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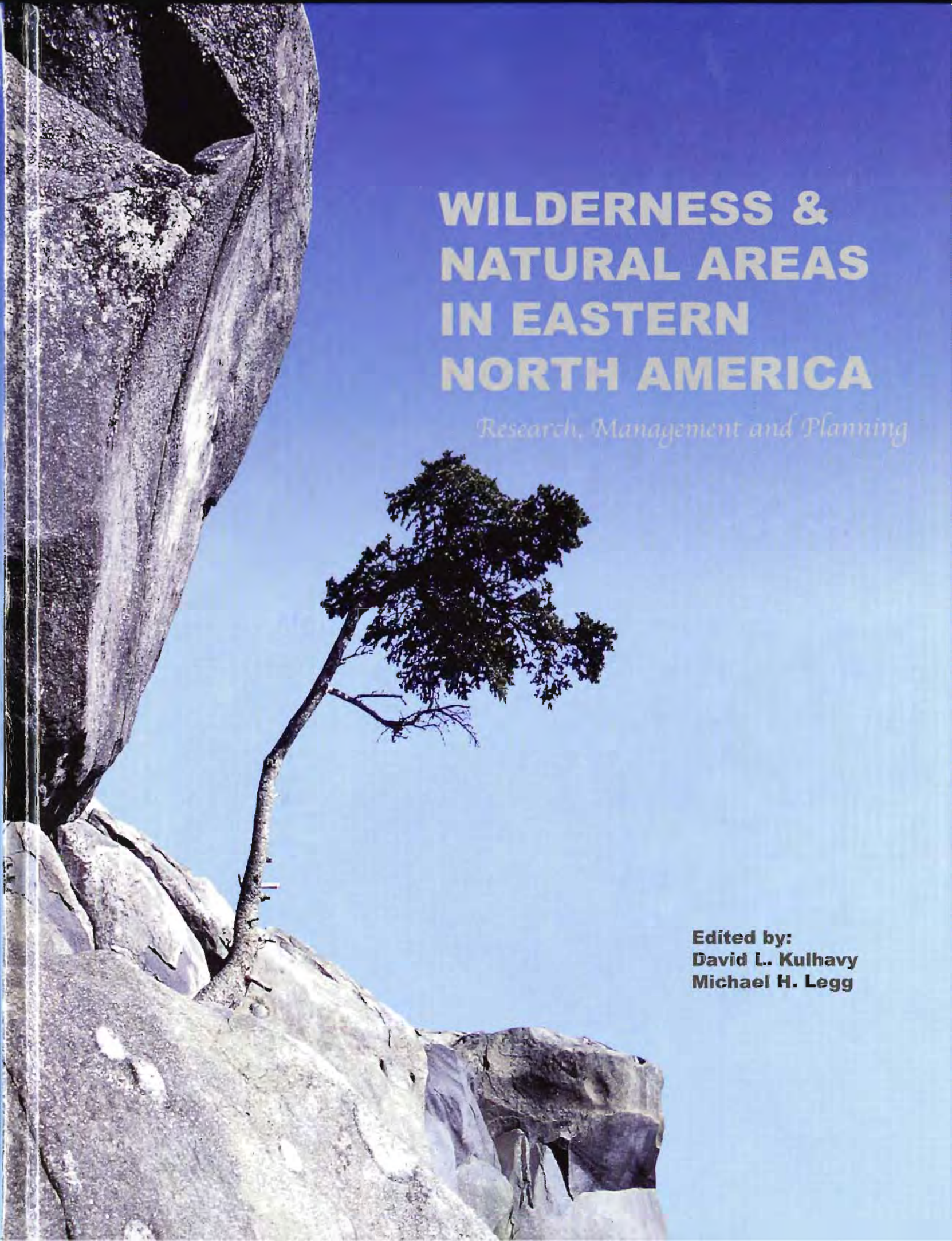

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Southern Pine Beetle and Fire in Wilderness Areas: The Kisatchie Hills Wilderness, Kisatchie National Forest

