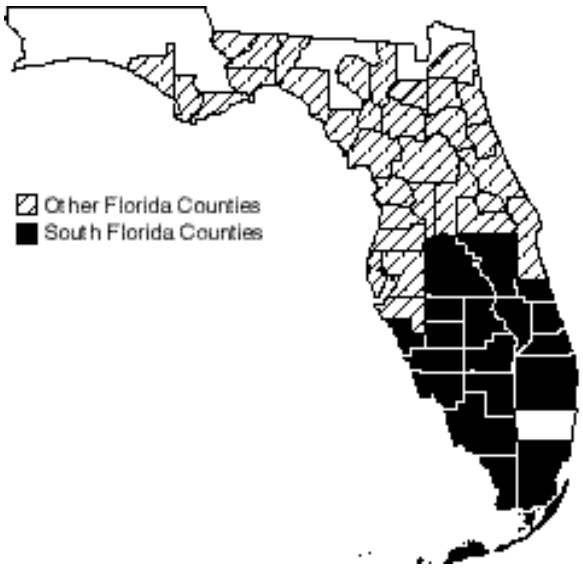
Bald Eagle

Haliaeetus leucocephalus

Federal Status:	**Threatened (July 12, 1995)**
Critical Habitat:	**None Designated**
Florida Status:	**Threatened**
Recovery Plan Status:	**Contribution (May 1999)**
Geographic Coverage:	**South Florida**

Figure 1. Florida distribution of the bald eagle.



The bald eagle is the only member of the sea eagle genus commonly found in the western hemisphere. In the eastern U.S., the bald eagle is the largest raptor and is commonly associated with large bodies of water. Bald eagles are considered common in South Florida and are known to breed throughout the state. Nest sites are usually located near large rivers, lakes, or estuaries where the eagle feeds primarily on fish and water-dependant birds. This large raptor was adversely affected by the bioaccumulation of pesticides, principally DDT. These organochlorines interfered with calcium metabolism, which resulted in eggshell thinning. Reduced productivity resulted in population declines and jeopardized the existence of this species. Banning of DDT and other organochlorines during the early 1970s reversed the decline in bald eagle numbers throughout its range. In Florida, overall bald eagle nesting has increased from a few hundred nesting territories in 1973 to 831 in 1995. Similar increases in nesting activity have been documented throughout the remainder of its range. Current threats to the bald eagle include: habitat fragmentation and loss, collisions with cars and powerlines, and shooting. In recognition of increases in the eagle population, efforts are currently underway to reevaluate the management of bald eagles in the southeastern U.S. and to refine conservation recommendations to reduce eagle-human conflict.

This account represents South Florida's contribution to the range-wide recovery plan for the bald eagle (FWS 1989).

Description

The bald eagle is a large raptor with a wingspan of about 2.1m and total body length of 0.9 m. Females are typically larger than males, although distinguishing them can be difficult unless both are side-by-side. Adult plumage is mainly dark brown with a pure white head and tail, while the eyes, feet, and bill are yellow (Palmer 1988). First year juveniles are often chocolate brown to blackish, sometimes with white mottling on the tail, belly, and underwings

(Palmer 1988). They may be confused with turkey vultures (*Cathartes aura*) in flight. The head and tail become increasingly white with age until full adult plumage is reached in the fourth or fifth year of age. During this same period, the legs, bill, and eyes change gradually from black to yellow.

Taxonomy

The bald eagle is in the order Falconiformes, family Accipitridae. Of the 289 species of hawk-like birds, there are 59 species of eagles (Grossman and Hamlet 1964, FWS 1989). The sea and fish eagles account for 11 species comprising 3 genera, of which eight species are in the genus *Haliaeetus*. The bald eagle is the only member of the genus *Haliaeetus* which regularly occurs in North America.

Also our nation's symbol, the bald eagle was first described in 1766 as *Falco leucocephalus* (Linnaeus), and was later renamed the southern bald eagle (*Haliaeetus leucocephalus leucocephalus*, Linnaeus). In 1897, a new northern subspecies was identified as *H. l. alascanus* (Townsend). Although the two subspecies of *leucocephalus* were described based on size and weight, few ornithologists acknowledge these subspecies because there is a continuous gradient in size from north to south throughout the range.

Distribution

The bald eagle was historically found throughout the North American continent from the Aleutian Islands and western Alaska to the Maritime Provinces of Canada and south to the Florida Keys, the Gulf Coast, and Baja California (Curnutt 1996). Apart from Alaska, most nesting bald eagles were found in Florida, the Chesapeake Bay area, the Great Lakes region, Maine, and the Pacific Northwest. In Florida, eagles were historically found throughout the state, although they were probably most abundant along large rivers and lakes. Eagles were probably never numerous in the panhandle of Florida. Currently in South Florida, bald eagle nesting is prevalent along the southwest Gulf Coast and the Kissimmee River valley including Polk and Osceola counties (Curnutt 1996) (Figure 1).

Habitat

Bald eagles are considered a water-dependant species typically found near estuaries, large lakes, reservoirs, major rivers and some seacoast habitats (Robards and King 1966, King *et al*. 1972, Weekes 1974, Whitfield *et al*. 1974, Gerrard *et al*. 1975, Grier 1977, Anthony and Isaacs 1989, Wood *et al*. 1989). Their distribution is influenced by the availability of suitable nest and perch sites near large, open waterbodies, typically with high amounts of water-to-land edge. Throughout their range, bald eagles demonstrate a remarkable ability to tolerate perturbations to their habitat. Their adaptability to a variety of habitat conditions makes generalizations about habitat requirements and nesting behavior difficult. Though variable, eagles have basic habitat requirements that must be met in order to successfully reproduce and survive during the winter or non-nesting season.

