples of functional landscapes in the Northern Tallgrass Prairie Ecoregion (2001).

Ancient Northern White-cedar are found on bluffs and other rocky sites around the Great Lakes, including the Boundary Waters Canoe Area Wilderness (BWCAW) and the volcanic rocks on the North Shore of Lake Superior. Lee Frelich has discovered Northern White-cedar, possibly as old as 2000 years (2001). Islands in Seagull Lake (Cook County) in the BWCAW support "excellent" examples of ancient cedar. The largest of the 250 islands, Threemile Island, has several stands. One is on a small bay protected by a granite peninsula. The peninsula is only about 50 feet in length; on the outer edge are six cedars, each 500 to 1000 years old. "The head of the bay has a dense, swampy, all-aged cedar forest with trees that blew down hundreds of years ago and are still alive. The branches of the toppled trees have turned up "to become individual trees that are now acquiring ancient characteristics themselves" (Frelich 2002). Other ancient Northern White-cedar grow at Basswood Lake (Becker County) (Frelich 2001).

D. W. Larson et al. have cored ancient white-cedar on bluffs above the Mississippi River in Dakota (Winona County) (2000). Frelich notes that ancient cedars are common in swamps in the BWCAW (Frelich 2001).

Minnesota supports remnant savanna sites that have had little or no logging but that cannot be categorized as old growth, because they have been extensively grazed by livestock and have suffered from fire suppression. Any logging would have been limited to occasional cutting for fuel wood, since the trees are not good-quality timber. Some of the savannas include land that has been plowed, but the areas were for the most part spared farming, because of their sandy soil. We list five high-quality savannas, all of which are in state-owned Scientific and Natural Areas and are subject to prescribed burning: **Prairie Smoke Dunes,** northwestern Minnesota (Norman County): 1107 acres of Bur Oak-Northern Pin Oak remnant sand savanna and open dune faces on which aspen are encroaching; **Uncas Sand Dunes**, northwest of Minneapolis (Sherburne County): a 745-acre area with primary Bur Oak-Northern Pin Oak savanna on sand dunes, which are interspersed with old pine plantations (MDNR is cutting out the planted pines); **Agassiz Dunes**, northwestern Minnesota (Norman County): a 435-acre tract of sand dune blow outs with Bur Oak-Northern Pin Oak sand savanna (aspen are encroaching on the site); **Saint Croix Savanna**, southeastern Minnesota (Washington County): a 112-acre area, of which approximately 64 acres are hill prairie, here essentially primary sand savanna with Bur Oak-Northern Pin Oak; **Helen Alison Natural Area**, north of Minneapolis (Anoka County): an 86-acre area, of which 60 acres are primary Northern Pin Oak-Bur Oak sand savanna (Djupstrom 1993; MDNR 2002).

The Minnesota Department of Natural Resources (MDNR) is conducting a state-wide old-growth inventory on state land. The department was required to adopt old-growth guidelines by January 1, 1991, as the result of an out-of-court settlement of a lawsuit challenging the environmental review of a proposed forest products plant. As a result, in 1990 MDNR area and regional staff developed a candidate list of old-growth sites. MDNR began evaluating candidate sites in the field in 1993. By the end of 2002, MDNR had designated 38,000 acres of old-growth forest (29,718 acres of actual old growth and 8282 acres of potential future old growth). These were stands of high quality. They had rejected for preservation as old growth 32,000 acres of candidate stands that were of lower quality or that failed to qualify for other reasons. At the end of 2002 one subsection, Hardwood Hills, had yet to be evaluated. In 1994 a goal of 690 acres of designated old growth had been set for Hardwood Hills.

MDNR defines as old-growth forest, communities that are dominated by long-lived tree species and that have not experienced catastrophic man-made or natural disturbance for a long period of time. For MDNR long means 120 years in relation to all old-growth species except White Spruce, for which the time period is 90 years. MDNR eliminates from consideration as old growth aspen-birch communities, White Birch, and Jack Pine.

Sites that MDNR designates as old growth are protected from logging. However, approximately 70% of all designated sites are less than 50 acres in size and thus would be extremely vulnerable to other forms of disruption. To maintain the viability of the old growth, MDNR establishes a buffer, called a "Special Management Zone" (SMZ), around each site. The buffer extends at least 330 feet in every direction from the edge of each old-growth stand. Logging is allowed in the SMZ, but wherever possible only on extended rotation and by methods other than clearcutting.

Minnesota is comprised of four ecological provinces: tallgrass aspen parklands, prairie parkland, Laurentian mixed forest (coniferous forest), and eastern broadleaf forest. Based on the definition of old-growth forest used by the Minnesota Department of Natural Resources, only the latter two of those provinces contain old growth. The overwhelming majority of the old growth sites are in the Laurentian mixed forest.

The 38,000 acres of designated actual and future old growth are found on four different classifications of land administered by MDNR: Scientific and Natural Areas (SNAs)(1820 acres), Wildlife Management Areas (WMAs) (2191 acres), State Parks (8669 acres), and lands administered by Forestry (25,426 acres--"Forestry lands in the Boundary Waters Canoe Area Wilderness/Shipstead-Nolan Act: no harvest areas" [4050 acres] and "Forestry Timberlands" [21,376 acres]). Given the large number of old-growth sites in Minnesota, we have had to be selective in our listing. Because descriptions of old growth in Scientific and Natural Areas are more readily available than are such descriptions of other types of areas, our chapter pays disproportionate attention to the SNAs.

The following state lands that we do not describe below have 300 or more designated acres of actual old growth: Bowstring State Forest (801 acres), Buena Vista State Forest (608 acres), Cloquet Valley State Forest (311 acres), Finland State Forest (1631 acres), George Washington State Forest (625 acres), Grand Portage State Forest (640 acres), Jay Cooke State Park (312 acres), Koochiching State Forest (1283 acres), Pine Island State Forest (750 acres), Red Lake Wildlife Management Area (702 acres), Savanna Portage State Park (2023 acres), Smoky Hills State Forest (376 acres), White Earth State Forest (400 acres), and Whitewater Wildlife Management Area (491 acres).

In 2003 the Chippewa and Superior National Forests are in the process of revising their respective forest management plans. The US Forest Service (USFS) has compiled a joint Draft Environmental Impact Statement (EIS) and separate management plans for the two forests. In preparing to write the documents, the staff of each forest studied old growth.

In 1993 USFS described for the first edition of our survey four specific stands on the Chippewa, three of which were entirely or mostly in Research Natural Areas (RNAs). Since 1996, USFS has scored forty pine and hardwood stands with an old-growth scoring system developed by Minnesota's Department of Natural Resources (MDNR). They found only a few, small stands that met the definition of old growth that USFS developed from MDNR's system.

Also since 1993, USFS teams on the Chippewa have identified "old-growth complexes" and "core areas," overlapping concepts that became "potential candidate special management complexes" in documents pertaining to the revision of the forest management plan. The teams apparently identified the complexes largely through consultation of databases, supplemented by talking to local people.

Various alternatives in the draft management plan include proposed candidate special management complexes and/or proposed candidate RNAs. The complexes and RNAs may overlap. For instance, a proposed complex may include a proposed RNA. Some of the proposed complexes and RNAs encompass old growth. However, USFS's main aim is to set aside the best representatives of their respective types of forest. The best representatives are not necessarily old growth. Therefore, a list of the proposed candidates does not indicate the locations of old growth, Al Wiliamson, Forest Ecologist said. He was unwilling to give us a list or to discuss specific proposed sites. Ten proposed sites are named in the Draft Environmental Impact Statement, but the names (Cutfoot Sioux, Flora Lake, Goche Lake, Mississippi, North Fork, Ottertail, Pimushe Lake, Sucker Bay, Sunken Lake, and Trout Lake) do not resemble the names of the well-known old-growth sites in the Forest.

The least harvested stands on the Chippewa are lowland stands, most of which have been altered by ditching and draining, Williamson said. The second least harvested stands are northern hardwoods, from which most of the White Pine has been removed. Therefore, whether or not old growth can be found to any extent on the Chippewa depends on how much human disruption one allows, he noted (Williamson 2001).

For the Superior National Forest, Robin Vora drew up a list of "Potential Natural Areas, Including Representative Ecosystems, on the Superior National Forest," excluding land protected as Wilderness, State Parks or State Scientific and Natural Areas (SNAs). He concentrated on using existing information, "field knowledge, maps, and high-altitude aerial photographs." His report, published in January 1997, recommended 93 areas for further field inventory. Using Vora's report, the staff of the National Forest drew up a list of 45 sites for field work in the summer of 1997. Chel Anderson conducted the field work, and in December 1997 her report "Evaluation of Selected Potential Candidate Research Natural Areas . . ." appeared.

The various alternative forest plans for Superior National Forest include, depending on alternative, up to 41 potential candidate RNAs. Most, but not all of them, appeared in Vora's and Anderson's reports. Lula supplied us with a list of the potential candidates, with their acreage. (This list later appeared in the Draft Environmental Impact Statement.) He told us, however, that the document describing the potential RNAs is too lengthy for reproduction. Therefore, for this survey, we have included information on existing RNAs with old growth and on a selection of the potential candidates, based on Vora's and Anderson's reports. We are unable to give exact acreage for the old

growth, as neither Lula's list nor Vora's report contains such figures, and Anderson seldom gives them. Furthermore, certain areas have apparently been partially logged since they were described in the 1997 reports.

SUPERIOR NATIONAL FOREST, in northeastern Minnesota

--**Boundary Waters Canoe Area Wilderness**. As stated above, an estimated 400,154 acres of never-logged forest, of which 51,510 acres blew down in 1999. Frelich breaks this forest into three types: Red and White Pine (61,675 acres of which 8108 acres have blown down); Jack Pine (301,979 acres of which 39,922 acres have blown down); lowland conifer/ash (36,500 acres, of which 3480 have blown down). He states that in addition the forest has 21,400 acres of primary "lichen" community with scattered dwarf trees (mostly Jack Pine, Red Pine, White Pine, Bur Oak, Northern White-cedar, and Black Spruce); and, scattered along lake shores, small groves of ancient Northern White-cedar. The groves are generally 0.1 acres or less and thus do not show up in inventories; but several hundred of them may exist (Frelich 2002).

Heinselman's 1996 book broke the types down into finer categories. We give his figures for ecosystems dominated by trees, though these figures are somewhat out of date, as an additional indication of the character of the area. UPLAND TYPES: Jack Pine-oak (21,400 acres, 4.7% of total area); Red Pine (17,700 acres, 3.9%); Jack Pine-Black Spruce (50,900 acres, 11.2%); Jack Pine-fir (28,700 acres, 6.3%); Black Spruce-feathermoss (28,700 acres, 6.3%); aspen-birch (28,700 acres, 6.3%); aspen-birch-White Pine (21,400 acres, 4.7%); maple-aspen-birch (32,300 acres, 7.1%); maple-aspen-birch-fir (28,700 acres, 6.3%); fir-birch (72,800 acres, 16.0%); Northern White-cedar (17,700 acres, 3.9%); LOWLAND TYPES: mixed conifer swamp forest (2300 acres, 0.5%); Black Spruce bog forest (33,200 acres, 7.3%); Tamarack bog forest (500 acres, 0.1%); Sphagnum-Black Spruce bog (9500 acres, 2.1%); ash-elm-swamp forest (500 acres, 0.1%); alder-willow wetland (11,400 acres, 2.5%) (Heinselman 1996).

Within the BWCA is the Lac La Croix Research Natural Area (St. Louis County): a 973-acre RNA with a 440-acre virgin, old-growth Great Lakes pine forest. The forest "is dominated by Red Pine on ridges and steep slopes and by White Pine on lower slopes and draws" (Rusterholz 1989, 1993).

--**Candle Lake*** (St. Louis County). A potential RNA of 408 acres, including 163 lowland acres that are now classified as suitable for logging. Anderson evaluated 900 acres in the area, including 165 acres of Northern White-cedar with Balsam Fir in the subcanopy. The stand showed "very scattered evidence of previous logging." Known as Lake Leander Cedar, this stand is presumably largely within the proposed candidate RNA. (The stand extends into state land.) The 900 acres also included "a largely undisturbed black ash and cedar wetland complex along the north side."

--**Dragon Lake*** (Lake County). A potential RNA of 2085 acres, with old-growth Red and White Pine. The proposed candidate includes 1630 acres of upland and 181 of lowland forest now classified as suitable for logging. Vora gave a 4140-acre Dragon Lake site (including lakes) the highest ranking of any natural area on the Superior National Forest, with 81 out of a possible 93 points overall and 16 out of a possible 20 for lack of disturbance. Anderson characterized the 4140 acres: "red pine forest, old growth, unthinned and thinned; white pine forest, old growth, unthinned and thinned; paper birch and aspen forest; black spruce, white cedar and mixed conifer swamp, including old growth" (Anderson 1997; Vora 1997).

--**Fall River Patterned Fen*** (Cook County). A potential RNA of 988 acres, 426 of which are lowlands. The only trees in the fen are Black Spruce on sphagnum hammocks, but the fen is undisturbed (Anderson 1997).

--**Kawishiwi Pines*** (Lake County). A 471-acre potential RNA that includes at least 240 acres of old-growth Red and White Pine (Lula 2002; MDNR 2002). Adjacent to the 471 acres is the state-owned 80-acre Kawishiwi Triangle Scientific and Natural Area with 29 acres of old-growth White Pine. The state-owned pines and presumably the USFS-owned pines date from regeneration following fires in 1854 (MDNR 2002).

--Keeley Lake Research Natural Area (Lake County). A 640-acre RNA within a 1280-acre tract that is 70% upland forest and 30% bog forest, with rock outcrops, streams, and the 121-acre Harris Lake. The larger area "has not been cut and has not had a significant burn for over 100 years." The upland forest is dominated by Jack Pine, in pure stands and in a mixture with Black Spruce, Quaking Aspen, Red Pine, and White Pine, the last two frequent only near the lake. The scattered lowlands support open meadows edged by alder thickets, and bogs with early to mature Black Spruce bog forest (Williams 1993).

--**Lake Agnes Hardwoods** (Lake County). Three hundred sixty acres of old-growth northern hardwoods: 260 acres in Superior National Forest, 80 acres of which are in the 792-acre candidate Lake Agnes Research Natural Area. The balance is under the control of the Minnesota Department of Natural Resources. Sugar Maple predominates. Moschatel, Broad-leaved Spring Beauty, and White Baneberry, all associated in Minnesota with old growth, live

here, Moschatel in unusual numbers (Williams 1993, Wilson 1993). According to Anderson's report, the area has 360 acres of old growth, but the old growth was "cut in the late 50s" (Anderson 1997).

--**Marble Lake Lookout Research Natural Area** (Lake County). Sixty acres of old-growth northern hardwood forest. Sugar Maple, Yellow Birch, and American Basswood are the dominant canopy species within the 120-acre RNA. Two plant species of special concern or watch status in Minnesota occur in the ground layer: Broad-leaved Spring Beauty and White Baneberry (Rusterholz 1993, Williams 1993).

--**Pearl Lake*** (Cook County). A 2652-acre potential RNA, presumably with old-growth northern hardwoods and old-growth Northern White-cedar swamp and upland Northern White-cedar. A portion of the hardwoods have been high graded, but researchers singled out for description a south-east and east-facing slope of approximately 100 acres dominated by Sugar Maple with some White Spruce but no Yellow Birch. The slope has no signs of logging, and is apparently too dry to support Yellow Birch (Anderson 1997, Vora 1997).

--**Schroeder Research Natural Area** (Cook County). Forty acres of "virgin" (Williams 1993) northern hardwood plus a 320-acre buffer, mostly of northern hardwoods in secondary succession. In scattered low parts of the 40 virgin acres are up to 10 acres of Black Ash and Northern White-cedar (Williams 1993, Rusterholz 1993).

