United States Department of the Interior

FISH AND WILDLIFE SERVICE
South Florida Ecological Services Office
1339 20th Street
Vero Beach, Florida 32960

November 9, 2007

David S. Hobbie
Chief, Regulatory Division
Post Office Box 4970
Jacksonville, Florida 32232-0019

Service Federal Activity Code: 41420-2007-FA-1494
Service Consultation Code: 41420-2007-I-0964
Subject: South Florida Programmatic Concurrence
Species: Eastern Indigo Snake and Wood Stork

Dear Mr. Hobbie:

The Fish and Wildlife Service's South Florida Ecological Services Office (Service) and the U.S. Army Corps of Engineers Jacksonville District (Corps) have been working together on efforts to streamline the consultation process for federally listed species associated with the Corps' wetland permitting program. The Service provided a letter to the Corps dated March 23, 2007, in response to a request from the Palm Beach Gardens Regulatory Office for a multi-county programmatic concurrence with a criteria-based determination of "may affect, not likely to adversely affect" (NLAA) for the threatened eastern indigo snake (*Drymarchon corais couperi*) and the endangered wood stork (*Mycteria americana*) as related to projects involving freshwater wetland impacts within specified counties. These counties were Miami-Dade (within the urban development boundary), Broward, Palm Beach, Martin, St. Lucie, Indian River, Okeechobee, Osceola, Polk, and Monroe. In our letter, we provided effect determination keys for these two federally listed species, with specific criteria for the Service to concur with a determination of NLAA.

The Service, in revisitation of these keys as mentioned in the Conservation Measures of our March 23, 2007, letter believes the expansion of the scope of use of these keys would result in increased permitting efficiency and species conservation benefits. Therefore, we propose to include all counties under the jurisdiction of the South Florida Ecological Services Office (Appendix 1) to be subject to our programmatic concurrence process and criteria as outlined in this letter. We have also included some revisions to the wood stork key with respect to hydrological evaluation and forage base. We provided a previous version of this key to the Corps on October 18, 2007. Per the Corps' request, several couplets were clarified and a revised key is provided. This revised key supersedes both the March 23, 2007, and October 18, 2007, version. This letter is submitted in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*).

Eastern indigo snake

Habitat

Over most of its range, the eastern indigo snake frequents several habitat types, including pine flatwoods, scrubby flatwoods, high pine, dry prairie, tropical hardwood hammocks, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats (Service 1999).

Eastern indigo snakes appear to need a mosaic of habitats to complete their life cycle. Wherever the eastern indigo snake occurs in xeric habitats, it is closely associated with the gopher tortoise (*Gopherus polyphemus*), the burrows of which provide shelter from winter cold and summer desiccation (Speake et al. 1978; Layne and Steiner 1996). Interspersion of tortoise-inhabited uplands and wetlands improves habitat quality for this species (Landers and Speake 1980; Auffenberg and Franz 1982).

Even though thermal stress may not be a limiting factor throughout the year in south Florida, eastern indigo snakes still seek and use underground refugia in the region. On the sandy central ridge of central Florida, eastern indigos use gopher tortoise burrows more (62 percent) than other underground refugia (Layne and Steiner 1996). Other underground refugia used include armadillo (*Dasypus novemcinctus*) burrows near citrus groves, cotton rat (*Sigmodon hispidus*) burrows, and land crab (*Cardisoma guanhumi*) burrows in coastal areas (Wilson and Porras 1983). Natural ground holes, hollows at the base of trees or shrubs, ground litter, trash piles, and crevices of rock-lined ditch walls are also used (Layne and Steiner 1996). These refugia are used most frequently where tortoise burrows are not available, principally in low-lying areas off the central and coastal ridges. In extreme south Florida (the Everglades and Florida Keys), eastern indigo snakes are found in tropical hardwood hammocks, pine rocklands, freshwater marshes, abandoned agricultural land, coastal prairie, mangrove swamps, and human-altered habitats (Steiner et al. 1983). It is suspected that they prefer hammocks and pine forests, because most observations occur in these habitats disproportionately to their presence in the landscape (Steiner et al. 1983). Hammocks may be important breeding areas as juveniles are typically found there. The eastern indigo snake is a snake-eater so the presence of other snake species may be a good indicator of habitat quality.