Bald eagle.
Photograph is clipart from Corel Ccorporation (1996).

Nesting Habitat

Nesting habitat includes a nest tree, perch, and roost sites, and adjacent high-use areas but usually does not include foraging areas. The active nest, perch, roost sites, and use areas around the nest, comprise the nesting territory. The size and shape of a defended nesting territory varies greatly depending on the terrain, vegetation, food availability, and eagle density in the area. Generally, bald eagle nesting habitat is adjacent to, or near large bodies of water that are used for foraging (Herrick 1924, Stevenson and Anderson 1994). Nest sites must also provide good visibility, and a clear flight path to the nest (Robards and King 1966, Anthony *et al*. 1982, Anthony and Isaacs 1989, Montana Bald Eagle Working Group 1991).

Most breeding eagles construct nests within several hundred meters of open water (Robards and King 1966, Robards and Hodges 1977, Henney *et al*. 1978), though these distances may increase in areas occupied by humans. Shorelines provide fishing and loafing perches, nest trees, and open flight paths (Whitfield *et al*. 1974). In most studies of nesting bald eagles, at least 90 percent of the nests were less than 200 m from open water. In Florida, most nests were located within 3 km of open water, substantially further than other reported distances (McEwan and Hirth 1979, Wood *et al.* 1989). In extreme southern Florida, nest sites are located principally near the coast, within 50 m of open water (W.B. Robertson, Jr., former NPS and USGS/BRD biologist, personal communication 1998).

Most eagles select nest trees that are larger and taller than surrounding trees (Grubb 1980, Anthony *et al*. 1982, Anthony and Isaacs 1989), except in extreme southern Florida where nests are typically located in mangrove snags (W.B. Robertson, Jr., former NPS and USGS/BRD biologist, personal communication 1998). Forest stands containing the nest site are usually multi-layered, mature, or old-growth stands. Most nest trees are alive, even though

mangrove snags are used extensively in extreme southern Florida. (W.B. Robertson, Jr., former NPS and USGS/BRD biologist, personal communication 1998). Nests are usually positioned below the treetop in live conifers, although many tree species have been used for nesting. The structure of the tree appears to be more important to nesting eagles than the species of the tree. Clear flight paths and a good line of sight are essential and nests are often found at or above the surrounding forest canopy in very large trees with open crowns and sturdy horizontal limbs.

Perch sites serve many functions. They may be used to hunt from, consume food, display, or act as sentry posts to advertise and defend the nesting territory (Montana Bald Eagle Working Group 1991). Perches may also be used for loafing, warming, drying, and refuge from the wind or rain. Unlike perches, roost sites are used at night for resting. Some perch sites may serve as roosts, but roost sites need not be near water and foraging sites. Roost trees are usually the tallest, dominant tree in the surrounding forest and are selected to provide protection from the wind and cold (Keister and Anthony 1983, Stalmaster 1987).

In Florida, nests are often in the ecotone between forest and marsh or water, and are constructed in dominant or co-dominant living pines (*Pinus* spp.) or bald cypress (*Taxodium distichum*) (McEwan and Hirth 1979). About 10 percent of eagle nests are located in dead pine trees, while 2 to 3 percent occur in other species such as Australian pine (*Casuarina equisetifolia*) and live oak (*Quercus virginiana*). The stature of nest trees decreases from north to south (Wood 1987, Wood *et al*. 1989) and in extreme southwest Florida eagles nest in black (*Avicennia germinans*) and red mangroves (*Rhizophora mangle*), half of which are snags (Curnutt and Robertson 1994). Nest trees in South Florida are smaller and shorter than reported elsewhere; however, comparatively they are the largest trees available (Wood *et al.* 1989, Hardesty 1991). The small size of nest trees in South Florida relative to other nest sites throughout the eagle's range is due to the naturally smaller stature of *Pinus elliottii*, *P. taeda*, *P. palustris* and *P. clausa* in South Florida, and the lack of pines (*Pinus* spp.) in extreme southern Florida.

Winter Habitat

In southern peninsular Florida, bald eagles breed and nest during the temperate winter. Contrary to changes in habitat use exhibited by northern bald eagle populations, eagles in the south do not substantially alter habitat use throughout the year. Some adults may remain in and defend their nesting territory outside of the breeding season (Palmer 1988), use or defend portions of their territory, or disperse and congregate at predictable food sources such as landfills. Of those adults that do not maintain territories throughout the year, most are not thought to leave the state. Conversely, following fledging, many juvenile eagles disperse north and summer from along the Atlantic Coast west to the Appalachian Mountains and north as far as Canada (Broley 1947, Wood and Collopy 1995).

Behavior

Reproduction

Bald eagles are monogamous and annual courtship behavior reinforces pair bonds (Palmer 1988). Pair bond formation includes dramatic pursuit flights,

high soaring, talon locking and cartwheeling (Johnsgard 1990). In establishing territories, eagles may also fly around the perimeter of their nesting areas visually communicating their presence. Pair bond behavior, as well as territory establishment and defense, probably occur concurrently throughout much of the eagle's range. Successful pair bond formation ultimately leads to nest site selection and nest construction for newly formed pairs or established pairs without nests. For pairs which have previously nested, nest repair or construction of an alternate nest may occur concurrent with copulation.