--**Watertank Lake*** (Lake County). A potential RNA of 854 acres, presumably with upland and lowland old growth. Anderson characterized a 2709-acre Watertank Lake site as a "large block of contiguous old and old growth forest encompassing both upland and lowland communities. . . . Old growth black spruce and cedar dominated lowlands." She noted relatively few disturbances. Scattered stumps indicated selective logging of the northern hardwoods; and there was "some degree" of fire impact. The site showed "a few recent small cuts," and a road bisected it from north to south. Vora gave it 15 out of a possible 20 points for lack of disturbance (Anderson 1997, Vora 1997).

--**Wolf Lake*** (St. Louis County). A potential RNA of 1097 acres, which presumably includes upland and lowland old growth. Anderson singled out for description an old growth conifer forest dominated by Northern White-cedar on a wet-mesic site grading to swamp. Yellow Birch and Paper Birch are in the canopy. The understory is mostly open patches of *Corylus cornuta* and *Acer spicatum*. She ranked it "AB." She also noted that the lowland communities have had "little or no disturbance." The potential RNA would remove 566 upland acres and 292 lowland acres from the timber base (Anderson 2002).

Red Lake Peatland, north and east of the Upper and Lower Red Lakes (Beltrami, Koochiching, and Lake of the Woods Counties)

A core area of 83,000 acres (now a state Scientific and Natural Area), surrounded by a 150,800-acre wetland and within which are more than 1000 acres of forest. Red Lake Peatland is "the largest, most highly developed, and diverse patterned peatland in the United States." It is second only to Lost River Peatland in rare plant species, with *Drosera linearis, Drosera anglica, Carex exilis*, and *Xyris montana* among others. Rare animals include the Short-Eared Owl, Yellow Rail, Eastern Timber Wolf, Wilson's Phalarope, and Greater Sandhill Crane. A small amount of drainage work has been attempted; some trees have been cut on bog islands and on the crested divide near highway 72 that bisects the east-central watershed; and some trees have been cut for Christmas decorations. As of 1984, ownership was 94% state (Beltrami Island and Pine Island State Forests and Red Lake Wildlife Management Area); 1% the federal Bureau of Land Management; 3% Red Lake Indian Reservation; and 2% private (MDNR 1984b).

Myrtle Lake Peatland (Koochiching County)

A 23,000 acre core area and a 13,300-acre surrounding wetland, in the eastern end of the Agassiz Lowlands peatland area. Myrtle Lake ranks second to Red Lake Peatland in ecological significance. A very big water tract passes along both sides of a huge raised bog. Disturbance is minimal-- winter trails. As of 1984, ownership was 97% state, 2% county, and 1% private (MDNR 1984b).

In a 1970 article on the Lake Agassiz Peatlands Natural Area, containing Myrtle Lake Peatland, Heinselman described seven types of peatland vegetation: 1) rich swamp forest, generally dominated in number of trees and basal area by Northern White-cedar, often overtopped by Tamarack, ash, or spruce; 2) poor swamp forest, usually dominated by stunted Tamarack in pure, open stands; 3) cedar string bog and fen complex; 4) larch string bog and fen complex; 5) Black Spruce-feathermoss forest, with tall, thickly set spruce; 6) sphagnum-Black Spruce-leatherleaf bog forest; 7) sphagnum-leatherleaf-Kalmia-spruce heath, with the only trees being occasional Tamarack and clumps of Black Spruce.

Manitou Forest Collaborative Management Area,* North Shore Highlands, northeastern Minnesota (Lake County)

A 75,000-acre forested landscape, adjacent to Crosby-Manitou State Park, which includes extensive old growth:

--A block of 3100 acres of old-growth northern hardwoods (dominants are Sugar Maple and Yellow Birch with occasional White Spruce and Northern White-cedar and White Pine). In northeast Minnesota, northern hardwood forests occur as large patch communities within the near-boreal aspen-birch-spruce-fir forest. The only known logging has been the historic removal of an occasional White Spruce and White Pine. Northern White-cedars are estimated to be up to about 300 years in age; Sugar Maple and Yellow Birch, up to about 200. The forest supports "exceptionally diverse fungi and uncommon plants, including Doll's eyes (*Actaea pachypoda*), Bloodroot (*Sanguinaria canadensis*), and Broad-leaved Spring Beauty." The Nature Conservancy purchased 1600 acres of the old growth as part of a 2000-acre tract that it bought from Wolf Wood Corporation in 2000. The state of Minnesota and other entities own the balance of the old growth hardwood community (Duffus 2001). The state has designated 1038 acres of its northern hardwoods within and outside the block (see below) as old growth (Carlson 2001).

--Additional old-growth northern hardwoods communities. They total some 1500 acres on state, county, and private land. The 1500 acres have experienced little logging. They were identified by the County Biological Survey and by an independent contractor employed by The Nature Conservancy as part of its Upper Forest Project. The Conservancy is engaged in a collaborative process with other key landholders, including Lake County, to protect a natural range of conditions and growth stages including old growth, within this 75,000 acre landscape. "TNC is learning from its partners as they are learning from TNC on sustaining natural and working forests" (Duffus 2001, TNC 2000).

--Also within the Collaborative Management Area, 817 acres of upland Northern White-cedar, 5 acres of lowland hardwoods, and 19 acres of lowland Northern White-cedar, owned and protected as old growth by the state (Carlson 2001).

Itasca State Park, in northwestern Minnesota (Clearwater County)

Within a 32,690-acre State Park, a total of 4094 acres of designated old growth. Of the 4094 acres, 654 acres are within the Itasca Wilderness Sanctuary Scientific and Natural Area (Manolis 2003). The old growth is mainly comprised of Red Pine, White Pine, and mixed Red and White Pine stands. The pines are 100 to 300 years in age. Controlled burns are being used to remove underbrush and stimulate regeneration of the pines (MDNR 2003). Because of an abundance of deer and the absence of fire in the 20th century, regeneration had almost stopped. As a result, shade-tolerant late successional trees or hazel had grown up to dominate the understory in most stands (Rusterholz 1993).

St. Croix State Park,* east-central Minnesota (Pine County)

A large complex of ash and lowland hardwoods in the 34,037-acre St. Croix State Park, along the St. Croix River. The state has designated 1127 acres of Black Ash, 461 acres of lowland hardwoods, 76 acres of upland Northern White-cedar, and 18 acres of oak as protected old growth. Black Ash is up to 220 years in age (Carlson 2001).

CHIPPEWA NATIONAL FOREST, in north-central Minnesota

In 1993 the forest staff described the four sites immediately below as showing no signs of logging and apparently qualifying as "true ecological old growth." All support Gray Wolves, a Threatened species (Mathisen 1993). To them can be added a fifth site, described in the literature and confirmed by Al Williamson (Williamson 2001).

--**Pine Point Research Natural Area** (Cass County): a 673-acre area on a peninsula extending into Leech Lake. It is predominantly Red Pine older than 275 years and has riparian associations. Jack Pine, Red Maple, aspen, and oaks are among the other species. Bald Eagles nest at this site.

--**Stony Point Research Natural Area** (Itasca County): a 404-acre hardwood area. It is on the north shore of Lake Winnibigoshish, and its ecology is strongly influenced by the lake. American Basswood, Black Ash and other

hardwood species older than 100 years dominate. Spring ephemerals flower in abundance. A Great Blue Heron rookery is on the periphery of the area, and Bald Eagles nest nearby (Mathison 1993).

--**Lost Forty** (Itasca County): a 144-acre area with large old Red Pine and White Pine, plus aspen and hardwoods. The majority of the acreage is in the National Forest's Lost Forty Special Interest Area; the balance in the state's Lost Forty Scientific and Natural Area. Minnesota DNR describes two types of old growth: 28 acres of mostly Red Pine forest with White Pine more than 300 years old, and 18 adjacent acres of White Spruce and Balsam Fir (2003). Wingard believes that most of the Lost Forty was not logged, due to its being mapped as a part of a lake; but says that the pines are densest in the east end of the Lost Forty and that the area probably burned repeatedly (1993).

--**Sugar Point** (Cass County): a 143-acre stand comprised primarily of northern hardwoods, including basswood, ash, and maple, more than 100 years old. The site supports a population of Goblin Ferns (*Botrychium mormo),* a sensitive species in Minnesota (Mathisen 1993).

--**Star Island*** in Cass Lake (Beltrami or Cass County): No more than 100 acres of old growth on a 1200-acre island, about a fifth of which is occupied by a lake. The old growth, one of the few USFS sites that measured up to MDNR's scoring system, is in the northwest corner of the island. According to a 1993 map, this corner encompasses areas of Norway Pine, Jack Pine, maple-basswood, and aspen. The island has a number of summer residences (Alway and McMiller 1933; Williams 2001).

Kabetogama State Forest, adjacent to Voyageurs National Park and Superior National Forest in northern Minnesota (Saint Louis County)

Actual old growth 1491 acres in extent plus 455 acres of future old growth (Manolis 2003). Within the Little Fork-Vermillion Highlands ecological subsection, where most of the Kabetogama State Forest lies, actual old growth is represented by the following six cover types: Black Ash 254 acres, Northern White-cedar 543 acres, lowland hardwoods 488 acres, Red Pine 746 acres, White Pine 385 acres, White Spruce 88 acres, for a total of 2504 acres (Baumann 2003).

Ownership of the 697,363-acre Kabetogama Forest as a whole is divided among Saint Louis County, Superior National Forest, and the state. Most of the forest, which is largely on bedrock and shallow soils, was cut at the turn of the century and experienced fires in the 1920s and 30s (Helquist 1993). We do not know whether there is old growth on county and federal land.

Sites of actual old growth on state-owned land include:

Ash Lake: About 89 acres of little disturbed White Pine forest. The stand is about 125 years old (Rusterholz 1993).

Black Duck Lake:* Upland Northern White-cedar old growth on an unnamed island (Wilson 2002).

Johnson Lake: Approximately 73 acres of old-growth White Pine forest, without evidence of disturbance. Much of this forest could be categorized as aspen-birch-White Pine.

Pine Island: in Vermillion Lake: White Pine forest, with Red Pine. The forest is 60 acres in size, 180 years old and has had "little human disturbance" (Rusterholz 1993).

Savanna State Forest,* west of Duluth (Aitkin County)

Several old-growth northern hardwood candidate stands each greater than 100 acres in size (Rusterholz 1993). MDNR has designated 942 acres of actual old growth and 27 acres of future old growth (Manolis 2003).

Nemadji State Forest, east-central Minnesota, on the Wisconsin border (Pine County)

Four large clusters of old-growth northern hardwoods:

--283 designated acres of old-growth northern hardwoods. Includes 150-year-old Sugar Maple.

--101 acres of old-growth northern hardwoods, 90 acres of old-growth Black Ash, and 38 acres of old-growth oak. Sugar maples are up to 140 years in age; Black Ash, to 217 years.

--59 acres of old-growth Black Ash and 38 acres of northern hardwoods. Sugar Maple are up to 200 years of age; Black Ash, 120 years.

--Ludwig Memorial Forest on an upland island almost surrounded by Black Ash swamps, Black Spruce swamps, and shrub swamps. Rusterholz wrote in 1993 that 274 acres of northern hardwoods occupy the western half of Memorial Forest. Adjacent to these hardwoods is a 119-acre stand of old-growth Black Ash. Other smaller areas of Black Ash are within the forest (Rusternholz 1993). The state has since designated 330 acres of current old growth

within the Forest (Manolis 2003). The designated old growth includes Sugar Maple to 155 years of age and Red Maple to 135 years (Carlson 2001).

The northern hardwood stand in Memorial Forest has been disturbed only by cutting of White Pine at the turn of the century. Rusterholz reported that Lee Frelich of the University of Minnesota characterized three northern hardwood associations in Memorial Forest: Red Maple forest; Red Oak-maple forest; and Sugar Maple forest, the last including some Yellow Birch and Red Oak. Within the first are big Red Maple, 40-60 cm dbh (diameter at breast height), and some White Pine stumps. White Pine and Red Maple together must once have dominated the stand (Rusterholz 1993).

Tettegouche State Park, in the North Shore Highlands (Lake County)

Within the 9346-acre park, old growth of four types: 294 acres of northern hardwoods, 142 acres of upland Northern White-cedar, 74 acres of Black Ash, and 94 acres of oak forest. Old White Pine grow in patches, but the pine here "do not by themselves constitute old-growth forest." Yellow Birch are up to 290 years in age; Sugar Maple, 225 years; and Northern White-cedar, 220 years. Black Bear congregate in the Park in the autumn to feast on berries, hazelnuts, and acorns (MDNR 2003).

Hovland Woods Scientific and Natural Area, in the North Shore Highlands (Cook County)

A 2850-acre complex of northern hardwoods and upland Northern White-cedar within five miles of Spring Beauty Hardwoods SNA. The state has designated 348 acres of northern hardwoods, 78 acres of upland white-cedar, and 11 acres of White Spruce within the complex as protected old growth. Sugar Maple are up to 215 years in age; white-cedar to 240 years old. The subsequent addition of Swamp River West to the complex brought the total of current old growth to 508 acres. The complex is owned by MDNR. It is within the boundary of Grand Portage State Forest but was originally private land. Therefore it is not managed as a part of the forest (Carlson 2001, Wilson 2002).

Crosby-Manitou State Park, in the North Shore Highlands (Lake County)

Within the 6682-acre park, old growth of two types: a 166-acre northern hardwoods forest and a 196-acre upland white-cedar Forest. Yellow Birch are up to 400 years old; Northern White-cedar, 300 years; and Sugar Maple, 200 years (MDNR 2003).

Lutsen Natural Area Scientific and Natural Area,* North Shore Highlands (Cook County)

Within the 720-acre state-owned Natural Area, 276 acres of old-growth upland hardwood forest. The old growth is "essentially undisturbed." Numerous individual trees range from 145 to 300 years in age (MDNR 2002, Manolis 2003).

Scenic State Park, in north-central Minnesota (Itasca County)

Within the 3360-acre park, 163 acres of Red Pine and 78 acres of White Pine, designated as protected old growth by the state. Red Pine are up to 261 years in age and White Pine to 210 years (Carlson 2001). The White Pine is located in three groups of stands. DNR evaluators found no cut stumps in two groups of stands; the third had a "very few old, cut stumps." The Red Pine areas are, for the most part in adjacent stands. A "significant proportion" of the Red Pine stands have been salvage cut (Rusterholz 1993).

Big Island Scientific and Natural Area,* northeastern Minnesota (St. Louis County)

A 210-acre island with old-growth communities that have not been designated as old growth by the state, apparently because they do not fit the old-growth categories on which inventories of state land in Minnesota are based. The island has not experienced fire or human disruption for more than 150 years. Old-growth communities include hardwood-conifer forest and aspen-birch forest. Basswood, Bur Oak, White Spruce, and White Pine are prominent in the canopy. A lowland conifer swamp with Tamarack, Black Spruce, and Northern White-cedar crosses the middle of the island (MDNR 2002).

Nerstrand Big Woods , in southern Minnesota (Rice County)

A 1340-acre stand, some 30% of which shows old-growth characteristics, with trees in the 100-120-year-old range. Most of the stand was heavily cut at the time of settlement or later and the stand was perhaps lightly and selectively cut about a hundred years ago. It has a variable grazing history, as it was originally parceled out into 5- to

10-acre woodlots. Nevertheless, it still has a ground layer; and it is significant as one of the biggest remnants of maple-basswood forest left in the United States. It is also significant as a remnant of the "Big Woods" that once covered 5000 square miles of southeast and south-central Minnesota (MDNR 2003). The stand is mainly in Nerstrand Big Woods State Park, but partly on private lands (Chapman 1993, Arnosti 1993, Rusterholz 1993). The state has designated 411 acres in the State Park as actual or future old growth (Manolis 2003).

