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ABSTRACT

An annual statewide survey of all known bald eagle nesting territories in Florida is conducted between November and March. Surveys are flown by fixed or rotary winged aircraft. New nests are searched for opportunistically in addition to surveying new nests reported by others prior to the survey. Replication of the survey methodology ensures that effort is comparable among years. Additional surveys were conducted during the 06-07 breeding season and will continue the next two breeding seasons. These additional surveys aim to locate previously undiscovered nests by focusing on potential bald eagle habitat in areas where there are currently no known nests. All nesting and productivity data for bald eagles in Florida are compiled and analyzed to generate annual population estimates that are used to determine the Florida eagle population trend. The continuation of this survey is critical for the conservation and management of the bald eagle in Florida. This will enable us to monitor the population of this recently delisted species.

INTRODUCTION

The bald eagle (*Haliaeetus leucocephalus*) is one of the most thoroughly studied birds, with perhaps more than 2,500 articles published on its biology or management (Buehler 2000). There is much information available concerning the life history and habitat requirements of the bald eagle in Florida. This includes: nesting requirements (Broley 1947, McEwan and Hirth 1979, Wood *et al.* 1989); effects of habitat protection (Nesbitt *et al.* 1993); analyses of setback distances and disturbance levels (Nesbitt *et al.* 1993, Millsap *et al.* 2004); and habitat use and movements (Wood 1992, Wood *et al.* 1998, Mojica 2006). Despite the wealth of information gathered previously, additional research is needed to ensure the long-term conservation and management of bald eagles in Florida.

Historically, Florida's bald eagle population "must have been well in excess of 1000 nesting pairs," and numbers around Tampa Bay and Merritt Island were thought to be "among the densest breeding concentrations of a large raptor known anywhere on earth" (Peterson and Robertson 1978). Following severe decreases in population size, several federal and state regulations were put in place to protect the bald eagle. The bald eagle was first protected nationally in 1918 under the Migratory Bird Treaty Act (16 U.S.C. 703–711), which protected nearly all native birds and their nests. The Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. 668–668c) offered additional protection against the take and disturbance of bald eagles and their nests. In 1972, the U.S. Environmental Protection Agency banned all domestic use of DDT.

The following year, the Endangered Species Act of 1973 (16 U.S.C. 1531–1544) was passed, and the bald eagle was added to the list of federally endangered and threatened species in 1978.

The elimination of DDT and the increased protection for the eagle led to the species recovery. The increase of bald eagle population in Florida occurred during a time of accelerated human occupancy throughout the state. The conclusion that can be drawn is that bald eagle populations can flourish even when faced with development pressures if appropriate habitat protections and development monitoring guidelines are in place. There is speculation based on the population trend leveling off that Florida may have reached its carrying capacity for the bald eagle (Figure 1). Despite this population plateau, the eagle population in Florida has remarkably recovered.

In response to a petition to reclassify the bald eagle filed in 2002, FWC convened a panel to review the biological status of the bald eagle in Florida (Sullivan *et al.* 2006). The panel concluded that bald eagles in Florida did not meet the criteria for listing at any level and had not met the criteria for the past five years. Consequently, the panel unanimously recommended that the bald eagle be removed from Florida's list of imperiled species. This decision was based on the following: (1) the bald eagle population occurs throughout Florida; (2) the population has not experienced extreme fluctuations in range or numbers; (3) the estimated number of adults has increased >300% during the past three eagle generations (24 years); and (4) the population is not projected to experience significant declines over the next three generations (Sullivan *et al.* 2006). Based on the recommendations of the biological review panel, the FWC proposed to remove the bald eagle from the state list of endangered or threatened species. Senior leadership put together an issue team, lead by Robin Boughton, to draft the Bald Eagle Management plan. This multi-disciplinary team is composed of members from many divisions of FWC including FWRI, HSC, and Law Enforcement. The team also includes two endangered species coordinators from the St. Johns Water Management District. The goal of the management plan is to establish conservation actions that will maintain a stable or increasing population of bald eagles throughout Florida in perpetuity. To achieve this goal, a decline in the eagle population must be prevented via the protection of nesting and foraging habitats through science-based management, clear regulations, public education, and law enforcement. The Bald Eagle Management Plan will guide continued regulation and monitoring activities that are necessary to prevent a decline in the population that would trigger a relisting effort—and possibly additional land-use restrictions. The team currently has a draft document and they are incorporating feedback and comments from stakeholders as well as the Senior Leadership Team. The final document is scheduled to be presented at a future Commission meeting.