In South Florida, nesting activities generally begin in early September, with egg laying occurring as early as late October, and peaking in the latter part of December. Depending on latitude, incubation may be initiated from as early as October to as late as March. Clutches usually consist of one or two eggs, but occasionally three or four are laid. Incubation takes approximately 35 days and fledging occurs within 10 to 12 weeks of hatching. Parental care may extend 4 to 6 weeks after fledging even though young eagles are fully developed and may not remain at the nest after fledging (FWS 1989).

Foraging

The bald eagle is an opportunistic feeder, but in South Florida the bulk of the diet is fish. Broley (1947) found catfish (*Ictalurus* spp.), mullet, and turtles to be the most common food items found at nests in Florida. He also found that the variety of prey items differs among individual pairs. McEwan (1977) reported 79 percent fish and 17 percent bird prey, by occurrence, based on 788 animal remains recovered from nests. Of these, the dominant items were catfish and the American coot (*Fulica americana*). Eagles in Florida Bay may take birds as large as great white herons (*Ardea herodias*) (J. Ogden, SFWMD, personal communication 1998).

Bald eagles typically hunt from perch sites or by soaring over foraging areas. Most foraging occurs early in the morning with another, less intense feeding period usually occurring late in the afternoon.

Movements

Juvenile birds fledged in Florida are highly migratory, with more than one-third of the recoveries made 1,620 km or more north of Florida, all during the non-nesting season (Broley 1947). Wood and Collopy (1995) found that juvenile Florida eagles tend to move rapidly to northern summering grounds ranging from South Carolina to Prince Edward Island, Canada. Most radio-collared juveniles return each year but a small proportion remain away for 2 to 3 years. The southward migration of juveniles is more dispersed and leisurely.

Little information is available on the dispersal of bald eagles as they approach early adulthood. If paired, it is assumed these birds remain in South Florida as do most other paired adults. If not paired, it is not clear whether these birds continue to migrate north during summer or remain in South Florida with the breeding adults. Similarly, it is not known whether all birds fledged in South Florida ultimately breed in South Florida.

Relationship to Other Species

Throughout their extensive range, bald eagles live sympatrically with many other species, but rarely interact except during the breeding season. Interspecific competition for nests may occur with great horned owls (*Bubo virginianus*), red-tailed hawks (*Buteo jamaicensis*), and several species of crows (*Corvus* spp.). Throughout the year, other bird species may occasionally mob or attack eagles, but these short-term interactions are not considered significant. Raccoons may also depredate eagle nests. Eagles may impact nesting ospreys (*Pandion haliaetus*) by disrupting nesting patterns, and they may also "steal" prey from ospreys (J. Ogden, SFWMD, personal communication 1998).

Interaction between eagles and humans is the single most important factor affecting bald eagles. As discussed in more detail below, anthropogenic affects have been responsible for degradation of nesting, foraging, and wintering habitat throughout the species' range. However, efforts to conserve and manage eagle habitat are resulting in the improvement of the bald eagle population throughout much of its range.

Status and Trends

Bald eagle nesting in Florida, which has traditionally been used to assess population status, has been widely studied, and published accounts are available from a variety of sources. Broley (1947) was the first to document a decline in eagle nesting in the late 1940s. A further decline from 73 to 43 active nesting areas was reported for west central Florida between 1936 and 1956 (Broley 1958). Howell (1937, 1941, 1949, 1954, 1958, 1962, 1968, 1973) reported a decline in nesting around Merritt Island from 24 nests in 1935 to four nests in 1971. McEwan and Hirth (1979) provided additional information on productivity and nest site selection. An excellent summary was provided by Peterson and Robertson (1978), in which they characterized the bald eagle population of the 1970s as less than 50 percent of historic numbers and still slowly decreasing. In contrast, Everglades NP has conducted eagle nest surveys since the early 1960s. These surveys indicate that nesting in Everglades NP remained stable between the 1960s and 1990s at about 45 to 50 nesting pairs (J. Ogden, SFWMD, personal communication, 1998).

Prompted by the work of Broley, State natural resource agencies and conservation organizations initiated surveys for nesting bald eagles in the early 1950s, which have continued in some form to the present day. Unfortunately, many of these studies were short term and covered only portions of the nesting range of the species. These studies did reveal, however, that in many locations, bald eagle numbers had declined from historic numbers. A nationwide survey by the FWS, State wildlife agencies, and conservation groups in 1974 indicated that eagle numbers and their reproductive success in certain areas were low enough to warrant protective actions. As more and more states began systematic surveys for bald eagles, better information became available to assess the status of the bald eagle throughout much of its range.

Since being listed as endangered, bald eagle populations have continuously improved. Improvement in population numbers resulted primarily from the

Table 1. Florida bald eagle nesting trends, 1973-95 (from Nesbitt 1995).