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Abstract: Southern pine beetle infestations affect wilderness areas in the southeastern United States. In the Kisatchie Hills Wilderness area in Louisiana, a southern pine beetle outbreak resulted in widespread destruction of longleaf pine. Nest trees of the red-cockaded woodpecker, an endangered species, also were killed. Following the epidemic, a fire fueled by beetle-killed pines went through the wilderness. Forest structure, species composition, successional processes and general ecosystem function were substantially altered as a result of these two related disturbances. Most wilderness areas containing southern pines were managed for pine timber before being designated as wilderness. Bark beetle outbreaks are a predictable form of negative feedback when all management is suddenly withdrawn. Resultant large areas of dead pine create conditions conducive to intense wildfires. Judicious use of bark beetle control tactics and prescribed fire can smooth the transition from managed forest to wilderness by protecting wilderness attributes and red-cockaded woodpecker habitat and cavity trees.
Keywords: southern pine beetle, Kisatchie Hills Wilderness, fire, longleaf pine, red-cockaded woodpecker, endangered species

Wilderness and natural areas in the southeastern United States with substantial areas of mature, dense stands of pine, especially loblolly, *Pinus taeda* ,and shortleaf, *P. echinata*, are often susceptible to outbreaks of the southern pine beetle, *Dendroctonus frontalis* Zimmermann (SPB), active in recent years. At the "Wilderness and Natural Areas in the Eastern United States: A Management Challenge" conference in 1985, emphasis on forest protection included a discussion of forest insects and disease as they impact wilderness and natural areas in the eastern United States. Billings and Varner (1986) presented an overview of the southern pine beetle in wilderness and natural areas. They emphasized the protection of these areas and indicated the challenge to wilderness managers. They stated "Several scenarios are possible:

"1) a wasteland of brush and dead pine snags that may eventually develop into a natural forest ecosystem,
2) an uneven-aged perpetual pine forest or
3) a climax forest of shade tolerant hardwoods, primarily oaks and hickories.
Choice No, 1 is perhaps the easiest to obtain. Just exclude beetle control and let a massive southern pine beetle outbreak eliminate the existing pine overstory." (p. 125).

Billings and Varner cite additional investigations that details control of southern pine beetle (Morris and Copony 1974, Texas Forest Service, 1978, Smith and Conner 1985).

Smith and Nettleton (1986) presented hazard rating for southern pine beetles on wilderness areas on National Forests in Texas. These wilderness areas were designated in 1984 and included Little Lake Creek, Upland Island, Turkey Hill, Big Slough and Indian Mounds. Billings documents the events in Indian Mounds as part of the current volume (Billings this

volume). In 1985, Smith and Nettleton, for planning purposes, rated these wilderness areas in Texas based on Mason et al. (1985). They found a higher amount of the areas in higher hazard classes (Table 1). Turkey Hill (42 %) and Little Lake Creek (25 %) and Upland Island (16 %) had the greatest percentages of high hazard ratings. On Ranger Districts, Raven Ranger District had the highest rating (18 % high hazard). Medium hazard was highest in wilderness areas in Indian Mounds (54 %), Little Lake Creek (53 %), Upland Island (41 %) and Turkey Hill (34 %).

Within the Ranger Districts, southern pine beetle hazard and risk rating was completed using the Texas Forest Service Grid Block System. (Billings and Bryant 1983). The wilderness areas in Texas with the highest hazard were Little Lake Creek and Upland Island (Table 2) with grid block 684, 89 % (Turkey Hill Wilderness), grid block 316, 75 % (Little Lake Creek Wilderness) and grid block 623, 75 % (Big Slough Wilderness). By 1995, the hazard rating based on the grid block system had increased to extreme in parts of Little Lake Creek and high in parts of Little Lake Creek, Upland Island, Turkey Hill and Indian Mounds.