This June the bald eagle was removed from the USFWS endangered species list. Although the bald eagle is no longer protected under the Endangered Species Act, it is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. The USFWS (2007) has redefined some of the terminology included in the Bald and Golden Eagle Protection Act, which prohibits the "take" of bald eagles, including their nests or eggs. The act defines take as meaning to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb" an eagle. The new (USFWS 2007) definition of "disturb" is to "agitate or bother a bald or golden eagle to the degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with

normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior."

FWC staff and others have monitored bald eagle nests in Florida since 1972. The information gathered during the past 35 years includes the locations of over a thousand eagle nesting territories, breeding productivity, core nesting areas, reproductive success, and population trends. The current survey represents a minimum estimate of the state's population (Nesbitt et al. 1990). To expand the survey, additional surveys were conducted during the 06-07 breeding season and will continue the next two breeding seasons. This additional survey expands the current survey by increasing the effort of locating previously undiscovered nests by focusing on potential bald eagle habitat in areas where there are currently no known nests. Historically, fewer eagle nests have been located in the Florida panhandle west of the Suwannee River compared to the peninsula. The panhandle region and other identified areas in the state will be surveyed with either more transects or increased flight time in suitable habitat to determine if there are undetected nests. All nesting and productivity data gathered during the surveys are compiled and analyzed to generate annual population estimates that are used to determine the Florida eagle population trend.

METHODS

A statewide survey of eagles was conducted during their nesting seasons (October through May). Surveys were flown by fixed or rotary winged aircraft. Replication of the survey methodology ensures that effort is comparable among years. Some nests were surveyed from the ground. The U.S. National Park Service (NPS) surveys Everglades National Park, and the Commission is responsible for the remainder of the state. All previously known bald eagle nests were checked for activity. All reported new nests were checked and any areas inadequately surveyed in the past were more thoroughly checked for nests.

The survey protocol followed Nesbitt et al. (1990) and include the following methods: reduce airspeed to 60-80 knots (111-120 kph), at an altitude of 300-500 feet (90-150 m), at a distance >300 m from the nest to avoid disturbance, no flights will take place during inclement weather or winds >20 knots (37 kph), and nests that are impossible to approach from the air because of FAA or military restrictions (i.e., too near an airport or military base) will be observed from the ground.

Nest locations were determined with the use of WAAS Global Positioning System (WGPS) unit with an accuracy of ±10 m of the true location. Locations were recorded in longitude and latitude to hundredths of a minute and stored and displayed in NAD83 datum. The township, range, and section of each nest location also will be provided. A system called "X Marks the Spot" developed by Paul Kubilis of the FWC will be employed to record the location of new nest sites. This method consists of flying over the nest from two separate directions at an angle >60 degrees and making a waypoint over the nest with each pass. This technique provides three separate points (two waypoints and the crossing point of the two over-flights). This method necessitates that the GPS be capable of recording a flight log and each flight must be downloaded before the next flight. Otherwise, with current memory limitation of these hand held GPS units, the flight log will over-fill and data will be lost.