Voyageurs National Park, in northern Minnesota (St. Louis County)

Three areas of unlogged forest, totaling over 190 acres, within the 220,000-acre park. The dominant species are Red Pine and White Pine, estimated to be up to 450 years old. The block-shaped sites are on the mainland in the northeast section of the park. The largest is on the point, south and west of Surveyor's Island. The two smaller are about 20 miles to the south: one near King William's Narrows and the other just east of Mukooda Lake. All are on parcels held in trust for members of the Chippewa tribe (Brock 1992).

Magney-Snively Park, in Duluth (St. Louis County)

Approximately 175 acres of old-growth northern hardwoods (greater than 160 years of age) within 300 acres of city park. The stand is dominated by Sugar Maple and Yellow Birch. Also present are basswood and Northern Red Oak. The subcanopy is dense and multi-layered; the understory, sparse. The stand was selectively cut, probably for old-growth White Pine. (Rusterholz 1990, 1993).

Wolsfeld Woods State Natural Area,* western side of Minneapolis (Hennepin County)

Within a 221-acre state-owned natural area, 133 acres of old-growth hardwoods that are a remnant of Minnesota's Big Woods. Tree species include Northern Red Oak, Ironwood, butternut, maple, elm, and basswood. Among the herbaceous species in the ground layer are trillium, hepatica, Bloodroot, and Dutchman's Breeches *(Dicentra cucullaria)*(MDNR 2002; Manolis 2003).

Spring Beauty Northern Hardwoods Scientific and Natural Area, in the North Shore Highlands (Cook County)

A 400-acre Scientific and Natural Area (SNA) in which the state has designated 115 acres of northern hardwoods as protected old-growth forest (Carlson 2001). The balance of the preserve includes additional northern hardwoods, some boreal hardwoods, and some aspen. In the designated old growth, Sugar Maple forms a continuous canopy, and dominates in the subcanopy too. Northern White-cedar, White Spruce, White Pine, and Yellow Birch are occasional. The hardwoods, inside and outside the designated old growth area, have had some selective cutting, and a part of the designated old growth was used as a sugar bush. Spring Beauty Hardwoods SNA is owned by MDNR. The land is within the boundary of Grand Portage State Forest, but, since it was privately owned when the State Forest was established, it is not managed as part of the State Forest (MDNR 1984a, Wilson 1993 and 2002, Carlson 2001).

Gustafson's Camp Scientific and Natural Area,* north-central Minnesota (Lake of the Woods County)

One hundred twenty-one acres of designated actual and future old growth within a 185-acre state natural area (Manolis 2003). "While old-growth red and white pine are the most distinguishing elements of this site, the surrounding aspen forest and the white cedar stand bordering the upland are also of key ecological interest." The name refers to a former logging camp (MDNR 2002).

Wood-Rill State Scientific and Natural Area,* western side of Minneapolis (Hennepin County)

A 93-acre old-growth remnant of Minnesota's Big Woods, within the 150-acre State Natural Area. The upland canopy is comprised of Northern Red Oak, basswood, Sugar Maple, and White Oak. Lowland forest containing Red Maple, Hackberry, basswood, Black Ash, and Green Ash grades into a small Tamarack Swamp. The Natural Area also includes a lake, ponds, and wet meadows. Bruce Dayton and his wife Ruth Stricker donated the 150 acres to the state (MDNR 2002, Manolis 2003, Rebuffoni 1996).

Purvis Lake-Ober Foundation Scientific and Natural Area,* northeastern Minnesota (St. Louis County)

A block of 78 acres of old growth: 68 acres of Red Pine and 10 acres of White Pine, plus additional scattered old growth, within the 140-acre natural area (Wilson 2002). MDNR has designated a total of 115 acres of

actual old growth (Manolis 2003). The owner of the land, who protected its forest and wolves for many years, donated it to The Nature Conservancy which transferred it to the state (MDNR 2002).

Burntside Islands Scientific and Natural Area,* northeastern Minnesota (St. Louis County)

Among the 150 islands in Burntside Lake, two "little disturbed forested bedrock islands." Pine Island supports 15 acres of never-logged pines, including 300-year-old Red Pines. The 49-acre Snellman Island supports pine forest, aspen-birch forest, and spruce-fir forest, which have not been logged since 1900. The Nature Conservancy gave the site to the State (MNDNR 2002). MDNR has designated 67 acres of actual old growth on the two islands (Manolis 2003).

Sakatah Lake State Park,* southeastern Minnesota (Le Sueur County)

Sixty-nine acres of old growth dominated by "ancient" oaks (MDNR 2003, Manolis 2003).

Richter Woods in southern Minnesota (Le Sueur County)

A 110-acre county park with 60 acres of old-growth maple-basswood forest, dominated by Sugar Maple, American Basswood, and dying American Elm. The site, which is in the Big Woods section of Minnesota, has suffered some selective logging in the past (Rusterholz 1989).

Wabu Woods State Scientific and Natural Area,* northeastern Minnesota (Itasca County)

Thirty-seven acres of old-growth northern hardwoods within the 104-acre Natural Area provided to the state by The Nature Conservancy (MDNR 2002, Manolis 2003). Additional old growth is found on adjacent county land (Wilson 2002).

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Lee Frelich has calculated that as of 1992, Wisconsin had 23,039 ha (56,906 acres) of primary forest. The breakdown by type was as follows: Northern White-cedar, 18,211 ha; Black Spruce-Tamarack, 2428 ha; Jack Pine, Red-White Pine, spruce-fir, oak-hickory, riverbottom, and northern hardwood each more than 400 ha. The percentage of primary forest that is old growth by the definition that Minnesota and Frelich use, that is, composed of long-lived species that are more than 120 years in age, is not known. Frelich calculated that presettlement forest in Wisconsin covered 8,987,000 ha (22,197,890 acres). Thus, in Wisconsin current primary forest is 0.25% of the presettlement forest (Frelich 1995).

The most extensive old-growth site in Wisconsin today is a privately owned tract, 3-4 miles across, that cannot be discussed because its future is under negotiation. Leaving this tract out of consideration, a majority of the old growth is now or, was within the past fifty years, in the hands of the Board of Commissioners of Public Lands. When Wisconsin became a state, the federal government gave to the state, land to distribute to settlers. At one time the Board of Commissioners controlled 10 million acres, approximately one-third of the land base of the state. The Board still holds almost 80,000 acres of what are known as State Trust Lands. Approximately 45,000 acres are swamp (Black Spruce, Tamarack, Northern White-cedar, alder, muskeg, and sedge meadow); the balance is upland. The Trust Lands today are mostly in small patches —40, 80, 120 acres. Roughly 80% of the current acreage of Trust Land is in the northern counties of Vilas, Oneida, Forest, Florence, Price, and Iron.

A higher percentage of the State Trust Lands than of other public lands is composed of remnant forests. Since these remaining Trust Lands were never distributed, many of them were never cleared or burned. They are not untouched, however. The Board of Commissioners conducts a logging program, consisting for the most part of selective logging of hardwoods. Although occasional fires occur through natural causes, at least half of the 80,000 acres is what may be called "older forest," and a significant acreage is old growth. Most of the old growth within the boundary of Nicolet National Forest is on current or former State Trust Land, for example.

The Board of Commissioners has the right to sell and to trade land. It usually sells to public entities. The board has sold to private parties including The Nature Conservancy. Selling lands to private parties, however, was discontinued in 1986. The money that it obtains from the sale of land and of timber is held for the benefit of schools, universities, and certain other institutions. The Board has amassed some half a billion dollars. With the interest on its funds (not with the income from logging), it makes low-interest loans to communities and school districts. Unfortunately the Board is not authorized to purchase land. The Wisconsin legislature would have to consent to the granting of such authorization. Meanwhile, the half billion dollars cannot be used for land purchases to benefit the environment, no matter how urgent the need.

The Board and its staff manage the 80,000 acres without a legally based public planning process. Wisconsin residents are less aware of the State Trust Lands than they are of other public ownerships. Unlike, the US Forest Service (USFS), the Board does not have to go through a planning process with public input. The Board chooses not to log lowland Northern White-Cedar, Tamarack, or Black Spruce. In addition, it defers from logging some of the sites that have been identified through a recent biotic inventory as having natural area quality of state significance. Other natural area quality sites--including existing old growth--continue to be managed for timber production. The board only owns 5000 acres of hardwards. The balance of the uplands are in other timber types.

Our site descriptions of State Trust Lands are only a sampling, as the sites are too numerous to present in their entirety here. Many of the Trust Land sites are part of larger complexes. The summary of the Draft Biotic Inventory 2003, on which we drew for our information on the Trust Lands, provides the acreage of the Trust Lands but not that of other lands in the complexes (Krause 2002, Board 2003).

USFS released a joint Proposed Land and Resource Management Plan and a joint Draft Environmental Impact Statement for the Chequamegon and Nicolet National Forests in the spring of 2003. The degree of protection that the proposed plan affords to identified old growth varies by alternative. The preferred alternative, Alternative 5, would set aside 86,100 acres as Old Growth and Natural Features Complexes (Management Area 8G). Alternatives 4, 7, and 9 would protect 93,2000 acres in such complexes. Old Growth and Natural Features Complexes "are characterized by ecosystem complexes and scattered individual stands which feature existing or developing old growth forest, as well as other exemplary natural communities." The proposed plan would also protect certain old-growth stands in Special Management Areas (MA 8F) and in Research Natural Areas (RNAs), a total of 99,100 acres

in the proposed plan. Currently the Forest Service has a policy of not logging wet forests (Epstein 2002), and various specific areas were deferred from logging pending adoption of the revised management plan (Parker 2002).

We give only a sampling of the old-growth areas in the National Forests, drawn from data sheets provided by Linda Parker, Forest Ecologist, reflecting the results of biological surveys of the forests. The data sheets describe numerous complexes at some length, but, as a general rule, do not indicate the acreage of old growth. Therefore we are often unable to give old-growth acreage in our site descriptions. Parker estimated in 1998 that there were probably a few thousand acres of current old growth in each National Forest, much of it in small isolated pieces. At that time, the Forest Service was still delimiting old-growth areas (Parker 1998).

The Wisconsin Department of Natural Resources has conducted and is conducting various inventories that have increased knowledge of old growth in the state. They include the Wolf River Biotic Inventory and Analysis and an analysis of old growth in the Northern Highland-American Legion, Brule River, Black River, and Flambeau State Forests. On state forests, the only general policy in regard to protection is not to log types that cannot be regenerated after logging, like Northern White-cedar (Epstein 2002).

For the various types of savanna that once covered extensive areas of Wisconsin, we describe below only samples of the scattered remnants. Pine barrens once occupied 2,300,000 acres. Today they are limited to areas no greater than 9000 acres where management is maintaining or restoring the natural vegetation. Scrub oak barrens or sand savanna, once 1,800,000 acres in extent, may be said to have fared somewhat better due to preservation of a large area in a military reservation. Oak openings, with mesic or wet-mesic prairie, once covered 5,500,000 acres; today they are reduced to small pockets. Sand savanna and oak openings are presently found on a total 100 to 150 sites, most of them overgrown because of a lack of fire and very small and isolated (Haney 1993, Matthiae 1993, Curtis 1959).

Some of the highest quality savannas or savanna complexes are considerably smaller than 40 acres. These areas include 7 acres of oak opening at The Nature Conservancy's relatively undisturbed 129-acre **Chiwaukee Prairie** (Kenosha County); 19 acres comprising the Wisconsin Department of Natural Resources' Bureau of Parks and Recreation's **Blue Spring Oak Opening State Natural Area** (Jefferson County); and 15 acres at the Wisconsin Bureau of Endangered Resources' 52-acre **Genesee Oak Opening and Fen State Natural Area** (Waukesha County) (Walters 1993).

Sites of other types of old growth that are less than 40 acres in size and that lend themselves to visiting include **Holmboe Conifer Forest State Natural Area**, on the edge of Rhinelander (Oneida County): 32 acres of "undisturbed" Eastern Hemlock, White Pine, and Red Pine, owned by The Nature Conservancy (Braker 1993, WDNR 2002); **Devil's Lake State Park** (Sauk County): a few acres of White Pine including 300-year-old trees on a bluff, and a few acres of old-growth White Pine, Red Maple, and Northern Red and White Oak on the lake's south shore (Lange 1993); **Krueger Pines State Natural Area*** (Lincoln County): within Council Grounds State Park, an old-growth northern dry-mesic forest dominated by large even-age White Pine (WDNR 2003); and **Uhrenholdt Memorial Forest** (Sawyer County): a 14-acre, old-growth natural area and a 105-acre managed forest with large White Pines. Now owned by the state, Uhrenholdt Forest once belonged to the family of Elizabeth Olson, wife of the environmentalist and writer Sigurd Olson, who helped to protect the tract (Kaleta 1993).

Menominee Indian Reservation, in eastern Wisconsin (Menominee County)

Two hundred thirty thousand acres of forested land, much of which are often described as “managed old growth.” The eastern part of the reservation has a substantial acreage that is second growth rather than old growth, because the reservation was formed after this area had been cut. The second growth is mostly mixed pine and oak, and occurs on a portion of the reservation with sandy soils. Parts of this area were barrens before European settlement.

The reservation's forest has a long history of selective cutting. Today each stand in the uplands, which constitute some 80% of the reservation, is entered once every ten to fifteen years on the average, for the cutting of selected trees (Kotar 1993). Shade-intolerant species are managed with clearcuts no larger than 30 acres in size (Landis 1992). In the past, individual stands have been cut as infrequently as once every 225 years (Waller 1993). As a result of the selective cutting, the original stands have some of the characteristics of old growth, but fewer large trees and snags and less woody debris than are usual with old growth (Epstein 1993).

The three most common types of forest, broadly defined, are dominated by a) Sugar Maple with other deciduous hardwoods (Yellow Birch and hemlock play very minor roles); b) hemlock and Yellow Birch, with Sugar Maple less prominent; c) and White Pine-Northern Red Oak-Red Maple. The reservation is near the northern limit of

American Beech, which is a canopy co-dominant in certain stands. Some individual stands have a fairly even mixture of White Pine and hemlock, with very few hardwoods. The reservation also has a scattering of Northern White-cedar swamps, and 30,000 fairly contiguous acres of White Pine. The White Pine is 160 years old and results from a fire. In presettlement times this section was in brush (Kotar 1993, Epstein 1993).

Stands in the lowlands, including cedar swamps, are not subject to a logging regime (Kotar 1993). Epstein thinks that "virtually none" of the upland forest is virgin, but that some of the wet forests are probably uncut (1993). Kotar says "chances are that there are acreages that have never been logged" (1993).

Fort McCoy Military Reservation, west-central Wisconsin (Monroe County)

Approximately 60,000 acres of sand savanna and sand prairie, remnants of which are probably representative of the presettlement landscape of the central sands area. Much of the savanna and prairie has grown up into a dense forest of Black Oak, Northern Pin Oak and Jack Pine. Thus specific sites vary in ecological value from "marvelous" to "quite poor." Researchers believe that root systems here and in other oak savannas may be as old as 5000 years, although the stems of the trees are usually no older than 200 years. Periodic fires killed the trees, which resprouted from the root systems. The dominant tree in the Fort McCoy savanna is Black Oak. It is accompanied by Northern Pin Oak, Bur Oak, a little White Oak, and Jack Pine (Haney 1993, Epstein 1993).