Southwide in 1987, southern pine beetle in wilderness areas were summarized (USDA Forest Service 1987). Of the total of 117,263 acres surveyed, 5567 acres (4.8 %) were infested (Table 3). The largest acreage was the Kisatchie Hills Wilderness (3930 acres), followed by Little Lake Creek (520 acres), Upland Island (457 acres), Indian Mounds 358 acres) and Turkey Hill (115 acres), all in Texas wilderness areas. By 1993, the acreages in wilderness areas in Texas had increased to 13,336 acres or 40 % of the 33,340 acres of wilderness areas in Texas (Billings, this volume).

Hazard and risk rating systems allow the manager to rate a stand's susceptibility to attack by the southern pine beetle and to estimate future stand conditions. Nebeker et al. (1995) rated red-cockaded woodpecker clusters in Mississippi. The term "hazard" refers to the susceptibility of an area to insect infestations based on site, stand and host factors; "risk" refers to the probability an infestation will occur within a given time span (Billings et al. 1985). Mitchell (Mitchell 1987, Mitchell et al. 1991) rated red-cockaded woodpecker clusters in loblolly and shortleaf pine stands in the Angelina Ranger District of the Angelina National Forest.

Nettleton and Smith (1983) compared wilderness areas versus Ranger Districts for numbers of southern pine beetle spots/ 1000 acres. Smith and Nettleton (1986) emphasize "that the areas chosen for wilderness attributes are also areas where southern pine beetle can be expected to cause extensive losses. This danger is highly evident during outbreak years which we are now experiencing. More importantly, these areas will continue to provide highly susceptible host type for the southern pine beetle during endemic periods." (p. 127).

Billings and Varner (1986) chronicled the Four Notch and Huntsville State Park experiences for control or no control of southern pine beetle. In the Four Notch Further Planning area on the Raven District of the Sam Houston National Forest, a 6,832 acre (2767 ha) tract was a candidate for wilderness designation. According to the final USDA Forest Service figures (Forrest Oliveria, USDA Forest Service, Pineville, LA), 3736 acres (1512 ha) were affected by the southern pine beetle outbreak representing 55 % of the Four Notch Further Planning Area. Of the total, 2927 acres (1185 ha) were salvaged by helicopter or by conventional means, 77 acres (31 ha) felled and left and 732 acres (296 ha) killed by southern pine beetle and left standing. The Four Notch unit was excluded from wilderness consideration. This is summarized as a case study in the southern pine beetle Environmental Impact Statement (USDA Forest Service 1987).

In the Huntsville State Park, Billings and Varner (1986) emphasize "Preservation of southern pine forests as wilderness, particularly those forest that are a product of intensive forest management, will necessarily require protection by man to preserve or prolong these valued attributes." (p. 133). (See also list of reference material at end of this article.)

Hertel et al. (1986) investigated integrated pest management concepts and their application in wilderness and natural areas management. Pest management is the component of forest management concerned with minimizing the negative impacts of insects, diseases, weeds and animals on a forest landscape. Integrated Pest Management is directed at the entire forest and is part of planned forest management. The strategies for Integrated Pest Management must be based on knowledge gained from research and development activities, on the ground experience and integration of results into an over all management plan.

The Final Environmental Impact Statement for the Southern Pine Beetle (USDA For. Serv. So. Reg. 1987) presents the case history of the Four Notch RARE II Study Area complete with chronological maps. The Big Thicket National Preserve, a 84, 555 acre areas managed by the USDI National Park Service, a total of 8677 acres of 51,184 acres of susceptible host type was infested (16.9%). The largest areas infested included the Lance Rosier Unit (2000 of 18,700 acres infested); the Big Sandy Creek Unit 2000 of 14,300 acres infested; and the Beech Creek Unit (3000 of 4856 acres infested). In 1977, the National Park Service formulated four criteria before suppression efforts for southern pine beetle would be undertaken:

1) the southern pine beetle infestation had to be within 1/4 mile of a unit boundary;

2) host type had to be of sufficient density to provide for spot expansion to a unit boundary;

3) sufficient density of host type had to exist on adjacent private timberland; and

4) monitoring data had to indicate that the spot was expanding towards a unit boundary. An exception to these criteria was permitted if an southern pine beetle infestation immediately threatened a red-cockaded woodpecker cavity tree.