In addition to the traditional survey described above, a proportion of plots of suitable eagle nesting habitat was surveyed using a modified "dual frame method" (Haines and Pollock 1998). The dual frame method combines the efficiency and cost effective advantages of a list sampling frame (i.e., the current list of all known nest locations based on the previous 5 nesting seasons from the traditional survey database; this is a low cost survey method albeit often found to be incomplete) and area frame sampling (i.e., designates randomly selected plots to be surveyed for nests for geographic boundaries or regions of interest; this has been shown to be very efficient for sampling albeit more costly to cover a large area as on a statewide basis). The area frame sampling implements a double-observer procedure for estimating number of nests missed during the traditional or list sampling frame survey method. The dual frame method of analysis uses the sample information from both the list frame and the area frame to arrive at a more precise estimate of nest density across the entire study area. To conduct the analysis, nests identified in the area frame sampling are separated into the two categories: the overlap (nests in the plots that also occur in the list frame or traditional survey) and non-overlap (nests that are newly found in the plots) domains. The non-overlap nests are identified, and are used to estimate the total number of nests not in the list frame. Because these reconciled nests are only the ones not in the list sample, the list and area estimates are independent, so the variances from the list and area samples can be added. The cost of obtaining an estimate of the total number of nests with the same standard error can be halved. The sum of the estimates from the area frame and the list frame are used to determine a total number of occupied eagle nests statewide. This methodology has been demonstrated to identify essentially 100% of the nests in the area surveyed (Mark Otto, USFWS unpublished report).

To implement this methodology for our modified dual frame survey, a map was generated showing all potential eagle habitat in Florida using GIS landscape information from the Closing the Gaps Program and the Bald Eagle Potential Habitat Model analysis. In addition to potential habitat, a selection criterion was developed based on scientific knowledge of bald eagle habitat selection in Florida and historical nesting location preferences. A grid of 6x6-mile (9.66x9.66-km) plots was overlain on the state. A subset of plots (n=101) was identified whose boundaries contained at least 50% coverage of potential eagle habitat (i.e., plots that have a greater likelihood of having nests) but contained no known nests (Figure 1). Plot locations (latitude/longitude locations of corners) were provided by the FWC staff and surveyed by two scientists. Each plot was surveyed along transect lines spaced at quarter-mile (0.4-km) intervals employing the double observer protocol (both observers in the rear seats and one observer on each side of the aircraft). A

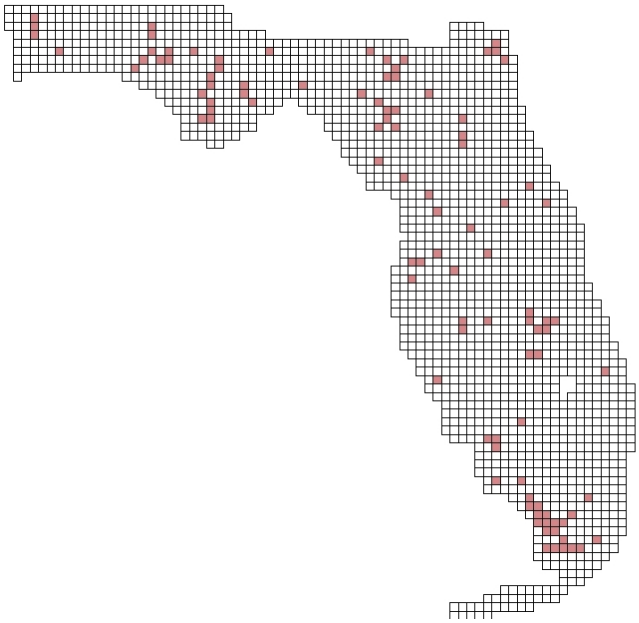

Figure 1. Grid cells selected for modified dual frame survey. Cells contain potential eagle nesting habitat and no known nests.

random sample of 16 plots was selected from this subset for implementation of the modified dual frame method the first year. The first year of sampling was more of a pilot study due to timing of the surveys and the realization that we needed to fine tune our selection criteria for the next year's survey. We are hoping to sample more plots over the next two years (at least 30 per year). New nests discovered during the modified dual frame survey will be incorporated into the master nest list and will be surveyed in the future with the annual statewide survey.

RESULTS

The 2006/2007 statewide survey began on 2 January 2007 and the last regular survey flight was flown on 15 March. We flew 5 flights this year as part of the modified dual frame survey. We sampled 16 plots in previously under surveyed areas that held potential eagle nesting habitat. A total of 8 confirmed and 1 potential nest nesting territories were located during those surveys resulting in 50% of the surveyed plots yielding new nests to add to our statewide survey effort. The number of active bald eagle nesting territories documented in 2007 was 1,218 (Table 1). The estimated number of young produced this year (1,263) was close to the number estimated for 2006 (1,325). The productivity rates for 2007 (based on 534 nests for which results were determined) were 1.07 per active territory and 1.46 per successful nest. These numbers represent an estimated population of between 3,240 (breeding adults and estimated non-breeders and subadults) and 4,550 (breeding adults, non-breeder subadults, and young produced in 2007). This survey does not include eagles that nest in Everglades National Park (traditionally 30 to 50 pairs) and if those numbers were included the estimated population would be increased by 112 to 187 eagles.