Year	# Active Territories	# Successful Nests	# Young Produced	Young/Active Territory	Young per Successful Nest
1973	88	55	74	0.84	1.35
1974	157	82	117	0.75	1.43
1975	246	145	213	0.87	1.47
1976	241	162	260	1.08	1.61
1977	270	170	265	0.98	1.56
1978	319	182	262	0.82	1.44
1979	353	223	324	0.92	1.45
1980	363	212	345	0.95	1.63
1981	359	234	368	1.03	1.57
1982	340	240	356	1.04	1.48
1983	374	231	351	0.94	1.52
1984	378	247	351	0.93	1.42
1985	387	280	435	1.12	1.55
1986	329	247	429	1.30	1.74
1987	391	251	400	1.02	1.59
1988	399	276	448	1.12	1.62
1989	439	310	474	1.08	1.53
1990	535	366	585	1.09	1.60
1991	601	285	591	0.98	1.54
1992	652	468	729	1.12	1.56
1993	667	447	679	1.02	1.52
1994	779	591	951	1.22	1.61
1995	831	621	982	1.18	1.58
Total	9,498	6,425	9,989	1.05	1.56
10-year Average	**518**	**362**	**572**	**1.11**	**1.59**

banning of DDT and other persistent organochlorines, and has been accelerated by other recovery efforts. In 1963, a National Audubon Society survey reported only 417 active nests in the lower 48 states with an average of 0.59 young produced per active nest. In 1995, about 4,450 occupied breeding areas were reported by the lower 48 states with an estimated average young produced per occupied territory of 1.17 (J. Millar, FWS, personal communication 1996). Compared to 1974, for example, the number of occupied breeding areas in the lower 48 states has increased 4.6 times. Since the late 1970s, the species has doubled its breeding population every 6 to 7 years (FWS 1995).

In Florida, bald eagle nesting and productivity has increased dramatically since the early 1970s (Table 1). Florida currently supports the highest number of breeding bald eagles of any southeastern state, supporting approximately 70 percent of the occupied territories in this region (Nesbitt 1995).

Habitat Alteration

The human population in Florida has grown dramatically over the past several decades. Between 1980 and 1995, the human population grew from an estimated 9.7 million to 14.2 million, making Florida the third most populous state (Florida Commission on Government Accountability to the People 1996). Human population growth in Florida has resulted in extensive alterations in land use. Kautz (1993) estimated that as of 1987, Florida's landscape was composed of 30 percent agricultural land and 13 percent urban development, leaving 57 percent in natural to semi-natural land cover. Intensive conversion of natural plant communities to agricultural, residential, and commercial uses has encroached, and continues to encroach, on bald eagle nesting and foraging habitats (Heinzman 1961, 1962; Wood *et al.* 1989). Adverse effects are particularly evident near water bodies since humans and eagles both prefer waterfront locations (Harris *et al.* 1987, Wood *et al.* 1989).

Habitat alterations affect the quantity, quality, and distribution of essential environmental factors needed to support bald eagles. Changes in the landscape reduce or fragment natural vegetative communities, thereby decreasing the suitability of nest sites. Human population growth and associated land alterations are also responsible for degradation of many of Florida's surface waters, indirectly affecting bald eagle foraging areas. In addition to the direct effects of altering the physical habitat, human growth, and the infrastructure necessary to support that growth, often indirectly result in an increased exposure of nesting bald eagles to human disturbance. New roads, houses, commercial complexes, agriculture, and recreational facilities which result from land conversions may have adverse effects on nesting eagles.

Nesting bald eagles are more sensitive to disturbance than non-nesting or wintering birds, and the early stages of the breeding cycle (nest construction or repair, egg laying, and incubation) are the most critical time (Mathisen 1968, Weekes 1974). Bald eagles are more likely to abandon a nest early in the season before a bond is established or young hatch. The vulnerability of eggs or young to adverse weather is also most critical early in the season. Disturbances later in the nesting cycle may be a problem if eaglets fledge prematurely (Grier 1969).

Human disturbance has been shown to reduce productivity, nest success, and territory use (Newman *et al*. 1977, Grubb 1980, Stalmaster 1987, Anthony and Isaacs 1989, Buehler *et al*. 1991, Montana Bald Eagle Working Group 1991, Steidl 1994, Anthony *et al.* 1995). In Oregon, Anthony and Isaacs (1989) found that nests were constructed further from human disturbances (recreational activities and roads) than were old nests in the same territory. Similarly, Fraser *et al*. (1985) found that nests on developed shorelines tended to be moved further from the water than nests on undeveloped shorelines. Segments of the Chesapeake Bay shoreline historically used for nesting have now become so saturated with human activity that bald eagles no longer use these sites (Buehler *et al.* 1991). Similarly, as shoreline development and human activity increases, eagles often rebuild nests further inland to avoid disturbance (Whitfield *et al*. 1974, Newman *et al.* 1977, Fraser *et al.* 1985). Bald eagles have altered nesting activity to avoid human disturbances in Saskatchewan and Manitoba (Gerrard *et al*. 1975) and forestry operations in western Florida (Broley 1947) and Oregon (Anthony and Isaacs 1989). Grubb (1980) showed that nests closer to human activity were less productive than secluded nests.

The effects of recreational disturbances on wintering and breeding eagles has been extensively researched. Most of this work has focused on eagle habitat along large rivers, lakes, and reservoirs in the Pacific Northwest. In general, it was found that recreational activities usually disrupt eagles temporarily over short time periods. In Florida, Wood and Collopy (1995) indicated that boating use throughout the year limited bald eagle use of foraging areas. Short term disturbance may have a cumulative impact and affect individual fitness through reduced reproductive success (Stalmaster and Newman 1978, Knight and Knight 1984, Harmata and Oakleaf 1992, Anthony *et. al*.1995).

The response of bald eagles to habitat change has not been comprehensively evaluated in Florida. However, as discussed above, research in other portions of the eagle's range indicates that in some situations, nesting bald eagles respond

negatively to human disturbance. Florida's bald eagle population has not shown any overt signs of stress (reduced territory occupancy, decreased productivity, increased nest failures, etc.). Recent analyses conducted by the GFC indicate that productivity of nests in urban areas did not differ significantly from nests in more rural areas (S. Nesbitt, GFC, personal communication 1998). However, it is generally believed that the threshold at which the stressors will first be recognized is rapidly approaching, particularly in the urban areas of southwestern and central portions of the State. In these areas, little unoccupied habitat remains and it is expected that eagles will begin nesting in areas more susceptible to disturbance.