Kisatchie Hills Wilderness Area Kisatchie National Forest

An important case study of bark beetle effects on wilderness areas and associated values may be seen from the 1986 southern pine beetle outbreak in the Kisatchie Hills Wilderness Area in the Kisatchie National Forest in Louisiana. The Kisatchie Hills Wilderness Area contains 8700 acres of pine and pine-hardwood forest.

The southern pine beetle affects both the pine resource and potentially cavity trees of the red-cockaded woodpecker, an endangered species. The seasonal behavior of the southern pine beetle leads to two different types of impact on the red-cockaded woodpecker. First, behavior associated with the southern pine beetle in refuge hosts (Coulson et al. 1985) can result in mortality to cavity trees (Conner et al. 1991, Rudolph and Conner 1995). Second, behavior associated with growth of southern pine beetle infestations can result in destruction of red-cockaded woodpecker foraging habitat (Coulson et al. 1995). On National Forests in Texas, the southern pine beetle was responsible for more than 50% of cavity tree mortality when bark beetle populations were at a non-epidemic level (Conner et al. 1991).

A significant portion of red-cockaded foraging habitat consists of mature older age-class loblolly, shortleaf or longleaf pine. The proximity of cavity trees and potentially high hazard foraging habitat creates a forest environment that may be conducive to southern pine beetle outbreaks.

Longleaf pine is the predominant species in the Kisatchie Hills Wilderness area as a result of reforestation efforts prior to wilderness designation. Longleaf pine generally are highly resistant to bark beetle attack because of their resin system (Wahlenberg 1946). In this case, longleaf pine were readily killed by this unusually explosive southern pine beetle outbreak. By mid-January, 1986, roughly 3900 acres (45% of the wilderness area) had been affected (Kulhavy et al. 1988).

Cut-and-leave was the only control tactic employed, with pines felled on about 3300 acres. Pines on the remaining acreage had been vacated by the beetles and were left standing as snags. Pine felling in mixed pine-hardwood stands resulted in residual stands dominated by hardwoods, particularly oaks (*Quercus* sp.), hickory (*Carya* sp.) and sweetgum (*Liquidambar styraciflua*). Bark beetle mortality along with control activities thus drastically altered normal succession.

On April 10, 1987, a lightning strike ignited a fire in the southern pine beetle cut and leave area. Heavy ground fuel, dry hot winds, rugged terrain and no use of mechanical or motorized equipment limited the response. By April 15, 2000 acres had burned threatening private land near Bayou Seep in the northeast quadrant. Fire hand crews from Arkansas, Louisiana and Texas attempted to build fire lines, then planned back fires to eliminate ground fuels. By the evening of April 15, following high winds and lack of success from back fires, the fire spread to 3000 acres. At the April 15 fire meeting, the decision was made to set fire lines at the boundary of the wilderness area. On April 16, the fire had spread to within 1/4 mile of Longleaf Pine Vista, an important historic site. Helicopters and air tankers and fire trucks were used to slow the fire spread. The Kisatchie Hills Wilderness Area fire affected 7500 acres, employed 500 fire fighters from 6 states and 4 agencies and the U. S. Army. It was the largest wildfire in Louisiana history.

Fire doesn't burn uniformly over large areas (Spurr and Barnes 1980), thus creating mosaics on a landscape scale. Although many trees were killed, many remained. Tree basal area was reduced and grasses were stimulated, effects that may favor longleaf pine recovery in the area.

Red-cockaded Woodpecker in Wilderness Areas

Jackson et al. (1986) summarized the status of red-cockaded woodpecker in wilderness areas in the southeastern United States. In 1986, there were an estimated 5 active, 16

Table 1. Acres by percent of southern pine beetle hazard class (includes all forest types within wilderness areas and associated Ranger Districts in Texas (from Smith and Nettleton 1986).