DISCUSSION

The rate of growth in the known population of nesting bald eagles in Florida in 2007 was a 4.5% increase over the number of active territories reported in 2006; this is more than the 1.83% average annual increase for the preceding 5 years. This recent rate of increase, though still positive, is declining when it is compared with 5 years during the 1990s (1990–1995); when the annual increase in active territories averaged 9.32% a year. There were additional indications this year that the population increase we have documented over the past 30 years is slowing. The number of young per active territory and the number of young per successful nest are both below the preceding 10 and 5 year means (Table 2). One reason why the growth curve (Figure 2) for Florida's bald eagle population may be leveling off is because the number of nesting eagles vis-à-vis suitable nest habitat and is approaching carrying capacity.

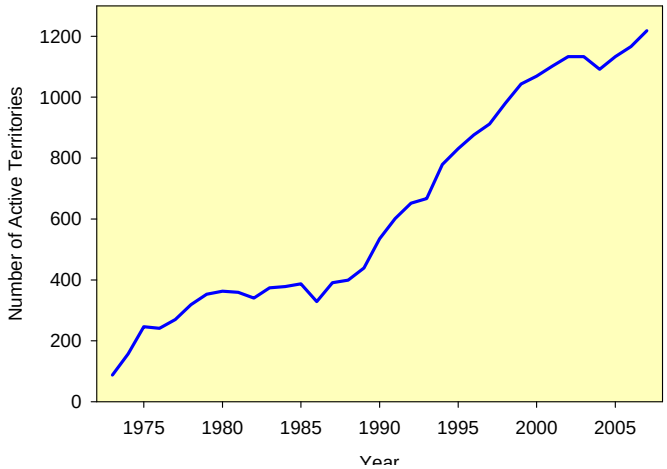

Figure 2. Bald eagle population growth curve for Florida from 1972 – 2007.

Geographic distribution of bald eagle nesting territories in Florida continues to be good. Sixty-one of Florida's 67 counties supported nesting bald eagles (Figure 3). Eight counties

were represented by only 1 nesting pair, while 16 were represented by >25 nesting pairs. Polk and Osceola Counties have the greatest number of eagle nesting territories with 113 and 112 respectively (Table 3).

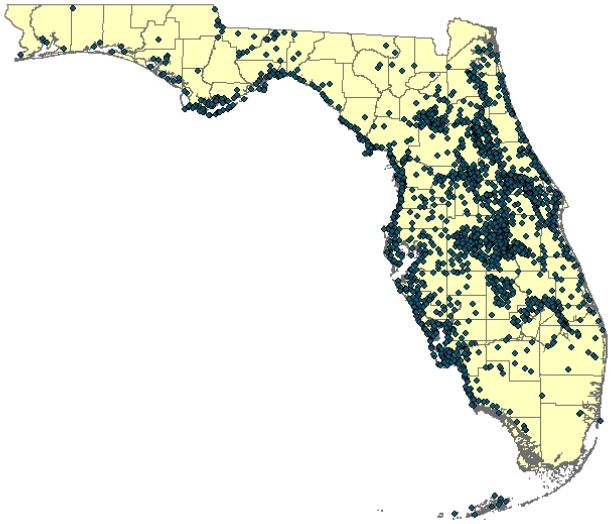

Figure 3. The 2007 geographic distribution of bald eagle nesting territories in Florida.

The bald eagle nesting season is defined as the period 1 October–15 May. Nest sites tend to be built near habitat edges (McEwan and Hirth 1980) in a living tree that offers a view of the surrounding area and that can support the eagle's often sizeable nest. Substrates used in Florida vary according to local conditions and include pines (*Pinus palustris* and *P. elliottii*), cypress (*Taxodium* spp.), mangroves (*Avicennia germinans* and *Rhizophora mangle*), and artificial structures (Millsap *et al.* 2004). The results of this year's survey revealed that Florida bald eagles nested in pine trees 82% of the time (69% live pines, 13% dead pines) (Table 4).