Conservation Measures

The Service routinely concurs with the Corps' NLAA determination for individual project effects to the eastern indigo snake when assurances are given that our *Standard Protection Measures for the Eastern Indigo Snake* (Service 2004) will be used during project site preparation and project construction (Appendix 2). There is no designated critical habitat for the eastern indigo snake.

In an effort to reduce correspondence in effect determinations and responses, the Service is providing an Eastern Indigo Snake Effect Determination Key, similar in utility to the Florida Panther Effect Determination Key and the West Indian Manatee Effect Determination Key presently being utilized by the Corps. If the use of this key results in a Corps determination of "no effect" for a particular project, the Service supports this determination. If the use of this Key results in a determination of NLAA, the Service concurs with this determination and no additional correspondence will be necessary[1]. This key is subject to revisitation as the Corps and Service deem necessary.

The Key is as follows:

A. Project is not located in open water.....*go to* B

[1] With an outcome of "no effect" or "NLAA" as outlined in this key, the requirements of section 7 of the Act are fulfilled for the eastern indigo snake and no further action is required.

Project is located solely in open water..... "*no effect*"

B. Permit will be conditioned for use of the Service's *Standard Protection Measures For The Eastern Indigo Snake* during site preparation and project construction .....*go to* C

Permit will not be conditioned as above for the eastern indigo snake, or it is not known whether an applicant intends to use these measures and consultation with the Service is requested[2] ..... "*may affect*"

C. There are gopher tortoise burrows, holes, cavities, or other refugia where a snake could be buried or trapped and injured during project activities .....*go to* D

There are no gopher tortoise burrows, holes, cavities, or other refugia where a snake could be buried or trapped and injured during project activities ..... "*NLAA*"

D. The project will impact less than 25 acres of xeric habitat supporting less than 25 active and inactive gopher tortoise burrows .....*go to* E

The project will impact more than 25 acres of xeric habitat or more than 25 active and inactive gopher tortoise burrows and consultation with the Service is requested[2] ..... "*may affect*"

E. Any permit will be conditioned such that all gopher tortoise burrows, active or inactive, will be evacuated prior to site manipulation in the vicinity of the burrow[3]. If an indigo snake is encountered, the snake must be allowed to vacate the area prior to additional site manipulation in the vicinity. Any permit will also be conditioned such that holes, cavities, and snake refugia other than gopher tortoise burrows will be inspected each morning before planned site manipulation of a particular area, and, if occupied by an indigo snake, no work will commence until the snake has vacated the vicinity of proposed work..... "*NLAA*"

Permit will not be conditioned as outlined above and consultation with the Service is requested[2] ..... "*may affect*"

Wood stork

Habitat

The wood stork is primarily associated with freshwater and estuarine habitats that are used for nesting, roosting, and foraging. Wood storks typically construct their nests in medium to tall

[2] Consultation may be concluded informally or formally depending on project impacts.

[3] If burrow excavation is utilized, it should be performed by experienced personnel. The method used should minimize the potential for injury of an indigo snake. The applicant should follow the enclosed Excavation Guidelines (Appendix 3). A member of the excavation team should be authorized for Incidental Take during excavation through either a section 10(a)(1)(A) permit issued by the Service or an incidental take permit issued by the Florida Fish and Wildlife Conservation Commission.

trees that occur in stands located either in swamps or on islands surrounded by relatively broad expanses of open water (Ogden 1991; Rodgers et al. 1996). Successful colonies are those that have limited human disturbance and low exposure to land-based predators. Nesting colonies protected from land-based predators are characterized as those surrounded by large expanses of open water or where the nest trees are inundated at the onset of nesting and remain inundated throughout most of the breeding cycle. These colonies have water depths between 0.9 and 1.5 meters (3 and 5 feet) during the breeding season.