The 435-acre Fort McCoy Barrens State Natural Area, within the military reservation, includes a barrens of approximately 200 acres, described by WDNR as “one of the least disturbed oak barrens remaining in Wisconsin.” The highly diverse understory includes four plants that are uncommon or rare in the area. The Natural Area also has two “spring-fed, headwater riparian communities in pristine condition” (WDNR 2002). The land around the riparian communities was probably logged, but not the riparian corridors. They support large White Pine, Red Pine, maple, oaks, and basswood (Mello 2003). For permission to visit the Natural Area, phone 608-388-5766 or 5734.

Namekagon Barrens, northeast Wisconsin (Burnett County)

Some 7000 acres of pine barrens, consisting of a core of 4000 virgin acres plus 3000 acres in which the larger trees have probably been logged off. The natural vegetation is Jack Pine with an admixture of scrub oak, largely Northern Pin Oak, plus heath-like shrubs, grasses, and forbs. In a portion of the barrens, prescribed burning has been so frequent as to take out the Jack Pine. South of the Namekagon River, which cuts across the barrens, the land is in outstanding condition. Here are Jack Pine and even some Red Pine, under which it is possible to burn without killing the trees. The vegetation here is reminiscent of the original barrens (Matthiae 1993).

Apostle Islands National Lakeshore, in Lake Superior (Bayfield County)

More than 1500 acres of old-growth forest, some of which is apparently virgin, on 5 islands that have never been commercially logged and on portions of 5 other islands in the 21-island National Lakeshore. Non-commercial logging has been minimal. Lighthouse keepers cut firewood, but today one has to look hard to find the stumps. The Lakeshore is on the southern edge of the boreal forest and at the northwestern limit of the hemlock-hardwood forest. Some of these islands have never been browsed by ungulates. In the unbrowsed areas, hemlock and Northern White-cedar are reproducing prolifically, and Canada Yew grows lushly. The National Park Service (NPS), which controls the Lakeshore, has been carrying out breeding bird surveys since 1990. They show that old growth is "especially rich" in birds (Banta 1992, Brander 1992, Epstein 1993). Fifty to one hundred feet above Lake Superior, on arches of rock carved out by the waves, ancient cedars the size of bonsai grow (Frelich 2002).

In 2001 the US Department of the Interior allocated funding for the National Park Service to conduct a Wilderness Suitability Study for the Lakeshore. The Wilderness Environmental Impact Statement, which is part of this study, is scheduled to be released in 2003. Meanwhile, under the 1989 General Management Plan for the Lakeshore, the 97% of the land that the plan states has wilderness characteristics is managed as though it were already Congressionally designated Wilderness .

Below, moving from east to west, we describe in turn the old-growth areas.

--Outer Island: a large island, which, according to the National Park Service, includes a 280-acre hemlock-northern hardwood-White Pine forest, never browsed. The forest is on the northern end of the island, the most northeasterly in the Lakeshore, in a lighthouse "reservation" or conservation area. Prominent trees include Eastern Hemlock, Yellow Birch, and White Pine. The hemlock is from 100 to 300 years old. Among the herbs are Corn Lily, Bunch-berry Dogwood, Spinulose Wood Fern, and Canada Mayflower. Within the stand is a Bald Eagles’ nest, active intermittently since 1982; and on the red clay bluffs next to the stand along the shoreline is Marsh Grass-of-

Parnassus, a state endangered species (Banter 1992, Brander 1992). Tyrrell and Crow analyzed a stand of hemlock-hardwoods that is apparently within the 280 acres. They describe the smaller area as 100 acres(40.8 ha), an estimated 374 years in age, and 60% hemlock (Tyrrell and Crow 1994).

--Michigan Island: an island, south of Outer Island, with a small old-growth hemlock stand on the northeast end.

--North Twin Island: a heavily forested 175-acre island never commercially logged. Dominant trees include Balsam Fir, Showy Mountain Ash, Yellow Birch, Paper Birch, Pin Cherry, and Northern White-cedar. Canada Yew and Mountain Maple are in the understory. White Pine forms a scattered super-canopy. Abundant herbs include Corn Lily, Spinulose Wood Fern, Canada Mayflower, and Starflower. Species of "special concern" in Wisconsin are Plains Ragwort and Common Hairgrass. On the island's northern end, a Bald Eagle nest has been active for most of the past decade.

--Devil's Island: a 318-acre island protected from commercial logging by designation as a lighthouse reservation in the late 1800s. Like North Twin, it is one of the northernmost islands in the Lakeshore. Devil's Island has a light station and a north-south road, used today only as a foot trail. Trees include Balsam Fir, Northern White-cedar, Yellow and Paper Birch, and White and Black Spruce. White Pine forms a very sparse super-canopy, and Mountain Maple and Canada Yew are in the understory. Herbs include Corn Lily, Bunch-berry Dogwood, Bracken Fern, Canada Mayflower, and Starflower. In the center of the island is a big bog. Sandstone cliffs and sea caves on the northern end provide habitat for rare plants, including Beautiful Sedge, Shore Sedge, and Butterwort, the first two threatened and the third endangered in Wisconsin. The island also harbors the following species of special concern in the state: Bird's Eye Primrose, Least Moonwort, Bog Reed Grass, Hair-like Sedge, and Chilean Sweet Cicely. This island too has a Bald Eagle nest.

--Long Island: a 297-acre barrier spit--since the mid- 1970s, a peninsula attached to the mainland, instead of an island. It shows no evidence of logging. The area is 7 miles long and less than 0.25 miles wide. Approximately 4 miles belong to NPS; The Nature Conservancy protects the remainder through an easement. The island is "a ridge and swale complex." Jack Pine, White Pine, and/or Northern Pin Oak adorn the ridges; and bogs occupy the swales. Large beach and dune communities line the shores. Formerly the peninsula provided nesting sites for the Piping Plover, a federally-listed Threatened species. It is still used heavily by migrating shorebirds, raptors, and songbirds; and is the site of a Bald Eagle nest.

--Oak Island: a large island near the Wisconsin mainland with an approximately 20-acre old-growth Sugar Maple forest and ravines with old-growth hemlock and White Cedar.

--Bear Island: a large island south of Devil's Island and north of Oak Island, with a 80-acre hemlock forest on its east side.

--Raspberry Island: 295 acres, less than 2 miles from the mainland in the western part of the Lakeshore. The entire island became a lighthouse reservation by the mid-1800s. Northern White-cedar, Balsam Fir, Canada Yew, Mountain Maple, Yellow Birch, and Paper Birch are prominent. Corn Lily, Spinulose Wood Fern, Bunch-berry Dogwood, and Canada Mayflower are among the herbs. Species of special concern are Common Hairgrass, Chilean Sweet Cicely, and Round-leaved Orchid.

--Sand Island: to the west of Raspberry Island, with approximately 90 acres of old growth, in which White Pine forms a super-canopy over Yellow and Paper Birch, Balsam Fir, White Spruce, and Red Maple.

--Eagle Island: the westernmost island in the archipelago. Never commercially logged, its 26 acres are thickly forested, and sport a lush understory of Canada Yew. It has a Great Blue Heron rookery, and, like Gull Island, provides important habitat for colonial nesting Herring Gulls and Double-crested Cormorants (Banta 1992, Brander 1992, Epstein 1993).

Lower Chippewa River State Natural Area, between Nelson and Eau Claire in western Wisconsin (Buffalo, Dunn, and Pepin Counties)

A 15,000-acre area along the Chippewa and Red Cedar Rivers, with extensive old growth of undetermined acreage in the bottomlands. State-owned lands in the flood plain have not been entered for 50 or 60 years and were only selectively logged before that time. In the river channel are islands with floodplain savanna and forest. On the surrounding hillsides are savanna and prairie. More than 25% of the remnants of prairie and oak savanna in the state, equaling more than 2000 acres, are located in the State Natural Area (WDNR 2003).

A feasibility study for the Lower Chippewa area has been conducted, and in 2002 the State Natural Area was approved. As a result, WDNR has the right to acquire up to 15,000 acres of land in the area. However, a management

plan has not yet been developed, nor has an analysis of the area for old growth been undertaken. The area is currently under various ownerships with much land in private hands. WDNR would like to protect by one means or another 60 miles along the Chippewa. The area already includes at least 2 State Natural Areas with old growth.

--Nelson-Trevino Research Natural Area, within the Upper Mississippi National Wildlife Refuge, northwestern Wisconsin (Buffalo County). Undetermined acreage of old growth within the 3740 acres of bottomland hardwoods that comprise the Research Natural Area. The Research Natural Area doubles as Nelson-Trevino Bottoms State Natural Area. The area extends for 4 miles along the Chippewa River, where it joins the Mississippi River. Along the main river channel, the forest must have been at least selectively logged for steamboat fuel, although no stumps are evident now (Drieslein 1993). The extent to which the interior was logged is less certain. Epstein, who first told us of the tract, says it is not possible to know how much is old growth, but significant portions show old-growth characteristics (1993). Drieslein thinks that three-fourths of the area is "pretty much undisturbed" (1993). Urich believes that the whole area has been logged since settlement times but probably not clearcut. The cutting was most likely selective but not on a scientific basis (1993). Silver Maple is the dominant tree. Cottonwood and Green Ash are also present. The trees are mostly 60 to 100 years in age and are not regenerating (Drieslein 1993).

--Tiffany Bottoms State Natural Area* (Buffalo County). A 402-acre area representative of the larger Tiffany Bottoms. The site includes some 60 or 70 acres of floodplain forest with Green Ash, hackberry, Silver Maple, River Birch, ashes, and basswood. It also has savanna on sandy, gravely material, with large open-grown Bur Oak and Swamp White Oak. In the savanna little logging but much livestock grazing took place. The amount of grazing varied with the owners. As a result, some areas have a very good herbaceous layer, while others are nothing but exotics (Epstein 2002, WDNR 2003).

Lower Wolf River Bottomlands Natural Resources Area, east-central Wisconsin (Outagamie, Shawano, Waupaca, and Winnebago Counties)

After completion of a feasibility study for a Lower Wolf River Bottomlands Natural Resources Area, designation of the area was authorized in 2002. As of early 2003, a master plan was under development. The Natural Resources Area includes 14 existing WDNR projects — mostly Wildlife Management Areas--and much private land. Total size is 214,000 acres; state-owned lands total 31,000 of those acres (Epstein 2002, WDNR 2002).

The Wisconsin Natural Heritage Inventory Program conducted a three-year integrated land and water biotic inventory of the entire Wolf River Basin, which drains 6400 square miles. The project, in which the Bureau of Endangered Resources and the Land and Water Program of DNR's Northeast Region cooperated, will support WDNR planning, including work on the Lower Wolf River Bottomlands Natural Resources Area and a Wolf River Basin plan on which work began in 1996. The report summarizing the work was released in 2002.

Eric Epstein reports that the Natural Heritage Inventory found bottomland hardwoods along the Lower Wolf River "that are very good." The Natural Resources Area includes many miles of contiguous forest with pockets of old growth from the tens of acres to a few hundred acres in size (Epstein 2002). John Krause points out 80 acres of old-growth bottomland hardwoods on the Lower Wolf River in Shawano County as one example (2002). An example of possible old growth is

--Mukwa Bottom Forest State Natural Area,* within Mukwa Wildlife Area, east-central Wisconsin (Waupaca County). A 160-acre State Natural Area comprised of diverse southern wet-mesic forest in the Wolf River floodplain. The forest has at least old-growth characteristics. WDNR, which owns the area, notes that trees range in size from saplings to occasional individuals 30 inches in diameter. "Areas with smaller trees appear quite natural with no evidence of past logging or grazing" (WDNR 2002).

Quincy Bluffs and Wetlands Preserve , in south-central Wisconsin (Adams County)

A 1690-acre tract belonging to The Nature Conservancy, in which are roughly 1000 acres of only selectively cut northern dry forest and 600 acres of selectively logged northern mesic forest. Quincy Bluff is a sandstone mesa, which rises almost 200 feet above wetlands to the east. The complex lies just south of the tension zone across Wisconsin, defining the northern edge of southern plant communities and the southern edge of northern communities. The Bluffs therefore are a mixed pine-oak woodland, with White Pine, Red Pine, and Jack Pine barrens in some places; Red Oak, White Oak, and Bur Oak woodland in others. Where cutting was done, the pines were the species taken out. The remaining pine is in the less accessible areas. Most of the dry woodland has grown up out of savanna, due to fire suppression; but 200 to 300 acres, in ravines and hilly areas, were probably wooded originally. The Nature Conservancy uses prescribed burning to restore savanna in the portions of the 1000 acres that have

become overgrown. The preserve also has a "nice Tamarack swamp, probably 100 acres" and a southern sedge meadow (Braker 1993; Drey 2001).

Spread Eagle Barrens, northeast Wisconsin (Florence County)

Some 5000 to 7000 acres, including virgin pockets totaling 1000 acres. Outside the virgin core the larger trees have probably been logged. The trees are Jack Pine with an admixture of scrub oak, predominantly Northern Pin Oak, and an occasional large Red Pine. The understory is somewhat diverse, though not as diverse as that of the oak openings in southern Wisconsin. There are grasses and forbs, along with ericaceous shrubs like blueberries and Sweet-fern. The Department of Natural Resources is in the process of restoring the land around the core by prescribed burns (Matthiae 1993).

St. Croix National Scenic Riverway, northwestern Wisconsin

Old growth of uncertain extent. The unit covers approximately 70,000 acres, extending an average of one fourth of a mile back from the high water mark on either shore of the St. Croix and the Namekagon Rivers. A. R. Weisbrod reported to Tyrrell that possibly "3%?" of this area is old growth, more than "810?" hectares or 2000 acres (Tyrrell 1991). Probably he includes the relevant portion of the Namekagon Barrens, which we describe in a separate entry. Hudick says that the whole riverway was heavily logged in the 1800s and fires burned all but the wettest areas (1993). The fires would have helped maintain the barrens.

Dennis Kaleta speculates that along the Upper St. Croix there may be quite a few places that have not been cut. The trees--mostly Green Ash and Black Ash--are small due to adverse growing conditions. He does not see old stumps in these areas as in some other locations. He also finds along the upper St. Croix trees of considerable size--White Pine, Red Pine, Northern White-cedar, aspen, and even Yellow Birch--usually scattered (1993). John Daugherty speaks of individual cedar trees located in bogs or swampy areas and spared because of their inaccessibility, also on the upper St. Croix, between Gordon Dam and the Moose River (1992).

--Farmington Bottoms State Natural Area (Polk County). A 906-acre Natural Area with bottomland forest showing little evidence of disturbance. Local landowners think that a portion of the southern end may have had some cutting and perhaps some livestock grazing. Back-water channels and bottomland ponds interlace the river-bottom forest. Silver Maple and Green Ash, the predominant trees, overhang the water, forming a closed canopy. Bald Eagle and Red-shouldered Hawks nest in the area. Epstein estimates that Farmington Bottoms has approximately 250 acres of mature forest, but says that with the high rate of disturbance and the rate at which stumps rot along the river, it is hard to determine the acreage (1992). The Natural Area, which also includes areas of water and upland forest, is owned by the National Park Service.

--Interstate Park (Polk County). Possibly 100 acres of old-growth bottomland forest within a 1375-acre park (Epstein 1993, 2002). (The Minnesota side of Interstate Park is a separate entity from the Wisconsin side and is managed by the Minnesota Department of Natural Resources.) Within Interstate Park is the 90-acre Lowland Forest State Natural Area with what a WDNR fact sheet describes as “mature lowland forest on what is periodically an island in the St Croix River” (WDNR 2003). Possibly Epstein and the fact sheet are giving different interpretations of the same site.

--Governor Knowles State Forest (Burnett County).

----Brant Brook Pines State Natural Area. Within the 190-acre State Natural Area, a 34-acre upland old-growth stand dominated by Red Pine. The Red Pine stand, which seems to be just outside the limits of the St. Croix Riverway, originated around 1894, probably after a fire. It was salvage cut after a windstorm (WDNR 2003, Tans 1979). A swamp hardwood forest of oak, Black Ash, and Red Maple is located below the Red Pine stand. Epstein characterizes the swamp hardwoods here as mature with some old-growth characteristics. The State Natural Area overlaps the Riverway.