Mortality

Within the lower 48 states, shooting has historically been a major source of mortality for bald eagles (Stalmaster 1987). Mortality from shooting is often expressed as a percentage of the total deaths. Published estimates of mortality from shootings are as follows: 62 percent from 1961 to 1965 (Coon *et al.* 1970), 41 percent from 1966 to 1968 (Mulhern *et al.* 1970), 46 percent from 1969 to 1970 (Belisle *et al.* 1972), 35 percent from 1971 to 1972 (Cromartie *et al.* 1975), 25 percent from 1973 to 1974 (Prouty *et al.* 1977), and 20 percent from 1975 to 1977 (Kaiser *et al.* 1980). Since the early 1980s, no systematic analyses of bald eagle mortality have been conducted; however, recent evidence suggests that mortality resulting from shooting is now exceeded by collisions with powerlines and automobiles (S. Nesbitt, GFC, personal communication 1998).

Perhaps the most dramatic declines in bald eagle populations nationwide were caused by environmental contaminants. Organochlorine compounds (DDT and its metabolites) are known to inhibit calcium deposition, which caused eggshell thinning, ultimately reducing reproductive success (Radcliffe 1967, Hickey and Anderson 1968). Mulhern *et al.* (1970) found widespread occurrence of DDT, DDE, and DDD in eagle carcasses; and at least one female had lethal levels of DDT and DDD. Similarly, cyclodiene dieldrin had been documented at lethal levels in eagles (Mulhern *et al.* 1970). Results of measurements from 87 eggshells collected from 1984 to 1987 from Florida nests showed that the shells were only slightly thinner, on average, than pre-1947 eggs. However, there were a few eggs with shells as much as 29 percent thinner indicating that there may still be localized problems with residual contaminants (Wood *et al.* 1989). Since a 1972 ban on the use of DDT in the U.S., increases in eagle productivity has been rapid.

Lead poisoning has been documented as a significant source of mortality in eagles (Pattee *et al.* 1981). The National Wildlife Health Research Center has diagnosed lead poisoning in more than 225 eagles during the last 15 years. Lead poisoning occurs when eagles eat prey that contains lead shot or has assimilated lead into its own tissues. Winter killed waterfowl that have ingested lead shot or were crippled during hunting season are typical sources of lead contamination (Stevenson and Anderson 1994). Chronic low levels of lead increase susceptibility to a variety of mortality factors including: neurological dysfunction, behavioral and learning aberrations, anemia, and increased susceptibility to disease. Restrictions on the use of lead shot for waterfowl hunting has reduced the incidence of lead contamination in bald eagles in the U.S.; however, lead shot is still used in other portions of the eagles' range *(e.g.* Canada and Mexico).

Mercury, in the form of methylmercury, is one of the most toxic naturally occurring substances. Mercury is metabolized at very slow rates and may accumulate in tissues over time resulting in a variety of sublethal effects including: reduced fitness, reproductive impairment, brain lesions, paralysis, and reduced survival of offspring (Fimreite and Darstad 1971, Heinz 1975, Pass 1975, Finley and Stendell 1978, Heinz 1979, Eisler 1987, Wren *et al.* 1995). Elevated mercury levels have been reported in bald eagles in the Northeast and Great Lakes region (Evans 1993); Ontario, Canada (Evans 1993); Oregon (Frenzel and Anthony 1989); and Alaska (Evans 1993). In South Florida, elevated mercury has been found in fish, alligators (*Alligator mississippiensis*), raccoons (*Procyon lotor*), Florida panthers (Puma (=Felis) concolor coryi) and some wading birds (Hord *et al*. 1990, Facemire and Chlebowski 1991, Roelke *et al*. 1991, Spalding and Forrester 1991, Brim *et. al*. 1994, Sundlof *et. al.* 1994).

Limited information is available on the bioaccumulation of mercury in bald eagles in South Florida. Preliminary analysis of blood from eagles in Florida Bay, Everglades NP, showed a mean level of 0.28 parts per million (ppm) in 1993 and a mean level of 0.31 ppm in 1995 (B. Mealy, Miami Museum of Science, personal communication 1996). These data, however, are derived from few samples and over a limited geographical range and may not adequately represent the threat of mercury contamination. Wood *et al*. (1993) collected blood, tissues, and feathers from bald eagles in central and northern Florida and found mercury levels in bald eagles to be above background levels that were considered high enough to elicit sublethal effects. Unfortunately, without extensive monitoring, sublethal effects such as changes in growth, development, reproduction, and behavior are difficult to identify and quantify. However, available information for South Florida indicates that mercury contamination and bioaccumulation in the environment and in other species may already be a problem (Royals and Lange 1990, Facemire and Chlebowski 1991, Spalding *et al*. 1994, Sundlof *et al*. 1994). Since many of the species studied are prey or are representatives of other species that may be prey, it is likely that the transfer of mercury to eagles will remain a conservation problem.