Successful nesting generally involves combination of average or above-average rainfall during the summer rainy season and an absence of unusually rainy or cold weather during the winter-spring breeding season (Kahl 1964; Rodgers et al. 1987). This pattern produces widespread and prolonged flooding of summer marshes, which maximize production of freshwater fishes, followed by steady drying that concentrate fish during the season when storks nest (Kahl 1964). Successful nesting colonies are those that have a large number of foraging sites. To maintain a wide range of foraging sites a variety of wetland types should be present, with both short and long hydroperiods. The Service (1999) describes a short hydroperiod as a 1 to 5-month wet/dry cycle, and a long hydroperiod as greater than 5 months. During the wet season, wood storks generally feed in the shallow water of the short-hydroperiod wetlands and in coastal habitats during low tide. During the dry season, foraging shifts to longer hydroperiod interior wetlands as they progressively dry down (though usually retaining some surface water throughout the dry season).

During the nonbreeding season or while foraging, wood storks occur in a wide variety of wetland habitats. Typical foraging sites for the wood stork include freshwater marshes and stock ponds, shallow, seasonally flooded roadside or agricultural ditches, narrow tidal creeks or shallow tidal pools, managed impoundments, and depressions in cypress heads and swamp sloughs. Because of their specialized feeding behavior, wood storks forage most effectively in shallow-water areas with highly concentrated prey. Through tactolocation, or grope feeding, wood storks in south Florida feed almost exclusively on fish between 1 and 10 inches (2 and 25 centimeters [cm]) in length (Ogden et al. 1976). Good foraging conditions are characterized by water that is relatively calm, uncluttered by dense thickets of aquatic vegetation, and having a water depth between 5 and 15 inches (5 and 38 cm) deep. Ideally, preferred foraging wetlands would include a mosaic of emergent and shallow open-water areas. The emergent component provides nursery habitat for small fish, frogs, and other aquatic prey and the shallow, open-water areas provide sites for concentration of the prey during seasonal dry-down of the wetland.

Conservation Measures

The Service routinely concurs with the Corps' "may affect, not likely to adversely affect" determination for individual project effects to the wood stork when project effects are insignificant due to scope or location, or if assurances are given that wetland impacts have been avoided, minimized, and adequately compensated such that there is no net loss in foraging potential. We utilize our *Habitat Management Guidelines For The Wood Stork In The Southeast Region* (Service 1990) (Appendix 4) (HMG) in project evaluation. The HMG is currently under review and once final will replace the enclosed HGM. There is no designated critical habitat for the wood stork.

The Service's South Florida Ecological Services Office has identified an 18.6-mile core foraging area (CFA) around all known wood stork colonies in south Florida that is important for reproductive success. Appendix 5 (to be updated as necessary) provides locations of colonies and their CFAs in south Florida documented as active within the last 10 years. The Service believes loss of suitable foraging wetlands within these CFAs may reduce foraging opportunities for the wood stork. To minimize adverse effects to the wood stork, it is our position that there should be compensation for wood stork foraging habitat lost due to the action. The compensation shall consider wetland type, location, function, and value (hydrology, vegetation, prey utilization), to ensure wetlands provided as compensation adequately replace wetland functions lost due to the project. Wetlands offered as compensation ideally should be of the same hydroperiod and located within the CFAs of the affected wood stork colonies. The Service may accept, in some cases, wetland compensation located outside the CFAs of the affected wood stork nesting colonies. Specifically, wetland credits purchased from a "Service Approved" mitigation bank located outside the CFAs could be acceptable to the Service, depending on location of impacted wetlands relative to the permitted service area of the bank, and whether or not the bank has wetlands having the same hydroperiod as the impacted wetland.

In an effort to reduce correspondence in effect determinations and responses, the Service is providing a Wood Stork Effect Determination Key, similar in utility to the Eastern Indigo Snake Effect Determination Key previously presented. If the use of this key results in a Corps determination of "no effect" for a particular project, the Service supports this determination. If the use of this Key results in a determination of NLAA, the Service concurs with this determination[4]. This Key is subject to revisitation as the Corps and Service deem necessary.

The Key is as follows:

A. Project within 0.54 mile of an active colony site[5] ……..…. "*may affect*[6]"

   Project more than 0.54 miles from an active colony site[5]…….....…..*go to* B

B. Project does not affect suitable foraging habitat[7] (SFH)……..……*no effect*"

   Project impacts suitable foraging habitat (SFH).....……..…..*go to* C

[4] With an outcome of "no effect" or "NLAA" as outlined in this key, and the project has less than 50 acres of wetland impacts, the requirements of section 7 of the Act are fulfilled for the wood stork and no further action is required. For projects with greater than 50 acres of wetland impacts, written concurrence of NLAA from the Service is necessary.