----Additional “older timber.” The Forest Superintendent states that several locations in the forest along the St. Croix, which are relatively inaccessible because of high water tables, have "older timber," normally Northern White-cedar, Black Ash, Silver Maple, and associates (Giles 1992).

--St. Croix Seeps State Natural Area.* A 210-acre Natural Area on a four-mile reach of the river. “An old-growth stand of red oak and white pine” grows on the southwest flank of a west-facing bluff. Below the pine is a seepage run with an “overstory of old-growth Sugar Maple and Eastern Hophornbeam.” The area, which is owned by the National Park Service, is habitat to rare dragonfly and fish species. (WDNR 2002).

Lower Wisconsin Riverway (Columbia; Dane, Iowa, Sauk, Richland Counties)

Along the lower Wisconsin River from Prairie du Chien to Prairie du Sac, many old bottomland hardwood stands mingled with second-growth stands. The stands are intermixed to such an extent that calculating the old-growth acreage would be a formidable task (Epstein 1993).

Established by state law in 1989, the Riverway has within its boundary 80,000 acres. Eric Epstein reports that the Riverway gives very good protection to a 90-mile stretch from Madison to the Mississippi (2002). Lands within the Riverway District "are to be maintained and protected to promote the physical and aesthetic characteristics of the riverway through permitting and purchase of riverway lands." WDNR has already acquired several tracts within the corridor to bring the total state land, as of late 2002, to 43,000 acres. Logging on lands visible from the river is regulated, with only selective logging on the river edge and bluffs.

An example of the state-owned land in the riverway with likely old growth is

--Wauzeka Bottoms State Natural Area, on the north side of the Wisconsin River (Crawford County). A 798-acre stand of "undisturbed floodplain forest." Silver Maple, Swamp White Oak, River Birch, and Green Ash dominate the canopy. Hackberry, American Elm, Honey Locust, Black Willow, American Basswood, and cottonwood are also present. The canopy varies from closed with an open understory to semi-open with a brushy understory of Common Buttonbush, Winterberry, Elderberry, and Prickly Ash. The breaks in the canopy are above Beaver ponds, oxbow lakes, and running sloughs. Almost the only evidence of past logging is at the western edge, near the Kickapoo River. A few cows occasionally enter the area from the north, but "the effects of grazing have been minimal." The Department of Natural Resources manages the area as part of its Lower Wisconsin Riverway (WDNR 1990).

Wyalusing State Park, in southwestern Wisconsin (Grant County)

Some 400 to 800 acres of old growth growing from the Wisconsin River floodplain to the bluffs 400 or more feet above. The old growth is in a single big block comprised of two State Natural Areas, Wyalusing Hardwood Forest and Wyalusing Walnut Forest, and the land between them. Outside the block but adjacent to the Natural Areas is very good second growth. The floodplain is southern wet-mesic forest with Silver Maple, elm, and cottonwood. Above the floodplain are southern dry-mesic forest and southern dry forest. In areas of rich soil in the Walnut Forest Natural Area, Black Walnut grows in two nearly pure stands and in stands with Northern Red Oak, American Basswood, and, to a lesser extent, American Elm, Hackberry, Butternut, and Sugar Maple. Higher, on thinner soil, are Black Oak and White Oak (WDNR 2002, Epstein 1993). Tyrrell cites the park as an example of old-growth mesic and wet-mesic northern oak forests (1998).

Brule River State Forest, in northwestern Wisconsin (Douglas County)

The Brule River flows north into Lake Superior. In the long, narrow state forest, on either side of the river are small areas of old growth that are temporarily or permanently protected.

As of early 2003, WDNR's Bureau of Forestry is in the process of revising the management plan for Brule River State Forest. The draft revision includes positive changes, in particular an enlargement of the Upper Brule River State Natural Area. However, because of other, less satisfactory aspects of the draft, Friends of the Brule River has asked for a judicial review. As of early 2003, the issue is in the courts (McNeil-Sarri 2003).

--Bois-Brule Conifer Bog State Natural Area: a 132-acre, 0.3-mile wide conifer swamp through which the Brule flows. Mature Northern White-cedar, Balsam Fir, and spruce, plus occasional patches of Black Ash and thickets of alder are found here. "The conifer swamp remains in near pre-settlement condition with evidence of only limited logging" (WDNR 2002, Rau 1999).

--**Upper Brule River State Natural Area**: a 182-acre area with 146 acres of northern wet-mesic forest and 34 of alder thicket. A conifer swamp, dominated by Northern White-cedar, Balsam Fir, and spruce, "is in near presettlement condition, with little evidence of logging." An unnaturally large deer population has, however, limited reproduction of trees and shrubs since 1940 (WDNR 2002, Rau 1999).

--Jack Pine areas:* south of the town of Brule, a 40-plus-acre area and smaller scattered areas of never-logged Jack Pine. The state forest service has set aside the 40 acres in a "deferral area" (Rau 1999, Shulz 2003).

--Brule River Conservation Easement Program: as of early 1993 covering approximately 5000 privately-owned acres within the boundaries of the southern portion of Brule River State Forest, some portions of which have "probably" never been artificially disturbed. They include stands of old-growth Red and White Pine, totaling perhaps some 100 acres, with individual trees possibly exceeding 300 years in age; and a lowland Northern White-

cedar swamp, covering approximately 300 acres. Bald Eagles, Osprey, and Timber Wolves inhabit the Brule as well as 11 species of birds considered rare in Wisconsin: Black-backed Woodpecker, Three-toed Woodpecker, Yellow-bellied Flycatcher, Swainson's Thrush, Ruby-crowned Kinglet, Cape May Warbler, Red Crossbill, Evening Grosbeak, Connecticut Warbler, Black-throated Blue Warbler, and Green Heron (Braker 1993, WTNC [n.d.], Drey 2001).

Dunbar Barrens, northeast Wisconsin (Marinette County)

Thirteen hundred acres, consisting of a virgin core of 300 to 500 acres surrounded by logged land. As at Spread Eagle Barrens, the trees are Jack Pine with an admixture of Northern Pin Oak (Matthiae 1993).

NICOLET NATIONAL FOREST

--Argonne Esker* (Forest County). An old-growth hemlock forest covering a braided esker, plus pockets of old growth, within a 6000-acre area. The finest portions of the esker forest are "'A' quality hemlock with some cedar and scattered super-canopy white pine." North of the esker is selectively cut hardwood forest dominated by Sugar Maple. Surrounding the esker and associated hardwoods is "an extensive matrix of mixed conifer swamp." The swamp is headwaters for the North Branch of the Popple River. Along the river is an old-growth hemlock/white-cedar stand with an unsalvaged blowdown (Parker 1998, 1999), also islands of old-growth pine (Draft Biotic Inventory 2003). Many pockets of hemlock, some in boulder fields, are scattered through the complex. Many of these stands have had some degree of cutting but others "are still in fine shape" (Parker 1998, 1999)

State Trust Lands occupy 2880 acres of the complex, including the esker and the best stands around it (Draft Biotic Inventory 2003). These lands have no formal protection. Argonne Esker is Nicolet National Forest Special Area #1. On USFS property several stands have been designated as old growth and "numerous" others have had logging deferred (Parker 1998, 1999). However, other upland stands have no protection, and selective cutting occurred as recently as the winter of 2000 (Draft Biotic Inventory 2003). Argonne Esker is proposed as an Old-Growth and Natural Features Complex in the Proposed Land and Resource Management Plan 2003.

--Rat Lake Swamp* -Popple River Headwaters (Forest County). "Vast, undisturbed conifer swamp along the upper reaches of the Popple River with extensive stands of black spruce, tamarack, and white-cedar swamp." "Several small drumlins within and adjoining this wetland complex contain remnant stands of older hemlock and hemlock hardwood forest, especially along the swamp margins. Scattered super-canopy white pines are scattered throughout the site" (Draft Biotic Inventory 2003). Second-growth hemlock hardwood forest comprises the majority of the upland forest (Draft Biotic Inventory 2003). USFS data sheets speak of "old growth hemlock forest along riparian fringe" and "remnant hemlock hardwood forest" of only "small acreage." They characterize the site as having 2877 acres, of which 520 acres are State Trust Land (Parker 1998, 1999). The State Trust Land inventory states that the Trust Land at Rat Lake Swamp -Popple River equals 1080 acres. Therefore, a portion of the Trust Land must be outside the boundaries of the National Forest and/or the area that USFS is describing. The Proposed Land and Resource Management Plan 2003 proposes Rat Lake Swamp -Popple River, apparently with Argonne Esker, as an Old Growth and Natural Features Complex.

--Woods Creek Cedars* (Florence County). "One of the most extensive and arguably best quality old growth white-cedar swamps on [Nicolet National Forest] lands. Much of this forested wetland is former Trust Lands. This swamp provides the headwaters to Woods Creek," the State Trust Land inventory notes (Draft Biotic Inventory 2003). The USFS Biological Survey characterizes Woods Creek as having an "extensive old growth cedar swamp" (Parker 1998, 1999). An adjacent 40 acres is still State Trust Land. "The older northern hardwood forest type found here is poorly represented on adjoining [Forest Service] lands, especially in protected areas." On lower slopes in the 40 acres are "remnant pockets of old growth hemlock, yellow birch, upland white cedar, and rarely, very large diameter (40"+) super-canopy white pines." The 40 acres have no protection from logging (Draft Biotic Inventory 2003). A USFS evaluation sheet lists the Woods Creek Cedars LAD Complex as 925 acres in total. USFS 's Proposed Land and Resource Management Plan 2003 names Woods Creek Cedars as a proposed RNA.

--Scott-Shelp Lakes (Forest County). A 46-acre stand of old-growth Eastern Hemlock with a White Pine super-canopy, within a 272-acre Natural Area owned and managed by the US National Forest Service but recognized as a State Natural Area by the state. The Natural Area is in turn within an 1888-acre USFS complex. The only apparent disruption in the northern mesic hemlock-pine stand was the cutting of cedar in a fairly narrow line along the shore of Shelp Lake. The Natural Area also includes 118 acres of state-significant northern wet forest, which has been logged

for some timber types "in the distant past" (WDNR 2002). A 266-acre area is a candidate RNA (RNA List). About 40% of the complex is within the Headwaters Wilderness. The Biological Survey notes that much of the complex outside the Headwaters Wilderness and the Scott Lakes-Shelp Lakes Natural Area is lowland conifer swamp, which is "relatively intact" and should be protected (Parker 1998, 1999). The Proposed Land and Resource Management Plan 2003 lists Scott-Shelp Lakes as a proposed RNA, Special Management Area, and Old Growth and Natural Features Complex.

--Argonne Experimental Forest* (Forest County). A 40-acre stand of old-growth hemlock-hardwood forest plus old-growth hemlock forest along a riparian fringe. Tyrrell and Crow estimate the age as 235 years, and note that the stand is 61% hemlock and has an average of 30 cut stumps of all species per hectare (Tyrrell and Crow 1994).

--**Franklin-Butternut Wild Lakes and Hardwood Forest** (Forest County). A mosaic of upland, wetland, and aquatic communities and old-growth, mid, and early successional forests on 1458 acres of pitted outwash terrain. Old-growth sites include the 25-acre Bose Lake Hemlock Hardwoods State Natural Area, an RNA with no evidence of logging. "Several interconnected stands of hemlock-dominated old growth are on the isthmus between Franklin and Butternut Lakes, on both sides of Butternut-Franklin Creek." "Smaller stands of old-growth hemlock are found on the east side of Sunfish Lake, on the landward end of the sand spit on the north side of Franklin Lake, and on a long esker-like ridge in the vicinity of Two Dutchmen Lake."

Bose Lake Hemlock Hardwoods is protected, as is Sunfish Lake, as a Special managment Area. Several other stands are set aside as old growth. Parts of the area, including the Frankln-Butternut Isthmus, get heavy recreational use. The Biological Survey team states that the isthmus should neverthless "probably" be given RNA status and that "many upland" and "most lowland" stands should have special management status (Parker 1998, 1999). Franklin-Butternut Lakes is proposed in the Proposed Land and Resource Management Plan 2003 for a Special Management Area.

--Cathedral Pines Tract* (Oconto County). At least 40 acres of old growth, the Cathedral Pines Special managment Area, within a tract of approximately 2000 acres, which is largely upland mesic forest. The Cathedral Pines stand is dominated by hemlock, above which White Pine and Red Pine rise. This stand and a few other pine stands originated after fire. The Cathedral Pines Special Area has trails and a parking area which "receive fairly heavy use."

Also in the 2000-acre complex is the 110-acre Archibald Tract along Archibald Lake, much of which "would likely qualify as old growth" although it has had selective logging. The Archibald Tract, including "some very nice, lightly managed hemlock stands, was owned by the Weyerhauser family. The family donated it to The Nature Conservancy, and in 1993 The Conservancy transferred it to USFS. The 2000 acres as a whole have "had a relatively light management history." The Proposed Land and Resource Management Plan 2003 recommends that Cathedral Pines be maintained as a Special Management Area, as recommended in the Biological Survey (Parker 1998, 1999).

--Fay Lake Hardwoods and Conifer Swamp LAD Complex* (Florence County). A "lengthy stretch" of old-growth Eastern Hemlock with super-canopy White Pine, along the Fay Lake Outlet river corridor within a 1012-acre complex. Also present in the old growth are Yellow Birch and Northern White-cedar. Large diameter trees (some White Pine over 24 inch dbh (diameter at breast height)), den trees, snags, nurse logs, and other coarse woody debris are common. The Fay Lake river corridor was not protected as of 1999, but, according to the Biological Survey, should be. Northern wet forest of "A" quality," morainal ridge crests, and an esker are also present in the complex. However, much of the complex has experienced heavy logging (:Parker 1998, 1999). In the Proposed Land and Resource Management Plan 2003, Fay Lake is proposed as an Old Growth and Natural Features Complex.

--Sevenmile Creek Pines* (Oneida County). "Undisturbed black spruce swamp" bordering a mile of Sevenmile Creek. "Uplands north of the creek feature old growth white pine with localized patches of hemlock" (Draft Biotic Inventory 2003). The USFS project is 388 acres in extent, but USFS ownership is patchy. State Trust Land comprises 120 acres of the site (Draft Biotic Inventory 2003). The recommended protection status is "representative research natural area for landtype. Past cutting and fragmented ownership may warrant Special Management Area or old-growth designation, however" (Parker 1998, 1999). Sevenmile Creek is proposed as an Old Growth and Natural Features Complex in the Proposed Land and Resource Management Plan 2003.

--Lost Lake Hemlocks* (Florence County). Old-growth hemlock-hardwood forest bordering Lost Lake within a 1116-acre complex. The stand is unlogged except for the cutting of a few "hazard trees." However, it currently "receives heavy recreational use." The forest around Lost Lake is protected as old growth. The Biological Survey recommended "old-growth designation" for other selected stands, especially those "covering the esker

system east of Lost Lake" (Parker 1998, 1999). Lost Lake is proposed as an Old Growth and Natural Features Complex in the Proposed Land and Resource Management Plan 2003.

--Pat Shay Lake Hemlocks* (Forest, Oneida, and Vilas Counties). Old-growth hemlock-hardwoods of "excellent quality" bordering Pat Shay Lake, within a 567-acre complex. The old-growth stands are dominated by hemlock. Sugar Maple and Yellow Birch are, also present. The old growth on the north shore has apparently never been logged; skidder trails are visible in the old growth on the south shore. A road winds through the old growth and is causing erosion and compaction. The old growth is presently "managed" as such, but the Biological Survey team recommended that it be an "Old Growth or Special Management Area" (Parker 1998, 1999). Pat Shay Lake is recommended as a Special Management Area in the Proposed Land and Resource Management Plan 2003.