Wilderness Area/ Ranger District	Hazard Class High	Medium	Low
Little Lake Creek	25	53	22
Raven Ranger District	18	21	59
Upland Island	16	41	43
Turkey Hill	42	34	24
Angelina Ranger District	4	15	81
Big Slough	10	17	73
Neches Ranger District	12	20	68
Indian Mounds	13	54	34
Yellowpine Ranger District	6	8	85

Table 2. Southern pine beetle hazard rating of Texas Wilderness Areas using the Texas Forest Service Grid Block System (Billings and Bryant 1983) (from Smith and Nettleton 1986).

Wilderness Area	Grid Block	Appox. % of WA	SPB Hazard	SPB Risk 1984	1985
Little Lake Creek	316	75	High	High	High
	266	21	High	High	Extreme
	265	4	High	Moderate	Extreme
Upland Island	882	47	Low	Low	Low
	832	39	High	Moderate	High
	833	9	High	High	High
	883	5	Moderate	Moderate	Moderate
Big Slough	623	75	Moderate	High	Moderate
	573	25	Low	Moderate	Moderate
Turkey Hill	684	89	High	Extreme	High
	685	11	Low	Moderate	Low
Indian Mounds	690	38	Low	Moderate	Low
	689	27	Moderate	High	Moderate
	740	18	Low	Moderate	Low
	739	17	Moderate	High	Moderate
	738	Adjacent	High	Extreme	High
	789	Adjacent	High	Extreme	High

1 Based from an analysis of pine host abundance and suitability for southern pine beetle infestations, derived from aerial photographs

2 Based on a combination of hazard class and 1982-1983 southern pine beetle activity.

3 Based on a combination of hazard class and 1983-1984 southern pine beetle activity.

Table 3. Percent of southern pine beetle infestations by wilderness area as of September 30, 1986 (USDA Forest Service 1987).

Wilderness	Acreage	Infested Acreage	Percent Infestation
Cheaha	6780	7	0.1
Sipsey	12,726	85	0.7
BlackForkMountain	7568	0	0
Caney Creek	14,344	15	0.1
Dry Creek	6310	0	0
Flatside	10,105	0	0
Poteau Mountain	10,844	0	0
Kisatchie Hills	8700	3930	45.2
Black Creek	4560	53	1.2
Leaf	940	0	0
Big Slough	3000	27	0.9
Indian Mounds	9946	358	3.5
Little Lake Creek	4000	520	13.0
Turkey Hill	5400	115	2.1
Upland Island	12,000	457	3.8
Totals	117,263	5567	4.8[1]

[1]Denotes average

inactive and 33 of unknown status. In 1993, there were approximately 25 active clusters in five wilderness areas: Little Lake Creek and Upland Island in Texas; Kisatchie Hills in Louisiana; and Mud Swamp/ New River and Brawl Bay, both in Florida (USDA Forest Service 1995). On state land in Oklahoma, there were 29 active clusters in the McCurtain County Wilderness (Wood 1977, Wood and Lewis 1977). A more extensive survey in 1989-1990 located 14 active groups with 31 individuals (Kelly 1991). Masters et al. (1995) reported 9 active clusters with 22 birds. They outlined historical fire occurrence in the McCurtain County Wilderness Area. On the Okefenokee National Wildlife Refuge in Georgia, managed by the USDI Fish and Wildlife Service, there were 26+ clusters of unknown status (Jackson et al. 1986). In 1995, Masters et al. reviewed the fire history and frequency of the McCurtain County Wilderness Area.