[5] An active colony is defined as a colony that is currently being used for nesting by wood storks or has historically over the last 10 years been used for nesting by wood storks.

[6] Consultation may be concluded informally or formally depending on project impacts.

[7] Suitable foraging habitat is described as wetland communities with shallow-open water areas that are relatively calm and have a water depth between 2 and 15 inches (5 to 38 cm) deep. Ideally, preferred foraging wetlands would include a mosaic of emergent and shallow open-water areas.

C. Project impact to SFH is from a single-family residence[8] ……..……..…."*NLAA*[4]"

Project impact to SFH is from other than a single-family residence…....……*go to* D

D. Project impacts to SFH not within the Core Foraging Area (CFA = 18.6 miles) of a colony site ……..…….……..……*go to* E

Project impacts to SFH within the CFA of a colony site …….…...…….*go to* F

E. Project impacts to SFHs have been avoided and minimized to the extent practicable, and compensation for unavoidable impacts is proposed in accordance with the CWA section 404(b)(1) guidelines and habitat compensation replaces the foraging value matching the hydroperiod[9] of the wetlands affected. See Appendix 6 for a detailed discussion of the hydroperiod foraging values, an example, and further guidance[10]…....……..... *NLAA*[4]"

Project not as above[11]…… "*may affect*[6]"

F. Project provides SFH compensation in accordance with the CWA section 404(b)(1) guidelines and is not contrary to the HMG; habitat compensation is within the appropriate CFA or within the service area of a Service-approved mitigation bank; and habitat compensation replaces foraging value, consisting of wetland enhancement or restoration matching the hydroperiod[9] of the wetlands affected, and providing foraging value similar

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[8] On an individual basis, development of a single-family residence generally will not have a measurable effect on wood storks, although we request the Corps to require mitigation for these losses when appropriate. Wood storks are a wide ranging species, and individually, habitat change from development of a single-family residence is not likely to adversely affect wood storks. However, collectively they may have an effect and therefore regular monitoring and reporting of these effects are important.

[9] Several researchers (Flemming et al. 1994; Ceilley and Bortone 2000) believe that the short hydroperiod wetlands provide a more important pre-nesting foraging food source and a greater early nestling survivor value for woodstorks than the foraging base (grams of fish per square meter) that short hydroperiod wetlands suggest. Although the short hydroperiod wetlands may provide less fish, these prey bases historically were more extensive and provided foraging needs of the pre-nesting storks and the early-age nestlings. Nest productivity may suffer as a result of the loss of short hydroperiod provisions. We believe that most wetland fill and excavation impacts permitted in south Florida are in short hydroperiod wetlands. Therefore, we believe that it is especially important that impacts to these short hydroperiod wetlands within CFAs are avoided, minimized, and compensated for by enhancement/restoration of short hydroperiod wetlands.

[10] For this Key, the Service requires an analysis of foraging prey base losses and enhancements from the proposed action as shown in the examples in Appendix 6 for projects with with greater than 5 acres of wetland impacts. For projects with less than 5 acres of wetland impacts, an individual foraging prey base analysis is not necessary although type for type wetland compensation is still a requirement of the Key. This analysis should include the concepts and procedures presented by the Service in our August 28, 2007, Biological Opinion for GL Homes (Terafina), Service Federal Activity Code Number 2007-FA-0653, Collier County, Florida. This document can be found at the internet website address http://www.fws.gov/filedownloads/ftp%5verobeach.

[11] A foraging prey base loss associated with couplet E corresponds to a nest productivity loss for the affected rookery. A prey base loss associated with couplet F is a biomass loss associated with non-nesting birds.

to, or higher than, that of impacted wetlands. See Appendix 6 for a detailed discussion of the hydroperiod foraging values, an example, and further guidance[10]..... *"NLAA[4]"*

Project does not satisfy these elements[11] ..... *"may affect[6]"*

These Keys will not apply to Comprehensive Everglades Restoration Plan projects, as they will require project-specific consultations with the Service.

Monitoring and Reporting Effects

For the Service to monitor cumulative effects, it is important for the Corps to monitor the number of permits and provide information to the Service regarding the number of permits issued that were determined "may affect, not likely to adversely affect." It is requested that information on date, Corps identification number, project acreage, project wetland acreage, and latitude and longitude in decimal degrees be sent to the Service quarterly.