--Alvin Creek Headwaters (Forest County). A 200-acre candidate RNA, which includes 20 to 30 acres of old-growth hemlock-hardwoods with a super-canopy of Red and White Pine. Also in the candidate RNA are 80 acres of Sugar Maple-basswood forest that received a "light selective/salvage cut" several decades ago but are reported to have an "intact" overstory and to show only "very minimal" signs of past disruptions. The site as a whole is 1172 acres, at the core of which the State School Trust owns 160 acres (Draft Biotic Inventory 2003, Parker 1998, 1999). In its Proposed Land and Resource Management Plan 2003, USFS proposes Alvin Creek Headwaters as a Special Management Area.

--Alvin Hemlocks* (Forest County). A 537-acre site containing a "large" strip-cut conifer swamp with "high quality" old-growth white-cedar in the uncut portions. Among the white-cedar are areas of Black Spruce and Tamarack and "very wet Black Ash forest." The cut strips now support alder. The complex is also the site of the largest contiguous tract of hemlock-hardwoods in the Florence Ranger District. The hemlock-hardwoods have been selectively cut, and skidder trails run through them. A small stand of hemlock-White Pine contains virgin super-canopy pine. Commercial forestry is the current land use for the complex and for the surrounding land. The Biological Survey suggests that the area "might be an appropriate candidate to manage for old growth characteristics and for possible designation as old growth" (Parker 1998, 1999). The Proposed Land and Resource Management Plan 2003 proposes Alvin Hemlocks as an Old Growth and Natural Features Complex.

Northern Highland—American Legion State Forest, in northern Wisconsin (Iron, Oneida, and Vilas Counties)

Very good hemlock remnants and a lot of good wetlands, Eric Epstein reports (2002). The six areas below were the only sites out of 52 candidate areas that received a rank of "A" in an assessment on "Community Restoration and Old Growth" on the Forest. An additional 14 were ranked "AB." All six include old growth, but since the acreage of the old growth has not been determined, we list them in the order of their ranking in the study. A new management plan for the forest is being developed. The plan will presumably designate and set aside these areas as old growth.

--Frog Lake* (Iron County). An 800-acre Candidate Old Growth Site adjacent to Frog Lake in the Manitowish Wilderness Area within the state forest. The Community Restoration and Old Growth Assessment Team (CROG) describes the Candidate Site as a "120-year old red and white pine site . . . Much of the site is 30-year old aspen with old pines in the overstory" (Eckstein 2001). The Wisconsin Department of Natural Resources (WDNR) has designated the 42-acre lake and the 150 acres of forest immediately adjacent to it as Frog Lake and Pines State Natural Area. WDNR describes the 150 acres as "old-growth northern dry-mesic forest." The logging history is not known, "but some cutting has occurred," the agency notes (WDNR 2002).

--Lake Laura* (Vilas County). A 3425-acre Candidate Old Growth Site surrounding Salsich Lake and touching Irving and Laura Lakes. The area contains an extensive block of hemlock-northern hardwood forest with an admixture of Northern Red Oak and White Pine. Within the block are "several inclusions of old growth hemlock and white pine" (Eckstein 2001).

--**Plum/Star Lakes** (Vilas County). An 842-acre Candidate Site, characterized by CROG as "old growth hemlock and hardwoods with scattered red oak and old red and white pine between Plum and Star Lakes." Plum Lake State Natural Area is within the Candidate Site. Researchers have described a hemlock-hardwood stand within and adjacent to the Natural Area. Tyrrell and Crow write of the stand as 249 acres (100.8 ha) in size, and estimate the age at 252 years (1994). The Wisconsin Department of Natural Resources describes the stand as 228 acres and as originating after fire about 1810. The stand was selectively cut for White Pine in the 1880s (WDNR 2002), and has an average of 8.6 stumps per hectare (Tyrrell and Crow 1994). Tree species in decreasing order of frequency are Eastern Hemlock, Sugar Maple, Yellow Birch, and basswood. As a result of a large deer population, "tree reproduction is sparse and the groundlayer depauperate" (WDNR 2002).

--Lake Alva* (Vilas County). A 320-acre Candidate Site, within which is "an 80-year old mixed northern hardwood site with old growth yellow birch and hemlock south of Alva Lake" (Eckstein 2001).

--Catherine Lake* (Iron County). A 924-acre Candidate Site, within which "old growth hemlock-hardwoods occur south and east of Catherine Lake" (Eckstein 2001).

--Twin Lakes* (Iron County). A 288-acre Candidate Site, within which old growth hemlock-hardwoods occur north of Twin Lakes (Eckstein 2001).

Island Lake Hemlocks*—West Branch of the Montreal River Headwaters, north-central Wisconsin (Iron County)

"Hummocky morainal topography with old-growth hemlock-hardwoods, some of which is still virgin forest." Second-growth northern hardwoods are interspersed with the patches of old growth. In depressions are small stands of swamp hardwoods and mixed conifer swamp. The site is surrounded by industrial forest that has been heavily logged. Iron County owns the bulk of the site. Other owners are the State Trust Lands (120 acres) and forestry companies. Logging is deferred on the state land (Draft Biotic Inventory 2003).

Avoca Prairie-Savanna State Natural Area, southeastern Wisconsin (Iowa County)

One hundred and seventy-five acres of oak opening or savanna within the 1885-acre Natural Area on an outwash sand terrace along the Wisconsin River. In the savanna are Bur Oak and Black Oak, scattered and in groves. The open-grown oaks look "much as they did during the original land survey of 1833." The Natural Area also includes a 970-acre wet-mesic prairie, the largest prairie remnant in Wisconsin. The Natural Area was mowed from the 1860s until the DNR's Department of Wildlife Management acquired it as a state wildlife area. Some livestock grazing occurred in the 1930s. Parts of the tract were burned yearly, before and after settlement. The DNR continues to burn the land on a regular schedule (WDNR 1989, 2002).

Black Hawk Island, in the Wisconsin River north of Wisconsin Dells (Juneau County)

A largely undisturbed, forested island of approximately 173 acres. Researchers have shown that the vegetation varies with soil type. Red Pine dominates "on the sandy Entisol" on a terrace about 1.5 meters above the river. "White Pine is most dominant on the Spodosol" on a terrace about 12 meters above the water. Across the top of the island, where soils are "sandy clay loam to clay loam Alfisols ," Red Oak and White Oak dominate. Sugar Maple, in company with basswood, is dominant on the silty clay-loam Alfisol. Hemlock grows almost alone on steep cliffs with Histosol, to the north. Where the soil has been plowed, aspen is dominant. "Most stands are old growth stands." The disturbances are infection by oak wilt, of Red Oak growing on Inceptisol; logging and plowing of two small areas (Pastor et al. 1982, 1984) before 1932, and cattle grazing also before 1932; plus trails. The University of Wisconsin Extension owns the area (Lindsey & Escobar 1976).

Cranberry Creek Mound Group State Natural Area,* in south-central Wisconsin (Juneau County)

An old-growth Jack Pine forest, 170 acres in extent, within a 253-acre Natural Area. The forest is "characterized by large forest-grown trees with many windthrows and no signs of thinning." The area features conical and effigy mounds built by Indians of the Woodland period. WDNR owns the site (WDNR 2002).

Totagatic Highlands Hemlocks State Natural Area, northwestern Wisconsin (Washburn County)

A 160-acre State Natural Area composed of 43 acres of old-growth northern wet-mesic forest, 104 acres of old-growth northern mesic forest, and an alder thicket. A stand of Northern White-cedar dominates the wet-mesic forest. The mesic forest includes a large stand of Eastern Hemlock along with Yellow Birch, American Basswood, and American Elm. The wet-mesic forest does not appear to have been cut; the mesic forest has been "lightly cut in the past." The natural area is now under the control of WDNR Endangered Resources, which acquired it from the Board of Commissioners of Public Lands (Kaleta 1993, WDNR 1989, 2002). The Commission still owns a nearby or adjacent 40-acre site that is also called Totagatic Highlands Hemlocks but is in neighboring Sawyer County. The State Trust Land and adjacent land that is owned by Sawyer County support second-growth northern hardwoods with a fringe of old-growth eastern hemlock-upland cedar (Krause 2002).

High Cliff Escarpment State Natural Area,* within High Cliff State Park, in south-central Wisconsin (Calumet County)

Talus slopes supporting approximately 123 acres of wet-mesic forest within the 125-acre State Natural Area beside Lake Winnebago. High Cliff State Park is on the Niagara escarpment. Described by WDNR as "undisturbed," it is made up of basswood, elm, Sugar Maple, White Ash, Green Ash, Hackberry, and Butternut. Near the lake are willows and cottonwood. The herbaceous layer is rich (WDNR 2002).

Clifford F. Messinger Dry Prairie and Savanna Preserve State Natural Area, within the southern unit of Kettle Moraine State Forest, southeastern Wisconsin (Jefferson, Walworth, and Waukesha Counties)

A State Natural Area comprised of 16 separate sites, among them Whitewater Oak Opening with 110 acres of savanna. Bur Oak dominates the south and southwest-facing slopes and the ridge tops; Northern Red Oak, the north-facing slopes; and White Oak elsewhere. Shrubs, including exotic honeysuckle, grew up among the trees after fire was suppressed. However, a wildfire that occurred in the 1950s opened the area somewhat. Now DNR conducts prescribed burns (WDNR 2002; Walters 1993).

Moose Lake State Natural Area,* north-central Wisconsin (Iron County)

A State Natural Area with pockets of old-growth Eastern Hemlock and possibly also old-growth lowland conifer and hardwoods. The lowland conifer and hardwoods are dominated by Black Ash, Black Spruce, and Northern White-cedar. The area centers in the 270-acre undeveloped Moose Lake. A variety of wetland communities surround the lake. The upland forest, beyond the wetlands, has "pockets of higher rocky terrain" dominated by basswood, Paper Birch, Sugar Maple, and Balsam Fir. Moose Lake is owned by WDNR, which purchased it from the Boards of Commissioners of Public Lands (Krause 2002) (WDNR 2002). Sixty acres of conifer swamp in the area still belong to the Board of Commissioners of Public Lands. Logging is deferred on them (Draft Biotic Inventory 2003).

Dunn Lake State Natural Area, in northern Wisconsin near Michigan's Upper Peninsula (Vilas County)

Virgin northern mesic forest, 50-100 acres in size, within a 562-acre preserve, purchased from the Board of Commissioners of Public Lands by the state Bureau of Endangered Resources (Epstein 1992, Krause 2002). The virgin stand is to the northeast of Dunn Lake and stretches eastward across the Presque Isle River. White Pine tower over large hemlock, Yellow Birch, Sugar Maple, and basswood. Bald Eagles nest here. Another old-growth stand is west of Sanborn Lake on an upland peninsula. Along Presque Isle River are "excellent examples of northern sedge meadow [80 acres], alder thicket [130 acres], and northern wet forest [28 acres]." While the northern half of the site is "virtually untouched," the uplands in the southern half have been heavily cut. (WDNR 1991, 2002).

Squirrel River Pines State Natural Area,* north-central Wisconsin (Oneida County)

The main feature of the 240-acre State Natural Area is northern dry-mesic forest on a "narrow, sandy peninsula running northeasterly towards the Squirrel River." A stand of big Red Pine, intermingled with White Pine saplings, is the dominant feature of the forest. The Red Pine are in the 16"-24" dbh size class, with a few trees as big as 30" dbh. Charred stumps and snags suggest that the stand probably had a fire origin. Around the peninsula is a wetland complex with northern sedge meadow, northern wet forest, and alder thicket (WDNR 2002). The land belongs to WDNR, which bought it from the Board of Commissioners of Public Lands (Krause 2002).

Haskel-Noyes Memorial Woods State Natural Area, within the Northern Unit of Kettle Moraine State Forest, in southeastern Wisconsin (Fond du Lac County)

Sixty-seven acres (27 ha) of forest that, with the possible exception of a couple of acres at the north end, have not been logged or burned by Euro-Americans. Fifty-two acres (21 ha) are composed of mesic forest. The overstory of the mesic forest is primarily Northern Red Oak and Sugar Maple. The mid-story dominant is Sugar Maple. The mixture of Northern Red Oak and Sugar Maple is probably the result of a wind storm that formed moderately large gaps in which the shade-intolerant Red Oak established itself. Such a disturbance has not occurred in the last hundred years. If there are no such events in the future, the forest will shift to Sugar Maple. The balance of the area is wet-mesic forest, also dominated by Sugar Maple and Red Oak. The forest was purchased by the state in 1947 "to prevent its imminent destruction by logging" (Cook 2000, WDNR 2002)

Jung Hemlock-Beech Forest State Natural Area,* in east-central Wisconsin (Shawano County)

A 63-acre remnant of the northern mesic forest that once covered "millions of acres." The forest is within an 80-acre State Natural Area that also includes several sedge-sphagnum bogs covering a total of about 7 acres and, at

the south end, abandoned fields that are succeeding to forest. In the forest, which appears to be 150-200 years in age, are hemlock, beech, Sugar Maple, Yellow Birch, and White Pine. The site shows no evidence of grazing or "recent" logging. The Biotic Inventory of the Wolf River Basin identified it as old growth (WDNR 2002, Epstein et al. 2002).

CHEQUAMEGON NATIONAL FOREST, in north-central Wisconsin

--**Memorial Grove Hemlocks and Squaw Creek Marsh Project** (Price County). Within the tract, which according to a USFS draft is in the 100-500-acre category (USFS 2000), is the 64-acre Memorial Grove Research Natural Area. The RNA includes 47 acres (19.2 ha) of old-growth hemlock-hardwoods. The stand is 69% hemlock, has an estimated age of 302 years, and exhibits 20 cut stumps per hectare, the majority of them hemlock (Tyrrell and Crow 1994). The old growth is surrounded by birch hardwoods, which are succeeding to hemlock-dominated forest or mixed pine type. Adjacent to the old-growth tract is the largely privately-owned Squaw Creek Corridor, with "good quality wetland communities." Only the RNA, which contains the old growth, is protected. The Biological Survey recommended giving special management status to the remaining federal land in the tract and the purchase of the Squaw Creek corridor (Parker 1998, 1999). Memorial Grove Hemlocks is proposed as an Old-Growth and Natural Features Complex in the Proposed Land and Resource Management Plan 2003 for the Chequamegon National Forest.

--Tucker Lake Hemlocks. Old-growth hemlock and Yellow Birch, which Epstein describes as a little less than 40 acres (1992), Hulbert as approximately 80 acres (1993), and Parker as occupying the majority of the 158-acre RNA (1993). Actually the original RNA evaluation report spoke of 60 acres of old growth. Some harvesting of White Pine probably took place about 80 years ago, but there has been no harvesting since (Hulbert 1993). The old growth is located on an isthmus between two lakes; on a point on the north shore of Tucker Lake; and in "small scattered inclusions." South of the Research Natural Area, aspen/birch stands have "significant inclusions of old-growth hemlock and mature pine forest." Tucker Lake Hemlocks as a whole is 500-1000 acres in size (Parker 1998, 1999).

--Chequamegon Hardwoods Research Natural Area. An 80-acre old-growth hardwood stand with Sugar Maple, American Basswood, and Yellow Birch (Parker 1993).

--Doering Tract,* south of South Fork Flambeau River (Price County). Large pockets of old-growth hemlock hardwoods with light cutting in the distant past, intermixed with mature second-growth northern hardwoods within a tract that is 100-500 acres in size. The hemlock-hardwoods south of FR 144 were selectively logged in the late 1980s (Farlinger 2002, Parker 1998, 1999). The Proposed Land and Resource Management Plan 2003 proposes the Doering Tract as a Research Natural Area and as an Old Growth and Natural Features Complex.