A unique characteristic of the Florida nesting eagle population is the increasing use of artificial or manmade structures. In 2007 there were 27 active territories located on artificial sites; this includes sites such as cell phone towers and power transmission poles. The use of artificial nest sites has not increased dramatically over the last 5 years (Table 4); however; during the first 10 to 20 years of the survey, the use of artificial nest sites was non-existent or very rare (1 or 2 statewide).

The current rate of development in Florida is thought to be one of the greatest threats to the bald eagle population. Georgia Kratimenos of FWC recently did an analysis using GIS which used shapefiles of the growth of Florida by 2060. The GIS layers are broken down into growth in 20 year intervals: 2020, 2040 and 2060. The analysis used a 330 foot distance buffer around each active bald eagle nest listed in the 2005-2006 database (1,166 nests total). She then overlaid the growth 2060 grid shapefile to determine the statewide number of nests affected by future development. The results indicated that by 2020, 192 nests have projected growth within their buffers, by 2040 128 nests will be affected and an additional 121 will be added to the list by 2060. By the year 2060, 388 of the nests that were active during the 2005-2006 will have development within the 330 feet buffer. Many of these nests will be affected within the 330 foot buffer on more than one occasion. This means that a third of the active bald eagle nests from the 2005-2006 survey will potentially be affected by development within 330 feet by the year 2060.

Looking at this data using a smaller scale of resolution gives one a better idea about how this might affect the bald eagle population in Florida over time. Two areas of Florida that have been identified as core nesting bald eagle populations and rapid development were used to see what percentages of bald eagle nests would be affected by 2060. Using the 2005-2006 bald eagle nest survey for Lee County, 47 nests were active, 5 were not active, and 21 were listed as gone. Of the 52 potentially active nests in Lee County, 23 nests (44%) will have development within 330 feet of the nest by 2060 (Figure 3).

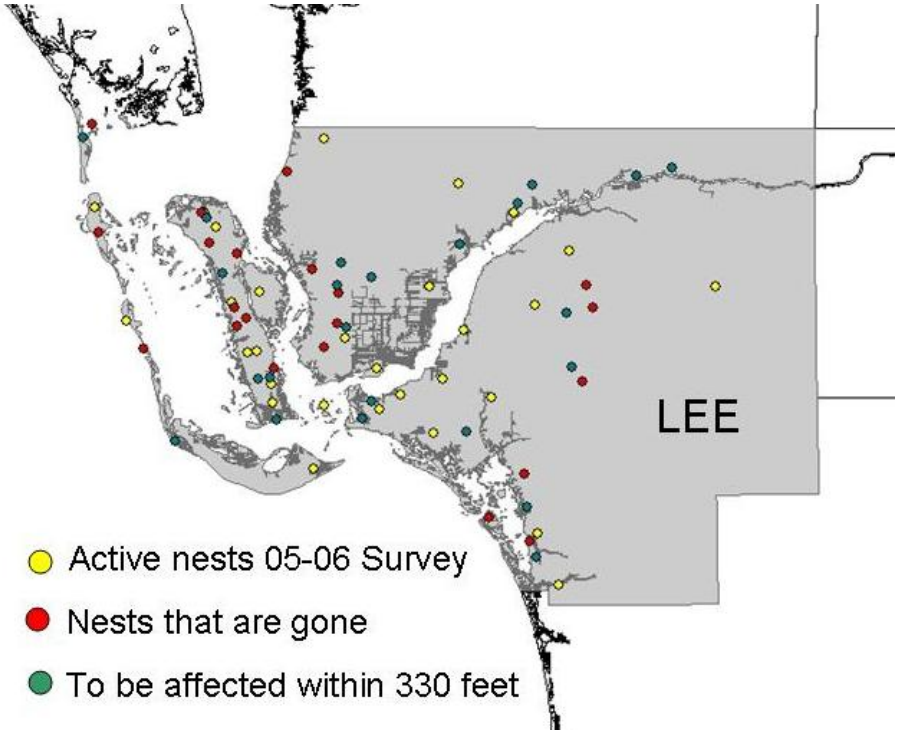

Figure 4. Bald eagle nests in Lee County from the 2005-2006 survey.