Thank you for your cooperation and effort in protecting federally listed species. If you have any questions, please contact Brad Rieck at 772-562-3909, extension 231, or Allen Webb at extension 246.

Sincerely yours,

Paul Souza
Field Supervisor
South Florida Ecological Services Office

Appendices

cc: w/Appendices
Corps, Jacksonville, Florida (Stu Santos)
EPA, West Palm Beach, Florida (Richard Harvey)
FWC, Vero Beach, Florida (Joe Walsh)
Service, Jacksonville, Florida (Billy Brooks)

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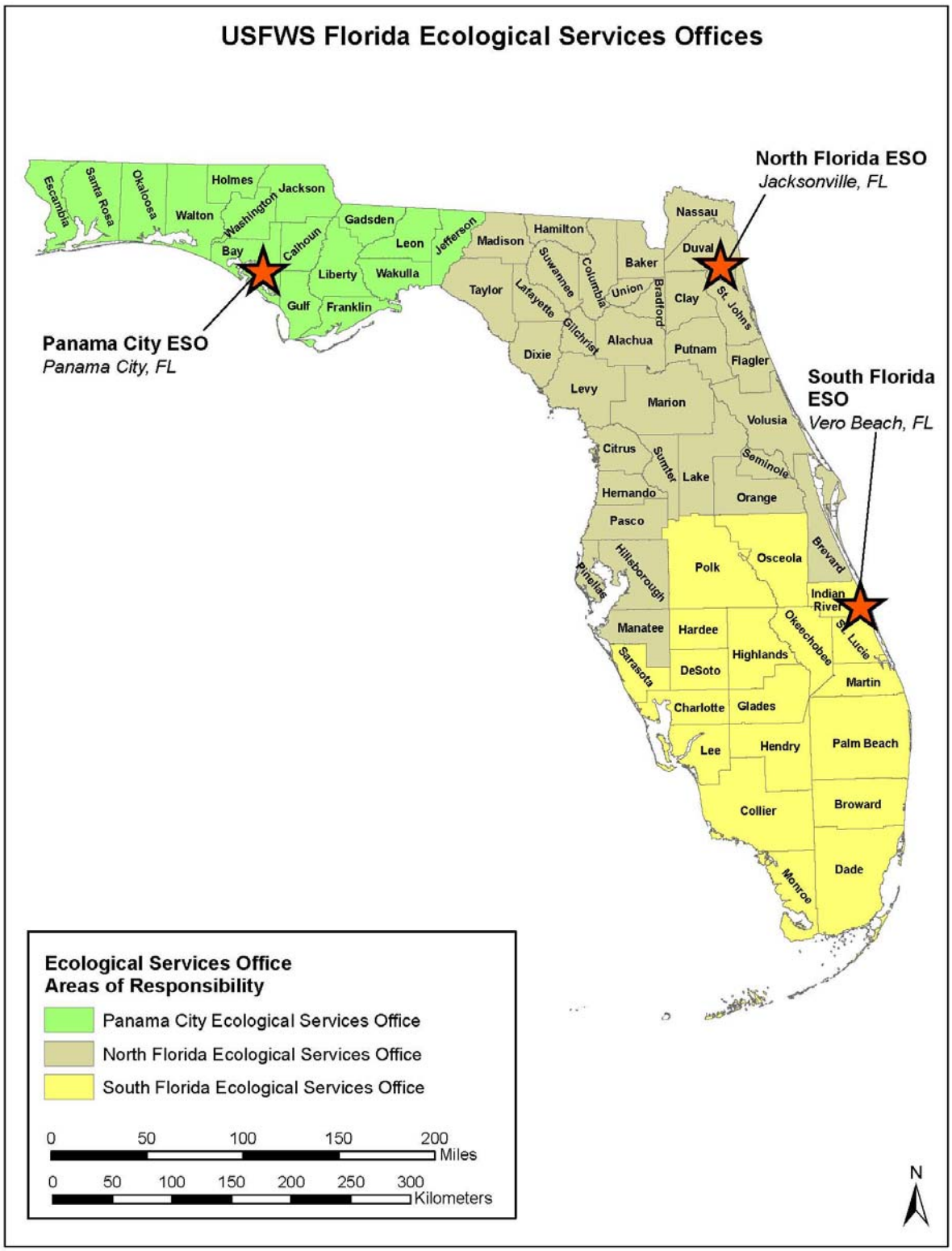
Appendix 1