Management

A nationwide recovery program for the bald eagle was established in the mid-1970s. The lower 48 states were divided into five recovery regions: Chesapeake Bay, Pacific, Southeastern, Northern States, and Southwestern. A recovery plan was prepared for each region by separate recovery teams composed of species experts in each geographic area. Each team established recovery goals and identified specific tasks needed to achieve these goals. In the southeastern U.S., the recovery plan established the reclassification criteria from endangered to threatened as 600 or more occupied territories throughout at least 75 percent of the eagle's historical range. In addition, reclassification of the southeastern population required that more than 0.9 young be produced per occupied nest, greater than 1.5 young be produced per successful nest, and at least one young be produced in 50 percent of the nests for each nesting season (FWS 1989). These criteria were based on a 3 year average. Delisting criteria have not been established for the bald eagle in the southeastern U.S.

To help achieve recovery goals for the bald eagle, the FWS, with the assistance of State wildlife resource agencies, produced bald eagle habitat management guidelines that provide recommendations to avoid or minimize detrimental human-related impacts on nesting bald eagles (FWS 1987). These habitat management guidelines provide much of the direction for the management of bald eagles in the U.S. and include measures designed to maintain or improve environmental conditions (FWS 1987). Though the guidelines vary slightly from region to region, they generally provide for the spatial and temporal protection of nesting and foraging sites and flight paths. These guidelines have been widely adopted by Federal and State agencies and are applied to both public and private lands.

A principal component of the guidelines for the southeastern U.S. includes a recommendation that two protective zones be established around bald eagle nests. A primary zone is recommended to encompass an area extending outward from the nest tree between 230 m and 460 m. The exact distance encompassed by this zone is dependent on the location of feeding areas, roosts, and perch sites within a particular nesting territory (FWS 1987). Within the primary zone it is recommended that certain activities be avoided at all times. Activities to be avoided include: residential, commercial, or industrial development, tree cutting, logging, construction, mining, or use of chemicals toxic to wildlife. Activities such as human entry and low-level aircraft flights over the primary zone are not recommended during the nesting season, but may be allowed in some situations during the non-nesting season.

The guidelines recommend a secondary zone extending from the outer boundary of the primary zone outward up to 1.6 km. Restrictions within the secondary zone are recommended to minimize disturbance that might compromise the integrity of the primary zone and to protect areas used by the nesting eagles outside of the primary zone (FWS 1987). Restrictions are recommended on new commercial and industrial development, construction of multi-story buildings or high-density housing developments, construction of roads that increase access to nest sites, and use of chemicals toxic to wildlife. Most other sources of disturbance are allowed within the secondary zone during the non-nesting season.

The guidelines have been used many times in Florida to avoid or minimize adverse effects to nesting bald eagles. Nesbitt *et al.* (1993) evaluated the effectiveness of the guidelines in protecting bald eagle habitat and found that eagle use and productivity was not significantly affected by human encroachment when the guidelines were implemented and adhered to. These results indicate that limited human encroachment was not yet affecting nesting eagles and that no modifications to the guidelines were needed in Florida.

Evaluation of long-term trends in nest success and productivity should provide the information necessary to evaluate continued effectiveness of the guidelines. Data analyses are anticipated to reveal regional differences, principally due to variations in duration, type, and magnitude of threats to bald eagles. If the results indicate decreasing trends either regionally or statewide, guideline modifications will identify more stringent protection of breeding and foraging habitat. Conversely, where trends are increasing, it is expected that the modified guidelines will relax some or all of the protective restrictions.

The effects of disturbance on bald eagles have become apparent over time in portions of the eagles' range. It is clear that bald eagle habitat is slowly being altered or destroyed throughout much of the species' range. The impacts, as described by Stalmaster (1987) are "cumulative and may have few effects on a local and short-term basis, but because it [habitat alteration] is so widespread and long-term in nature, the effects to eagles are tremendous." Stalmaster (1987) was referring to the effects of forest management on bald eagle nesting when he stated that "once altered, forest habitat is rarely allowed to return to the old-growth state that the eagle prefers ...the last vestiges of old growth are now being removed and replaced with fast-growing, economically efficient forest stands." Throughout much of the bald eagles' range, we believe that nesting and wintering habitats are threatened by many other types of anthropogenic factors that will slowly make these areas unsuitable for eagles.

However, by all accounts, the bald eagle population in South Florida has increased dramatically over the last 20 years. The success of eagles in Florida may ultimately be the primary reason for the recovery and delisting of eagles in the southeastern U.S. Even in this time of optimism, there remain concerns about the future of bald eagles in South Florida. Nesbitt *et al*. (1993) indicated that even though the number of nesting eagles in Florida has recovered to one-half to two-thirds of historic numbers, the amount of feeding and nesting habitat remaining in Florida may not be sufficient to support the eagle population that existed in the early 1900s. Wood *et al*. (1989) indicated that Florida eagles are faced with significant disturbances from human land-use patterns, especially land alterations associated with urban development. In combination, these and other factors may be working synergistically to reduce the value of bald eagle habitat in Florida. Currently, however, the threshold of human disturbance which triggers large-scale observable adverse effects has not yet been reached or is not detectable under current monitoring programs.

In Florida, only the total number of nesting eagles and statewide reproductive success have been used as the benchmarks for assessing the health of the bald eagle population. Undoubtedly, many of the same cumulative effects noted elsewhere are affecting eagles in South Florida. Whether bald eagles in South Florida respond adversely to these cumulative effects is a question that must be answered before we proclaim South Florida's eagle population to be recovered.

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Recovery for the Bald Eagle

Haliaeetus leucocephalus

Recovery Objective: DELIST the species once recovery criteria are met.

South Florida Contribution: South Florida's contribution to meeting this recovery objective will be achieved by maintaining or increasing the number of successful nests and the average annual productivity.