The same analysis was used to look at Polk and Osceola Counties. These two counties have the greatest density of bald eagle nests in Florida and are known as being one of the most important core nesting areas in the state. Using the 2005-2006 bald eagle nest survey for Polk and Osceola Counties, 228 nests were active, 32 were not active, 20 were of unknown status and 97 were listed as gone. Of the 280 potentially active nests in both counties, 118 nests (42%) will have development within 330 feet of the nest by 2060 (Figure 5).

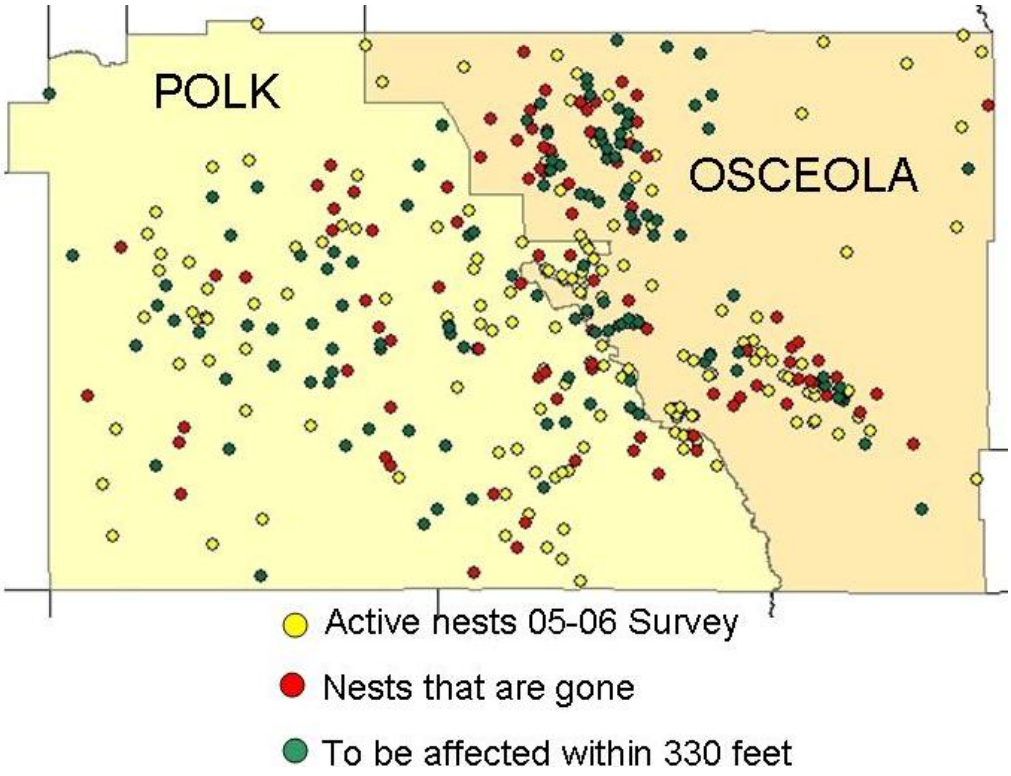

Figure 5. Bald eagle nests in Polk and Osceola Counties from the 2005-2006 survey.