In developing the Environmental Impact Statement for managing the red-cockaded woodpecker , the need to control southern pine beetle outbreaks that threatened red-cockaded woodpecker habitat was evaluated. Under the Final Environmental Impact Statement for the Suppression of the Southern Pine Beetle (USDA Forest Service 1987) control activities would be initiated in wilderness if a southern pine beetle infestation was within one-half mile of an essential woodpecker group, adverse effects are likely to occur within the next 30 days, and the group's continued existence is threatened. The current status of management favoring red-cockaded woodpeckers and controlling southern pine beetle outbreaks in wilderness is ambiguous. The Record of Decision, Final Environmental Impact Statement for the Management of the Red-cockaded Woodpecker and its Habitat on National Forests in the Southern Region (1995) states the following (page 4):"Originally Alternative E (the selected alternative) eliminated the inclusion of wilderness in HMAs (habitat management areas) and designated wilderness RCW clusters as non-essential. It was pointed out during the review that wilderness comprised of forest types which could be maintained as suitable RCW habitat primarily with prescribed burning should be considered for inclusion in HMAs. Therefore the flexibility to place wilderness within HMAs has been included. If this occurs, wilderness direction in Forest Plans will provide the appropriate management activities to sustain RCW habitat, compatible with individual wilderness direction." Although prescribed fire is emphasized, midstory control also may be applied (page 18). Wilderness woodpecker groups are still considered non-essential (page 19). "Alternative E does allow control of southern pine beetles within wilderness to protect RCW groups within 1/4 mile of, but outside the wilderness boundary or their foraging habitat." (USDA Forest Service, 1995).

The 1982 decision to control infestations in the Caney Creek Wilderness Area on the Ouachita National Forest in Arkansas was based on an environmental assessment of appropriate control techniques. The eight spots detected in the fall of 1982 were treated by cut and hand spray and cut and leave. Approximately 75 acres were treated to control the eight spots. Two small spots detected in October 1983 were monitored and went inactive (USDA Forest Service 1987). On the Black Creek Wilderness Area in Mississippi, southern pine beetle infestations were treated by cut and hand spray and cut and leave. Three southern pine beetle infestations were treated over a five acre area using chemical treatment (cut and spray) and two acres by cut and leave. Forty-six acres were killed by the southern pine beetle. A total of 22 infections were detected and 19 were not treated. On wilderness areas in Texas, there were a total of 599 southern pine beetle infestations in 1985 and 1986. Fifty-six percent (337 spots) were not treated, but were monitored until they became inactive; forty-four percent (262 infestations) were controlled to protect adjacent lands or RCW clusters. Cut and leave was used to control 190 infestations and cut and remove was used to control 72 spots. Of the 34,346 wilderness acres, 1393 or 4 percent were cut for southern pine beetle. An additional 85 acres of trees were killed by southern pine beetle.

In the Limits of Acceptable Change initiative on Turkey Hill and Upland Island Wilderness areas in Texas, endangered, threatened and sensitive communities; fire as a management tool; and southern pine beetle were the three highest ranked concerns on the Upland Island wilderness; and fire as a management tool, southern pine beetle, water quality, recreation and endangered, threatened and sensitive communities on Turkey Hill Wilderness (Rebori 1994). Within opportunity classes, areas subject to southern pine beetle management had low to medium opportunities for solitude; areas characterized by a 0.25 mile perimeter inside the wilderness for areas bordering private lands (or sensitive area). Fire is proposed to bring back presettlement vegetation and to ensure perpetuation of sensitive plant species (Rebori 1994, Rebori and Legg, this volume).

Disturbances, defined as a physical force or process that can cause a sudden change in a system, can be described from

1) the initial predominant effect;
2) frequency;
3) spatial distribution; and
4) temporal distribution.

These characteristics define the magnitude of the disturbance on the system (White 1979, Rykiel 1985).

As stated by Billings (1998, this volume), much of the southern pine dominated wilderness was previously managed for pine timber. Bark beetle outbreaks are a predictable consequence of suddenly withdrawing management from previously managed mature pine forests. From 1987 to 1993 about 40 percent of the pines in Texas wilderness have been killed by bark beetles (Billings 1998). Substantial impacts on wilderness attributes occur as a result of this negative feedback. In the future, judicious management activities such as hazard reduction by thinning, prescribed fire, and prompt beetle control may lessen the danger of drastic impact from bark beetle epidemics and wildfire.

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