Recovery Criteria

Delisting criteria for the bald eagle in the southeast region are currently being developed. Until this species is delisted, South Florida's contribution to recovery of the bald eagle in the southeast is in accordance with the recovery criteria as indicated in the current approved Southeastern States Bald Eagle Recovery Plan. Specifically, South Florida can contribute to the recovery of the bald eagle in the southeast by furthering the goals of: nesting productivity of at least 0.9 chicks per occupied nest, greater than 1.5 young per successful nest, and at least 50 percent success in raising at least one young. These criteria must be accompanied by three years of data.

Species-level Recovery Actions

S1. **Determine distribution of the bald eagle in South Florida**. This task is covered by the bald eagle monitoring program performed by GFC described below in task 3.

S2. **Protect and manage bald eagle populations in South Florida**.

S2.1. **Prevent or mitigate the effects of behavioral degradation**. Behavioral degradation is the modification of normal eagle activity by any disturbance which reduces an area's ability to support eagles. These disturbances may result in increased energy expenditures, decreased feeding efficiencies, reduced reproductive potential, or decreased habituation by eagles.

S2.1.1. **Identify and quantify effects of disturbance on nesting eagles and incorporate into management plans**. Quantifying disturbance effects must focus on increases or decreases in annual productivity.

S2.1.2. **Identify and quantify the effect of disturbance on bald eagle feeding sites and incorporate into management plans as indicated in task H1.2.5**. The impact of disturbance to foraging eagles is not clear, but reduced feeding efficiency and increased energy expenditures are likely. The effect of these factors on productivity must be examined.

S2.1.3. Continue to require permits for all research activities which have the potential to negatively impact eagles. The effects of disturbance from research projects should be evaluated against the information to be gained and the project's enhancement of the recovery potential of eagles.

S2.1.4. Help the Department of Defense develop and implement bald eagle guidelines for use on Military Areas of Operation in South Florida.

S2.2. Reduce bald eagle mortalities in South Florida. Minimizing mortality will involve documenting the type, amount, source, and location of mortality and providing effective enforcement of existing laws.

S2.2.1. Enforce laws protecting bald eagles. Maintain and/or augment active enforcement of existing laws and preventive actions designed to reduce the number of violations. Law enforcement personnel at the State and Federal levels should be made aware of the potential sources of harm to bald eagles.

S2.2.2. Establish and maintain adequate rehabilitation facilities. Mortality may be reduced through the use of rehabilitation facilities. Existing emergency care protocols should continue at established, permitted rehabilitation facilities.

S2.2.3. Reduce mortality from aerial collisions. Structural modifications and project planning modifications in documented problem areas can reduce potential sources of mortality for bald eagles. The frequency of collisions between eagles and towers or powerlines may be reduced by locating structures away from eagle habitat and increasing structure visibility *(i.e.* installing marker balls or other marker models).

S2.2.4. Reduce eagle mortality due to collisions with automobiles. Increasing roadway clear zones and minimizing access to carrion may reduce collision mortality. Cooperation with DOT is essential to completing this task.

S2.2.5. Work with utility companies and municipal governments to reduce mortality from electrocution. Appropriate design and location of power lines can reduce mortality due to electrocution. Poles and lines should be designed to prevent electrocutions in areas of high eagle use.

S2.2.6. Prevent mortality due to poisoning. Prohibit the use of poisons for predator control in areas used by feeding eagles. This would alleviate the problem of secondary or unintentional ingestion of poisons which are being used for the control of other species.

S2.2.7. Prevent poisoning mortality due to secondary ingestion of euthanized domestic animals. Educate veterinarians and municipalities of the dangers of depositing euthanized domestic animals in landfills. Develop landfill management recommendations to reduce likelihood of secondary ingestion of barbiturates.

S3. Continue to monitor bald eagle nesting activities in South Florida. Population monitoring is necessary in order to determine the status and distribution of the species. The GFC currently monitors eagle nests twice per nesting season. This activity should be continued and expanded, as necessary, to provide important information on nesting success and the success of the habitat

management guidelines, in addition to providing essential information on the population status throughout the state. If the bald eagle is to be delisted in the future, this information is essential to ensuring delisting criteria, once developed, are met.

S4. Develop public information and education materials to inform the public of the recovery needs of the bald eagle in South Florida. Public information programs should provide updated, accurate information on the status and needs of eagles and the relationship between eagle recovery and the well-being of man. While support must be evoked from the general public, specific problems such as indiscriminate shooting of eagles must be resolved by focusing efforts at specific user groups.

S4.1. Continue to use permanently incapacitated eagles for educational presentations. Exhibiting disabled eagles during lectures is an effective method of teaching. Such activities should, however, be carefully limited to qualified, permitted, individuals and employ only eagles which may not be returned to the wild.

S4.2. Prepare general informational brochures for distribution in South Florida. This should include life history information relative to the southeast since many general accounts depict only characteristics of northern populations. This brochure should present accurate status information as well as recovery needs. It should also give sources for additional informational materials.

S4.3. Develop and distribute information to pilots concerning the potential for disturbance of nesting eagles by aircraft. A poster should be developed and distributed to all public, private, and military airports. Information on eagle and eagle nest protection should also be included in the Airman's Information Manual in the section on bird strike hazard.

S5. Develop delisting criteria for the bald eagle in South Florida. Delisting criteria for the bald eagle will be developed on a regional basis by the Southeastern Bald Eagle Recovery Team.