Concentrations of nests are clustered around several significant wetland systems in the peninsula. FWC staff has identified 16 areas of concentrated bald eagle nesting activity that contain a majority of the known bald eagle nests in Florida (Figure 6). Many of these "core nesting areas" have persisted for decades, suggesting the presence of high-quality breeding and foraging habitats (Nesbitt *et al.* in review). In the past, greater than 60% of the total bald eagle nesting territories was located in one of the core nesting areas. These core nesting areas, which are numbered chronologically from their discovery, are located in the following areas: (1) Lochloosa, Newnans, and Orange Lakes in Alachua County; (2) Lake George in Lake, Marion, Putnam, and Volusia Counties; (3) The middle St. Johns River in Brevard, Seminole, and Volusia Counties; (4) the Kissimmee chain of lakes in Osceola and Polk Counties; (5) The Placida Peninsula in Charlotte and Sarasota Counties; (6) The Harris chain of lakes in Lake, Marion, and Sumter Counties; (7) The Lee County coast; (8) St. Vincent National Wildlife Refuge in Franklin County; (9) St. Marks National Wildlife Refuge in Wakulla County; (10) The Lower St. Johns River in Clay, Flagler, and St. Johns Counties; (11) Rodman Reservoir in Flagler and Marion Counties; (12) The central Gulf coast in Citrus, Hernando, and Pasco Counties; (13) Central Polk

County; (14) Lake Istokpoga in Highlands County; (15) The northeast shore of Lake Okeechobee in Martin and Okeechobee Counties; and (16) Charlotte County. Changes in size, configuration, and location of these core nesting areas are continually monitored, and their importance to the overall population of bald eagles in Florida will be determined as new data become available. There are many unanswered questions regarding the future of the bald eagle in Florida. The core nesting areas in Florida appear to be very important for the bald eagle population; however the response of the eagles to increasing development in those areas remains unknown.

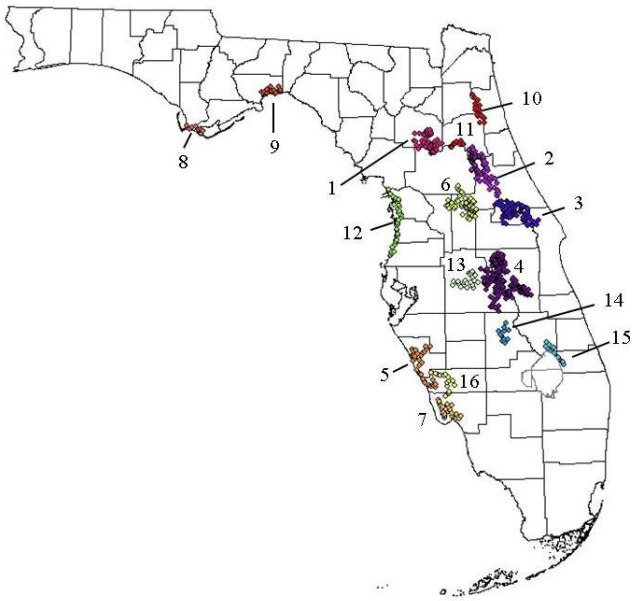

Figure 6. Locations of core nesting areas in Florida (not including ENP)

An important research need that has been identified is to reevaluate the distance in which nesting bald eagles are disturbed. Upon delisting the bald eagle in Florida, it will be beneficial to determine the level of protection needed to sustain the population in perpetuity. It is critical that the proper buffer zones around active bald eagle nests are identified and can be justified from a biological perspective. Survey protocols for eagle nest monitoring can be modified in conjunction with a well designed research project which takes into account the inference of the study, rural vs. urban birds, historical nesting locations and developments. The study must use scientists to observe nesting bald eagles to determine the effectiveness of buffer zones and the individual levels of tolerance by the nesting pair. There is no reason to expect that with effective habitat management the species will not be able to sustain the current population level.

ACKNOWLEDGMENTS

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REFERENCES

Broley, C.L. 1947. Migration and nesting of Florida bald eagles. *Wilson Bulletin* 59:3–20.

Buehler, D.A. 2000. Bald eagle (*Haliaeetus leucocephalus*). Number 506 in *The Birds of North America* (A. Poole, P. Stettenheim, and F. Gill, editors). The Academy of Natural Sciences, Philadelphia, PA, and the American Ornithologists' Union, Washington, D.C.

McEwan, L.C., and D.H. Hirth. 1980. Food habits of the bald eagle in north-central Florida. *Condor* 82: 229–231.

Millsap, B., T. Breen, E. McConnell, T. Steffer, L. Phillips, N. Douglass, and S. Taylor. 2004. Comparative fecundity and survival of bald eagles fledged from suburban and rural natal areas in Florida. *Journal of Wildlife Management* 68: 1018–1031.