--Mud Lake Cedars,* north-central Wisconsin (Price County). "Undisturbed, old-growth, wet-mesic cedar swamp at the foot of a large drumlin system south of Foulds Springs." According to a USFS draft, the site, which it there names "Mud Lake Bog and Cedar Swamp," belongs in the category of 1000-5000 acre areas (Parker 1998, 1999). In the swamp are small hemlock-White Pine islands. The "swamp portion of this site is essentially pristine with 20"+ cedar common. Regeneration is balsam fir and mountain maple thickets." On the uplands surrounding the swamp are second-growth northern hardwoods. The site is next to "one of the largest most significant peatland complexes in the forest." State Trust Lands comprise 120 acres of the site; the balance is owned by the US Forest Service. Logging is deferred on the State Trust Land (Draft Biotic Inventory 2003). USFS proposes Mud Lake as an Old-Growth and Natural Features Complex in its Proposed Land and Resource Management Plan 2003.

--Stony Creek,* north-central Wisconsin (Price and Oneida Counties). "Extensive stands of undisturbed black ash and white cedar swamp. Much of the cedar is in old-growth condition. A tiny amount of old-growth hemlock occurs along the swamp margin." Second-growth northern hardwoods cover the uplands. State Trust Lands comprise 160 acres of the area. USFS owns the balance. On the State Trust Lands logging is deferred (Draft Biotic Inventory 2003).

Kickapoo Valley Reserve,* in southwest Wisconsin (Vernon County)

A total of several hundred acres of old-growth forest within the 8569-acre Kickapoo Valley Reserve between the villages of La Farge and Ontario. Types of old growth include maple-basswood, hemlock-White Pine, and red oak-White Oak (Epstein 2002).

In the 1960s, the federal government planned to build a dam on the Kickapoo River for flood control. The scheme was abandoned in 1973, and in 1996 federal legislation ordered that the US Army Corps of Engineers transfer 1200 acres of the land acquired for the dam to the Bureau of Indian Affairs in trust for the Ho-Chunk nation and the

remaining 7369 acres to the State of Wisconsin. The former Corps land now constitutes the Reserve and is managed on a day to day basis by a Kickapoo Reserve Management Board, the majority of whose members are local people. They have set aside a 3600-acre Kickapoo Valley Reserve State Natural Area within the Reserve (WDNR 2002).

Adjoining the Kickapoo Reserve is **Wildcat Mountain State Park**, owned by WDNR. The 3512-acre State Park has old growth similar to that in Kickapoo Reserve (Epstein 2002).

Patterson Hemlocks State Natural Area,* north-central Wisconsin (Oneida and Vilas Counties)

Within a 310-acre State Natural Area, an old-growth hemlock-Yellow Birch-White Pine forest. The old growth is situated "on an isthmus between Clear and Fuller Lakes, with the stand on the west side of Clear Lake being undisturbed." Super-canopy White Pine grow in scattered clumps. The hemlock and Yellow Birch are up to 30 inches in diameter, and some White Pine are 3 feet in diameter and 120 feet high (WDNR 2002).

Germain Hemlocks State Natural Area* (Oneida County)

A State Natural Area comprised of 88 acres of old-growth northern mesic forest on steep-sided stony ridges. Large hemlock, over which super-canopy White and Red Pine tower, dominate the forest. Associates in the canopy include Yellow Birch, Sugar Maple, Red Maple, and Red Oak. Hemlock are reproducing well. The sparse to moderate shrub layer includes Mapleleaf Viburnum and Beaked Hazelnut. The area is owned by WDNR and received its Natural Area designation in 2002 (WDNR 2003).

Pine Hollow, in south-central Wisconsin (Sauk County)

Some 30 to 50 undisturbed acres in 204 acres of mature northern hardwood forest owned by The Nature Conservancy. Nearby is another Nature Conservancy preserve, Hemlock Draw, a relic hemlock forest of some 30 acres (Braker 1993).

Finnerud Pine Forest State Natural Area, in northern Wisconsin (Oneida County)

A northern dry-mesic forest dominated by Red Pine with a few White Pine, occupying approximately 80 acres of a 120-acre State Natural Area. Kline estimates the Red Pine to be at least 150 years of age (1992); the DNR describes them as being over 140 years old. Many are 2 feet in diameter. They are believed to have grown up after a fire. A very little cutting has been done on the site (Kline 1992). In addition to the pine, the canopy includes Paper Birch, Red Oak, Red Maple, and aspen. In the dense shrub layer are tree saplings, Beaked Hazelnut and briars. The Natural Area also encompasses an open sphagnum bog and a mile of the Lake Kawaguesaga shoreline. The Natural Area and additional land forming a total of 300 acres are owned by the University of Wisconsin and managed by the University of Wisconsin Arboretum. Access is restricted, and anyone seeking permission to visit must contact the Arboretum (Kline 1992, Lindsey & Escobar 1976, WDNR 2002).

The Big Block, within Flambeau River State Forest, north-central Wisconsin (Sawyer County)

A 1600-acre area, containing two State Natural Areas, in which most trees were blown down during a severe wind storm July 4, l977. The state had purchased the Big Block and forbidden cutting in a 0.25 mile strip along the river, as the result of a battle by conservationists in the 1940s to save the area (WDNR 2002). The Big Block was reportedly virgin when purchased (Dunn et. al. 1983).

--Flambeau River State Natural Area: formerly known as a Scientific Area. Three hundred and seventy acres containing what was once a "landmark old-growth northern mesic forest" (WDNR 1989). In 1976 the age of the stand was estimated to be 220 years (Lindsey & Escobar 1976); and the stand was dominated by Eastern Hemlock, Yellow Birch, and Sugar Maple with some American Basswood, White Ash, and White Pine (WDNR 2002). The 1977 blow-down was not complete in two small sections of the Big Block within and next to the Natural Area. Part of the leveled forest was salvage cut; deer and hare exclusion zones have been established in both salvaged and unsalvaged areas. Sugar Maple, Yellow Birch, and American Basswood are now growing in the Natural Area; hemlock is disappearing (WDNR 2002).

--Lake of the Pines Conifer-Hardwoods State Natural Area. A 156-acre State Natural Area that was originally Eastern Hemlock and Yellow Birch. A band of these trees on the peninsula was left standing after the storm. In the blow-down area, young Sugar Maple, Yellow Birch, and American Basswood are growing. After the storm, some of the Natural Area was salvage cut. In the past, the Natural Area had been logged on the small portions that are not hemlock-hardwood (WDNR 2002).

Port Wing Boreal Forest State Natural Area, in northern Wisconsin (Bayfield County)

Two areas of virgin dry-mesic boreal forest on sand spits, inland from current beaches on Lake Superior, within a 188-acre, two-unit State Natural Area. The boreal forest, which totals 100 acres, probably originated after a blow-down or fire in the mid- or late-1800s. The small size of the trees may have forestalled cutting. Red Pine and White Pine dominate. Beneath them grow White Spruce, Balsam Fir, and other species. An open water-sedge bog complex separates the forest from the beaches. Homes have been built next to the east woods. The Wisconsin Bureau of Endangered Resources owns the site (Epstein 1993, WDNR 2002).

Page Creek Marsh* (Marquette County)

More than 100 acres of Black Oak openings within a 591-acre preserve owned by The Nature Conservancy. The preserve has been disrupted by livestock grazing and fire suppression in the past (Walters 1993; Richter 1998; Drey 2001).

Plagge Woods State Natural Area,* in west-central Wisconsin (Chippewa County)

An 80-acre old-growth northern mesic forest, dominated by basswood, red and white oaks, and Sugar Maple. The forest covers the northern and southern slopes of a ridge on the southeastern edge of the Flambeau Ridge. It "was cut only sporadically prior to 1920" and "much virgin timber remains." Trees are of varying ages. Donated to the state by Henry and August Plagge, the site is controlled by WDNR, Parks and Recreation (WDNR 2002).

Lulu Lake Preserve , southeastern Wisconsin (Walworth County)

"Small but viable oak openings" totaling 50 acres within a 1500-acre preserve, half of which belongs to the WDNR and half to The Nature Conservancy. In the past the openings have been disrupted by livestock grazing and fire suppression. The Nature Conservancy is conducting prescribed burns to restore the natural species and structure (Walters 1993; Richter 1998).

Spring Green Preserve (Sauk County)

Within the 900-acre Spring Green Preserve, 60 acres of oak barrens, disrupted by livestock grazing and lack of fire in the past. The Nature Conservancy, which owns the preserve, is removing invading trees such as Black Locust and Eastern Red-cedar from the prairie and oak savanna as well as conducting prescribed burns (Walters 1993; Richter 1998).

Renak-Polak Maple-Beech-Woods State Natural Area, in southeastern Wisconsin (Racine County)

An "outstanding" 46-acre southern mesic forest and an 8-acre southern wet-mesic forest within a 60-acre preserve. Sugar Maple, American Basswood, and American Beech dominate. The forest is "predominantly old-growth," but trees have been cut for fuelwood, and the northeastern portion was at one time lightly grazed by livestock. Shrubs dominate openings left by the death of elms. Wildflowers put on a spectacular display in the spring. The University of Wisconsin owns the land. Nature Conservancy volunteers and Wisconsin Department of Natural Resources staff have taken on management tasks, primarily removing exotic species such as Garlic Mustard (WDNR 2002, Braker 1993; Richter 1998).

Baxter's Hollow, in south-central Wis consin (Sauk County)

Four thousand acres owned by The Nature Conservancy, in which are 30 to 50 acres of "undisturbed" White Pine forest and 40 acres of "undisturbed" Northern Red Oak forest, dominated by Red Oak, White Oak, and American Basswood (Braker 1993). Otter Creek, a rapid and clear stream, flows through Baxter's Hollow, a gorge cut in quartzite. Most of the site is covered by southern dry-mesic forest, a remnant of the Big Woods (WDNR 2002). Epstein characterizes Baxter Hollow as probably southern Wisconsin's most intact watershed, but says that it is mostly second growth, with only some 200 acres of old growth (Epstein 1993). Welsh believes that the entire area was grazed by livestock (2003). A 1995-acre area within The Nature Conservancy's preserve is a State Natural Area (WDNR 2002).

Ellison Bluff State Natural Area,* northeast Wisconsin (Door County)

A "vertical forest" of Northern White-cedar in a 170-acre State Natural Area. The State Natural Area is within Ellison Bay County Park on the Niagara Escarpment. The park, which is located in the Town of Liberty Grove, consists of the Heineman tract, an 86.2-acre parcel with approximately 2000 feet of Green Bay shoreline, and the land in the original 88-acre Ellison Bluff County Park. Ellison Bluff rises almost 200 feet above the waters of Green Bay in a series of terraces showing post-glacial lake levels. The exposed rock ledges and perched talus of these terraces form the habitat for rare snails. The vegetation of the talus includes Northern White-Cedar, Mountain Maple, Canada Yew, and Elderberry. A white-cedar on the Heineman tract has been aged at 250 years (Drey 2001). The tract needs further study to determine the history of the vegetation (Grimm 2003). The Heineman tract is undeveloped and will remain that way; in a portion of the original park, a lookout was constructed (Wolken 2001; Door County 2001).

Washington Island and Rock Island to the north of the Door Peninsula may have old growth on cliffs overlooking Lake Michigan, Mike Grimm reports, but, as far as he knows, no researcher has investigated the situation there (2003).

Weir White Oaks State Natural Area,* in southwestern Wisconsin (Lafayette County)

A 52-acre "old-growth southern dry-mesic forest dominated by abundant large white oaks with red oak, basswood, sugar maple, and white ash." The Pectaonica River west of the forest protected it from prairie fires, which moved from west to east. No livestock grazing took place. Therefore the ground layer is "extremely rich." Sugar Maple is reproducing on the eastern but not the western portion of the site. The site is privately owned and was designated a State Natural Area in 2002. The Natural Area is not open to the general public.

Tellock's Hill Woods State Natural Area,* in east-central Wisconsin (Waupaca County)

An "old-growth northern mesic forest" on the north-facing slope of a drumlin within the 54-acre State Natural Area. The gentler portion of the slope supports a "relatively undisturbed beech-maple forest." The steeper portion is nearly pure hemlock, growing amid large boulders. The Natural Area is owned by WDNR (WDNR 2002, Epstein et al. 2002).

Bass Lake Preserve ,* northern Wisconsin (Iron County)

A 1000-acre site, within which are pockets of Eastern Hemlock and White Pine that have experienced only minimal disturbance. On ridges and islands that were hard to reach, these pockets are in a matrix of wetlands. The wetlands grade up to deciduous uplands that have been cut quite heavily in the past (Richter 1998).

Oakfield Ledge State Natural Area*, in south-eastern Wisconsin (Fond du Lac County)

"Mostly undisturbed" woodland within a 40-acre State Natural Area on an exposure of the Niagara Escarpment. The site is a west-facing, boulder-strewn slope, with rock ledges and 40-foot deep crevices. It is on the east side of Horicon Marsh, well known as a stopover for migrating birds. Tree species include basswood, Sugar Maple, Slippery Elm, Rock Elm, Northern Red Oak, and Shagbark Hickory. Beneath them are Canada Yew, ferns, and a rare rock cress. The top of the escarpment was grazed by livestock (WDNR 2002).

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Appendix

SPECIES

Alternate-leaf Dogwood	*Cornus alternifolia*
American Basswood	*Tilia americana*
American Beech	*Fagus grandifolia*
American Chestnut	*Castanea dentata*
American Columbo	*Frasera caroliniensis*
American Elm	*Ulmus americana*
American Holly	*Ilex opaca*
American Mountain-ash	*Sorbus americana*
American Sycamore	*Platanus occidentalis*
Anacua	*Ehretia anacua*
Appendage Waterleaf	*Hydrophyllum appendiculatum*
Arkensas Meadow Rue	*Thalictrum arkansanum*
Ashe Juniper	*Juniper ashei*
Arlantic White-cedar	*Chamaecyparis thyoides*
Baldcypress	*Taxodium distichum*
Balsam Fir	*Abies balsamea*
Balsam Poplar	*Populus balsamifera*
Beaked Hazel	*Corylus rostrata*
Bear Oak	*Quercus ilicifolia*
Beautiful Sedge	*Carex concinna*
Big Bluestem	*Andropogon gerardi*
Bird's Eye Primrose	*Primula mistassinica*
Bitter Pecan	*Carya aquatica*
Bitternut Hickory	*Carya cordiformis*
Black Ash	*Fraxinus nigra*
Black Cherry	*Prunus serotina*
Black Crowberry	*Empetrum nigrum*
Black Gum	*Nyssa sylvatica*
Black Hickory	*Carya texana*
Black Huckleberry	*Gaylussacia baccata*
Blackjack Oak	*Quercus marilandica*
Black Locust	*Robinia pseudocacia*
Black Mangrove	*Avicennia nitida*
Black Oak	*Quercus velutina*
Black Spruce	*Picea mariana*