Habitat-level Recovery Actions

H1. Prevent further loss and degradation of bald eagle habitat in South Florida. Despite the amount of habitat loss and degradation throughout South Florida, the number of bald eagles with breeding territories in South Florida has increased. Nevertheless, the continued loss and degradation of bald eagle habitat in South Florida is expected to cause population declines in the long-term if it continues unabated or unmitigated. In the long-term the persistence of bald eagles in South Florida will require protection of their nests, foraging areas, migratory corridors, and juvenile dispersal areas.

H1.1. Continue to gather information on the effects of habitat loss and degradation of habitat on bald eagles in South Florida. One of the challenges to protecting habitat for bald eagles in South Florida is the different responses of individual pairs to habitat loss and degradation within their territories. Some pairs will abandon their territories when minimal amounts of disturbance occur, while other bald eagle pairs will ignore seemingly significant disturbance. Future efforts to conserve bald eagles in South Florida will require better information on how different types of habitat loss affect bald eagle pairs and identification of biological effects (such as reduced productivity) that occur regardless of the behavioral responses of nesting adults.

H1.1.1. Identify alterations to terrestrial and aquatic habitats that adversely affect bald eagles in South Florida. Alterations of aquatic habitat have affected eagles in a variety of ways. Altered hydrology due to

channelization for flood protection and water storage and agricultural, commercial, and residential uses of surface and groundwater affect the amount of surface water available to support forage fish and other terrestrial prey. Agricultural, commercial, and residential development also affect water quality and the ability of aquatic resources to provide suitable foraging sites for bald eagles.

H1.1.2. Quantify essential characteristics of occupied bald eagle habitat. Quantification of the characteristics of habitats, undertaken in a systematic and uniform format, is needed. Such characteristics should be determined by comparing differences between historic and currently occupied territories. In addition, areas of high productivity should be compared and contrasted to areas of low productivity. This should provide for the accurate prediction of impacts during early planning stages and allow for the protection of potential as well as occupied habitat.

H1.1.3. Quantify responses of bald eagles in South Florida to habitat alteration. Individual eagles, pairs, or groups of eagles vary widely in their response to alteration of habitat. Information is needed to address the effects of disturbance, including the duration, frequency, and intensity as they relate to each stage of reproduction.

H1.2. Protect bald eagle habitats in South Florida through site management. Management of occupied territories in South Florida is the first priority of recovery. Nowhere else in its range is the eagle under greater threat from habitat changes than in the South Florida Ecosystem.

H1.2.1. Continue to implement and adhere to "Habitat Management Guidelines for the Bald Eagle in the Southeast Region"(op cit). The current level of knowledge for bald eagle habitat management is reflected in these guidelines and they should be used in resource planning. They should also be reviewed and revised as new information becomes available.

H1.2.2. Develop specific management plans for each breeding territory. Individual management plans should be developed for each breeding area whenever possible. This should include occupied, recently occupied, and historic nesting areas. The plans should be designed to accommodate local factors of habitat use, use-area configuration, nesting success, and level of tolerance to disturbance.

H1.2.3. Protect eagle habitat through cooperative agreements, easements, acquisition or other appropriate means. Funding for habitat management should be sought from a multitude of sources including Federal, State, local, and private sources.

H1.2.4. Identify and incorporate important bald eagle habitat in land use plans and planning. Identify important habitat in order to ensure that accurate information is available for the development of land use plans.

H1.2.5. Use section 7 of the ESA to protect bald eagles and their habitats. Interagency consultations on permits issued by the U.S. COE pursuant to section 10 of the Rivers and Harbors Act and section 404 of the Clean Water Act are important for the conservation of bald eagles in South

Florida. With the human population in South Florida expected to almost double over the next 15 years, these interagency consultations will become increasingly important to prevent bald eagles in South Florida from declining.

H1.3. Prevent or mitigate the degradation of eagle habitat from environmental contaminants. Mercury occurs throughout South Florida and may reduce recovery opportunities for eagles in South Florida. The numbers, nesting effort, and fecundity of bald eagles that nest in areas where high levels of mercury are known or suspected should be monitored to detect possible mercury contamination. Similarly, addled bald eagle eggs, carcasses and prey from areas where high levels of mercury are known or suspected should be tested for mercury contamination.

H2. Develop methods to restore previously occupied habitat or to establish new territories. In South Florida, an increasing number of bald eagles, territories occur in areas that are being cleared for residential housing or for industrial sites. In some instances, individuals have applied for permits to take bald eagles incidental to land clearing for residential housing. At the same time, several managers of wetland mitigation banks have included bald eagles as beneficiaries of their mitigation banks without demonstrating opportunities to restore or enhance the value of bald eagle territories. In the past, the FWS and GFC have had no information on opportunities to restore previously occupied bald eagle territories or to establish new territories. This information, which would require some experimentation, would help establish measures to minimize or mitigate the effects of habitat loss or degradation on bald eagles associated with land clearing for residential housing construction in South Florida.

H3. Increase public awareness of habitat-related issues that affect the recovery of the bald eagle in South Florida.

H3.1. Produce an information brochure for landowners. Land management information and guidelines should be prepared for landowners including information on where to obtain additional professional assistance. State foresters should be included in this effort since they provide silvicultural expertise to private landowners.

H3.2. Establish displays at public boat landings to provide information on laws, penalties, rewards, and identification of eagles. Many boaters utilize public landings for access to aquatic habitat used by eagles. This includes use by hunters and fishermen as well as by recreational and commercial boaters. These user groups should be provided with information on identification and legal protection of eagles. Local phone numbers where violations may be reported should also be included.