Mojica, E.K. 2006. Migration, home range, and important use areas of Florida sub-adult bald eagles. Master's thesis, University of Georgia. Athens, GA.

Nesbitt, S.A., G.L. Holder, D.A. Mager, and S.T. Schwikert. 1990. Use of aerial surveys to evaluate bald eagle nesting in Florida. Pages 207–210 *in* Proceedings of the Southeast Management Symposium and Workshop. National Wildlife Federation. Washington, D.C.

Nesbitt, S.A., M.J. Folk, and D.A. Wood. 1993. Effectiveness of bald eagle habitat protection guidelines in Florida. Proceedings of the Annual Conference of Southeastern Associated Fish and Wildlife Agencies 333–338.

Sullivan, D., T.H. Logan, C.M. Martino, S.[A.] Nesbitt, and T. Steffer. 2006. Biological Status Report for the Bald Eagle. Florida Fish and Wildlife Conservation Commission. Tallahassee, FL.

USFWS. 2007. National bald eagle management guidelines. Washington, D.C.

Wood, P.B., T.C. Edwards, and M.W. Collopy. 1989. Characteristics of bald eagle nesting habitat in Florida. *Journal of Wildlife Management* 53: 441–449.

Wood, P.B. 1992. Habitat use, movements, migration patterns, and survival rates of sub-adult bald eagles in north Florida. Ph.D. dissertation, University of Florida. Gainesville, FL.

Wood, P.B., M.W. Collopy, and C.M. Sekerak. 1998. Postfledging nest dependence period for bald eagles in Florida. *Journal of Wildlife Management* 62: 333–339.

LIST OF TABLES

Table 1. Results of Bald Eagle Nesting Activity in Florida 2002–2007 (excluding ENP).

Year	# Active	# Not Active	# Gone	# Unknown
2002	1098	251	463	32
2003	1116	352	355	21
2004	1077	237	469	61
2005	1158	171	453	61
2006	1166	174	499	89
2007	1218	228	491	79

Table 2. Productivity Results for Bale Eagle Nesting in 1997–2006 and 2007.

Year	# Active Nests	# Young Produced	Young / Active Nest	Young / Successful Nest
1997	912	1,216	1.33	1.63
1998	980	1120	1.14	1.31
1999	1,043	1220	1.17	1.50
2000	1,069	1,165	1.09	1.62
2001	1,102	1,311	1.19	1.60
2002	1,133	1,280	1.13	1.52
2003	1,133	1,280	1.14	1.54
2004	1,092	1,318	1.14	1.54
2005	1,133	1,473	1.30	1.59
2006	1,166	1,527	1.31	1.52
Mean preceding 10 years (SD)	**1,076.3 (78.9)**	**1,291 (127.3)**	**1.19 (0.087)**	**1.54 (0.09)**
Mean preceding 5 years (SD)	**1131 (26.2)**	**1375 (116.2)**	**1.20 (0.09)**	**1.54 (0.03)**
2007	1,218	1,303	1.07	1.46

Table 3. The number of active bald eagle nesting territories in the "top 10" counties in

Florida for the 2006-2007 nesting season.

County	# Territories	County	# Territories
Polk	113	Lee	50
Osceola	112	Marion	46
Lake	69	Brevard	42
Volusia	60	Alachua	42
Seminole	51	Franklin	40

*This does not include Monroe County and Everglades National Park.

Table 4. Nesting Substrate Used by Bald Eagle Nesting in Florida 2003*–2007.

Year	Australian Pine		Other		Oak		Sand Pine		Cypress		Pine		Artificial
	Live	*Dead*	*Live*	*Dead*	*Live*	*Dead*	*Live*	*Dead*	*Live*	*Dead*	*Live*	*Dead*	
2003	10	3	3	2	8	1	12	0	79	13	839	120	21
2004	11	1	6	3	13	2	8	0	84	13	807	100	23
2005	12	0	5	2	12	2	6	1	86	8	918	80	20
2006	14	5	6	1	12	7	10	0	89	13	865	117	21
2007	17	6	7	3	14	1	8	1	84	12	862	165	27