Black Titi	*Cliftonia monophylla*
Black Walnut	*Juglans nigra*
Black Willow	*Salix nigra*
Blue Cohosh	*Caulophyllum thalictroides*
Blue-eyed Mary	*Collinsia verna*
Bluejack Oak	*Quercus incana*
Bog Reed Grass	*Calamagrostis inexpansa*
Box Elder	*Acer negundo*
Bracken Fern	*Pteridium aquilinum*
Broad Beech Fern	*Dryopteris hexagonoptera*
Broad-leaved Spring Beauty	*Claytonia caroliniana*
Buckberry (Coralberry)	*Symphoricarpos orbiculatus*
Buckthorns	*Rhamnus sp.*
Bugbane	*Cimicifuga rubifolia*
Bunchberry Dogwood	*Cornus canadensis*
Bur Oak	*Quercus macrocarpa*
Bushy Panic Grass	*Panicum dichotomum*
Butterwort	*Pinguicula vulgaris*
Buttonbush	*Cephalanthus occidentalis*
Buttonwood	*Conocarpus erecta*
Cabbage Palm	*Sabal palmetto*
Canada Mayflower	*Maianthemum canadense*
Canada Yew	*Taxus canadensis*
Cane	*Arundinaria gigantea*
Carolina Ash	*Fraxinus caroliniana*
Carolina Buckthorn	*Rhamnus caroliniana*
Carolina Hemlock	*Tsuga caroliniana*
Carter's Mustard	*Warea carteri*
Catawba Rhododendron	*Rhododendron catawbiense*
Catbriers	*Smilax spp.*
Cedar Elm	*Ulmus crassifolia*
Chalk Maple	*Acer leucoderme*
Cherrybark Oak	*Quercus falcata var. pagodifolia*
Chestnut Oak	*Quercus prinus*
Chilean Sweet Cicely	*Osmorhiza chilensis*
Chinquapin Oak	*Quercus muehlenbergii*
Christmas Fern	*Polystichum acrostichoides*
Cocoplum	*Chrysobalanus icaco*
Common Elderberry	*Sambucus canadensis*
Common Hairgrass	*Deschampsia flexuousa*
Common Juniper	*Juniperus communis*
Common Sweetleaf	*Symplocos tinctoria*
Corn Lily	*Clintonia borealis*
Cucumber Tree	*Magnolia acuminata*
Dahoon Holly	*Ilex cassine*
Deciduous Holly	*Ilex decidua*
Deerberry	*Vaccinium stamineum*
Devil's Walkingstick	*Aralia spinosa*
Downy Serviceberry	*Amelanchier arborea*
Dwarf Palmetto	*Sabal minor*
Dwarf Sumac	*Rhus copallina*
Dwarf Trillium	*Trillium pusillum*
Eastern Cottonwood	*Populus deltoides*

Eastern Hemlock	*Tsuga canadensis*
Eastern Hophornbeam	*Ostrya virginiana*
Eastern Red-cedar	*Juniperus virginiana*
Eastern Redbud	*Cercis canadensis*
Ebony Spleenwort	*Asplenium platyneuron*
Elephant's Foot	*Elephantopus carol*
Erect Trillium	*Trillium erectum*
Farkleberry	*Vaccinium arboreum*
Fetterbush	*Lyonia lucida*
Florida Anise Tree	*Illicium parviflorum*
Florida Myrsine	*Myrsine floridana*
Florida Willow	*Salix floridana*
Flowering Dogwood	*Cornus florida*
Fox Squirrel	*Sciurus niger*
Fraser Fir	*Abies fraseri*
Fraser's Magnolia	*Magnolia fraseri*
French's Shooting Star	*Dodecatheon frenchii*
Galax	*Galax gaphylla*
Gallberry	*Ilex glabra*
Garlic Mustard	*Alliaria officinalis*
Goblin Fern	*Botrychium mormo*
Golden-crest	*Lophiola americana*
Goldthread	*Coptis groenandica*
Gopher Apple	*Licania michauxii*
Gray Birch	*Betula populifolia*
Great Rhododendron	*Rhododendron maximum*
Green Ash	*Fraxinus pennsylvanica*
Greenbriers	*Smilax spp.*
Green Hawthorn	*Crataegus viridis*
Gum Bumelia	*Bumelia lanuginosa*
Gumbo Limbo	*Bursera simaruba*
Hackberry	*Celtis occidentalis*
Hair-like Sedge	*Carex capillaris*
Hairy Jointweed	*Polygonella basiramia*
Hairy Sweet Cicely	*Osmorhiza claytoni*
Hairy Wild Petunia	*Ruellia humilis*
Harebell	*Campanula rotundifolia*
Hay-scented Fern	*Dennstaedtia punctilobula*
Heart-leaved Plantain	*Plantago cordata*
Highbush Blueberry	*Vaccinium corymbosum*
Highlands Scrub St. John's-wort	*Hypericum edisonianum*
Hobble Bush	*Viburnum alnifolium*
Honey Locust	*Gleditsia triacanthos*
Indian Grass	*Sorghastrum nutans*
Ironwood	*Carpinus caroliniana*
Jack Pine	*Pinus banksiana*
Japanese Honeysuckle	*Lonicera japonica*
Kate's Mountain Clover	*Trifolium virginicum*
Lake Placid Scrub Mint	*Dicerandra frutescens*
Large-flowered Bellwort	*Uvularia grandiflora*
Large-flowered Skullcap	*Scutellaria montana*
Large-flowered Trillium	*Trillium grandiflorum*
Laurel Oak	*Quercus laurifolia*

Lead Plant	*Amorpha canescens*
Least Moonwort	*Botrychium simplex*
Live Oak	*Quercus virginiania*
Loblolly-bay	*Gordonia lasianthus*
Loblolly Pine	*Pinus taeda*
Longleaf Pine	*Pinus palustris*
Loose-flowered Panic Grass	*Panicum laxiflorum*
Lowbush Blueberry	*Vaccinium vacillans*
Low Sweet Blueberry	*Vaccinium angustifolium*
Lungwort	*Lobaria pulmonaria*
Mapleleaf Viburnum	*Viburnum acerifolium*
Marsh Grass of Parnassus	*Parnassia palustris*
Meehan's Mint	*Meehania cordata*
Mockernut Hickory	*Carya tomentosa*
Moschatel	*Adoxa moschatellina*
Mountain Aster	*Aster acuminatus*
Mountain Cranberry	*Vaccinium vitis-idaea*
Mountain Golden Heather	*Hudsonia montana*
Mountain Laurel	*Kalmia latifolia*
Mountain Maple	*Acer spicatum*
Mountain Paper Birch	*Betula papyrifera var. cordifolia*
Mountain Pepperbush	*Clethra acuminata*
Mountain Winterberry	*Ilex montana*
Mountain Wood Fern	*Dryopteris spinulosa var. dilatata*
Muscadine Grape	*Vitus rotundifolia*
Naked-flowered Tick Trefoil	*Desmodium nudiflorum*
Narrow-leaved Horse-gentian	*Triosteum angustifolium*
Needle Palm	*Rhapidophyllum hystrix*
New York Fern	*Dryopteris noveboracensis*
Northeastern Aster	*Aster tardiflorus*
Northern Pin Oak	*Quercus ellipsoidalis*
Northern Red Oak	*Quercus rubra*
Northern White-cedar	*Thuja occidentalis*
Nuttall Oak	*Quercus nuttalli*
Ogeechee Tupelo	*Nyssa ogeche*
Ohio Buckeye	*Aesculus glabra*
Osage-orange	*Maclura pomifera*
Oval Ladies-tresses	*Spiranthes ovalis*
Overcup Oak	*Quercus lyrata*
Ozark Chinquapin	*Castanea ozarkensis*
Paper Birch	*Betula papyrifera*
Papery Whitlow-wort	*Paronychia chartacea*
Partridge Berry	*Mitchella repens*
Pasture Rose	*Rosa carolina*
Pawpaw	*Asimina triloba*
Peachleaf Willow	*Salix amygdaloides*
Pecan	*Carya illinoensis*
Pennywort	*Obolaria virginica*
Periwinkle	*Vinca minor*
Persimmon	*Diospyros virginiana*
Pigeon-plum	*Coccoloba diversifolia*
Pignut Hickory	*Carya glabra*
Pin Cherry	*Prunus pensylvanica*

Pin Oak	*Quercus palustris*
Pitch Pine	*Pinus rigida*
Pitcher Plants	*Sarracenia spp.*
Planertree (Water Elm)	*Planera aquatica*
Poison Ivy	*Radicans toxicodendron*
Pond-apple	*Annona glabra*
Pond Cypress	*Taxodium ascendens*
Pond Pine	*Pinus serotina*
Pondberry	*Lindera melissifolia*
Post Oak	*Quercus stellata*
Poverty Oats	*Danthonia spicata*
Prickly Ash	*Xanthoxylum americanum*
Pumpkin Ash	*Fraxinus profunda*
Purple Cliffbrake	*Pellaea atropurpurea*
Purple Trillium	*Trillium erectum*
Quaking Aspen	*Populus tremuloides*
Rattlesnake-master	*Eryngium yuccifolium*
Red Baneberry	*Actaea rubra*
Redbay	*Persea borbonia*
Redbud	*Cercis canadensis*
Red Mangrove	*Rhizophora mangle*
Red Maple	*Acer rubrum*
Red Mulberry	*Morus rubra*
Red Pine	*Pinus resinosa*
Red Spruce	*Picea rubens*
Rhodora	*Rhododendron canadense*
River Birch	*Betula nigra*
Rock Skullcap	*Scutellaria saxatilis*
Rosemary	*Ceratiola ericoides*
Rough-leaved Loosestrife	*Lysimachia asperulaefolia*
Round-leaved Dogwood	*Cornus rugosa*
Round-leaved Orchid	*Platanthera orbiculata*
Rugel's Ragwort	*Cacalia rugelia*
Sand Pine	*Pinus clausa*
Sassafras	*Sassafras albidum*
Saw Grass	*Cladium jamaicensis*
Saw Palmetto	*Serenoa repens*
Scarlet Oak	*Quercus coccinea*
Scrub Blazing Star	*Liatris ohlingerae*
Scrub Hickory	*Carya floridana*
Serpentine Aster	*Aster depauperatus*
Shadbush	*Amelanchier canadensis*
Shagbark Hickory	*Carya ovata*
Shale Skullcap	*Scutellaria leonardii*
Sheep Laurel	*Kalmia angustifolia*
Shellbark Hickory	*Carya laciniosa*
Shingle Oak	*Quercus imbricaria*
Shining Clubmoss	*Lycopodium lucidulum*
Shore Sedge	*Carex lenticularis*
Short-bristled Hornedrush	*Rhynchospora corniculata*
Shortleaf Pine	*Pinus echinata*
Showy Mountain Ash	*Sorbus decora*
Showy Orchis	*Orchis spectabilis*

Shumard Oak	*Quercus shumardii*
Sicklepod	*Arabis canadensis*
Silverbell	*Halesia spp.*
Silver Maple	*Acer saccharinum*
Slash Pine	*Pinus elliottii*
Slippery Elm (Red Elm)	*Ulmus rubra*
Small-fruited Hickory	*Carya ovalis*
Smooth Serviceberry	*Amelanchier laevis*
Snow Trillium	*Trillium nivale*
Snowberry	*Gaultheria hispidula*
Solomon's Seal	*Polygonatum biflorum*
Sourwood	*Oxydendrum arboreum*
South Florida Slash Pine	*Pinus elliotti var. densa*
Southern Magnolia	*Magnolia grandiflora*
Southern Red Oak	*Quercus falcata*
Southern Red-cedar	*Juniperus lucayana*
Southern Sugar Maple	*Acer barbatum*
Sparkleberry	*Vaccinium arboreum*
Spicebush	*Lindera benzoin*
Spinulose Wood Fern	*Dryopteris spinulosa*
Spotted Wintergreen	*Chimaphila maculata*
Spruce Pine	*Pinus glabra*
Squirrel-corn	*Dicentra canadensis*
Starflower	*Trientalis borealis*
Stiff Clubmoss	*Lycopodium annotinum*
Striped Maple	*Acer pensylvanicum*
Sugar Maple	*Acer saccharum*
Sugarberry	*Celtis laevigata*
Summer Grape	*Vitis aestivalis*
Sundews	*Drosera spp.*
Swamp Bay	*Persea palustris*
Swamp Black Gum	*Nyssa biflora*
Swamp Chestnut Oak	*Quercus michauxii*
Swamp Cottonwood	*Populus heterophylla*
Swamp-privet	*Forestieria acuminata*
Swamp Snowbell	*Styrax americana*
Swamp White Oak	*Quercus bicolor*
Sweet Birch (Black Birch)	*Betula lenta*
Sweet Fern	*Comptonia peregrina*
Sweet Haw	*Viburnum prunifolium*
Sweet Pepperbush	*Clethra alnifolia*
Sweet White Violet	*Viola blanda*
Sweetbay Magnolia	*Magnolia virginiana*
Sweetgum	*Liquidambar styraciflua*
Switch Grass	*Panicum virgatum*
Table Mountain Pine	*Pinus pungens*
Tamarack	*Larix laricina*
Three-toothed Cinquefoil	*Potentilla tridentata*
Thrinax palms	*Thrinax spp.*
Titi	*Cyrilla racemiflora*
Toothache Grass	*Ctenium aromaticum*
Trumpet Vine	*Campsis radicans*
Tulip Tree	*Liriodendron tulipifera*

Turkey Oak	*Liriodendron tulipifera*
Two-flowered Cynthia	*Krigia biflora*
Umbrella Magnolia	*Magnolia tripetala*
Undine	*Parnassia grandiflora*
Venus' Flytrap	*Dionaea muscipula*
Virginia Pine	*Pinus virginiana*
Water Ash	*Fraxinus caroliniana*
Water Hickory	*Carya aquatica*
Water Oak	*Quercus nigra*
Water Tupelo	*Nyssa aquatica*
Wax Myrtle	*Myrica cerifera*
Wedge-leaved Button Snakeroot	*Eryngium cuneifolium*
White Ash	*Fraxinus americana*
White Baneberry	*Actaea pachypoda*
White Basswood	*Tilia heterophylla*
White-mangrove	*Laguncularia racemosa*
White Oak	*Quercus alba*
White Pine	*Pinus strobus*
White Spruce	*Picea glauca*
White Wicky Laurel	*Kalmia cuniata*
Wild Sarsaparilla	*Aralia nudicaulis*
Wildenovi's Sedge	*Carex wildenovii*
Willow Oak	*Quercus phellos*
Winged Elm	*Ulmus alata*
Winterberry	*Ilex verticillata*
Wintergreen	*Gaultheria procumbens*
Wiregrass	*Aristida stricta*
Witchhazel	*Hamamelis virginiana*
Witherod	*Viburnum cassinoides*
Wood Nettle	*Laportea canadensis*
Wood Sorrel	*Oxalis montana*
Woodland Sunflower	*Helianthus divaricatus*
Yaupon	*Ilex vomitoria*
Yellow Birch	*Betula alleghaniensis*
Yellow Buckeye	*Aesculus octandra*
Yellow Lady's Slipper	*Cypripedium calceolus var. pubescens*
Yellow Mandarin	*Disporum lanuginosum*
Yellow Nailwort	*Paronychia virginica var. virginica*
Yellow Water-Crowfoot	*Ranunculus flabellaris*
Yellow-eyed grasses	*Xyris spp.*

About the Author

Mary Byrd Davis is director of the Eastern Old-Growth Clearinghouse and of Earth Island Institute's Yggdrasil Institute. She cofounded *Wild Earth*, compiled *Old Growth in the East: A Preliminary Overview* (Earth First! Journal, 1990) and edited *Eastern Old-Growth Forests: Prospects for Rediscovery and Recovery* (Island Press, 1996). Other publications include *The Military-Civilian Link: A Guide to the French Nuclear Industry* (Westview, 1988), *The Green Guide to France* (Green Print, 1990), *Going Off the Beaten Path: An Untraditional Travel Guide to the U.S.* (Noble, 1991), *Les déchets nucléaires militaires français,* with coauthor Bruno Barrillot (CDRPC, 1994); and *La France Nucléaire: Matières et Sites 2002* (Wise-Paris, 2001). She holds a master's degree in library science from Simmon's College and a doctorate in English from the University of Wisconsin, Madison. She divides her time between central Kentucky, northern New York, and Lyon, France, where she is vice president of the Documentation and Research Center on Peace and Conflicts.