Service Area Map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Hardee
Okeechobee
Highlands
Sarasota
DeSoto
Martin
Charlotte
Glades
Lee
Hendry
Palm Beach
Collier
Broward
Monroe
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Appendix 2

Standard Protection Measures for the Eastern Indigo Snake

STANDARD PROTECTION MEASURES FOR THE EASTERN INDIGO SNAKE

1. An eastern indigo snake protection/education plan shall be developed by the applicant or requestor for all construction personnel to follow. The plan shall be provided to the Service for review and approval at least 30 days prior to any clearing activities. The educational materials for the plan may consist of a combination of posters, videos, pamphlets, and lectures (*e.g.*, an observer trained to identify eastern indigo snakes could use the protection/education plan to instruct construction personnel before any clearing activities occur). Informational signs should be posted throughout the construction site and along any proposed access road to contain the following information:

    a. a description of the eastern indigo snake, its habits, and protection under Federal Law;
    b. instructions not to injure, harm, harass or kill this species;
    c. directions to cease clearing activities and allow the eastern indigo snake sufficient time to move away from the site on its own before resuming clearing; and,
    d. telephone numbers of pertinent agencies to be contacted if a dead eastern indigo snake is encountered. The dead specimen should be thoroughly soaked in water and then frozen.

2. If not currently authorized through an Incidental Take Statement in association with a Biological Opinion, only individuals who have been either authorized by a section 10(a)(1)(A) permit issued by the Service, or by the State of Florida through the Florida Fish Wildlife Conservation Commission (FWC) for such activities, are permitted to come in contact with an eastern indigo snake.

3. An eastern indigo snake monitoring report must be submitted to the appropriate Florida Field Office within 60 days of the conclusion of clearing phases. The report should be submitted whether or not eastern indigo snakes are observed. The report should contain the following information:

    a. any sightings of eastern indigo snakes and
    b. other obligations required by the Florida Fish and Wildlife Conservation Commission, as stipulated in the permit.

Revised February 12, 2004

Appendix 3

Gopher Tortoise Burrow Excavation Guidelines

Excavation Guidelines

In areas where the water table is high, gopher tortoise burrows may be commonly 8 to 10 feet long and have an angle of decline of 4:1 to a depth of less than 3 feet. Where the water table is not a restriction, length has reached 67 feet with a depth of 21 feet.

A team of at least 3 experienced persons is desired for the excavation of each burrow: one to dig with shovel or machinery; one to scope and track the burrow tunnel utilizing pvc pipe or other tracer; and one to coordinate, hand-scoop and handle any occupants of the burrow (holder of FWC and/or Service permit).

Excavation may be done manually by shovel, if, for instance, burrows are shallow (high ground water table). Otherwise, excavation by backhoe is a common option. Any digging machinery must be equipped with a tooth-less bucket/digging blade for burrow excavation.

Digging should begin at the mouth of the burrow and carefully follow the tunnel path, as identified by the tracer, to the end chamber. If a backhoe is used, the bucket should remove soil by “dragging” along the path of the tunnel, rather than maximizing soil removal by “gouging”. The backhoe should be positioned behind the burrow mouth and scrape along the line of the tracer. The backhoe should not dig any closer than approximately six inches to the top of the tunnel, as soil should be removed at this point by hand, progressively, as the team works together towards the end chamber. Special attention should be exercised in navigating to the end chamber, as the tunnel frequently turns 20-30 degrees at its beginning. Soil removal in the end chamber should be by hand with attention to signs of occupancy.

Appendix 4

Habitat Management Guidelines for the Wood Stork in the Southeast Region

HABITAT MANAGEMENT GUIDELINES FOR THE WOOD STORK IN THE SOUTHEAST REGION

HABITAT MANAGEMENT GUIDELINES FOR THE WOOD STORK IN THE SOUTHEAST REGION

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U.S. Fish and Wildlife Service

Cover design by
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HABITAT MANAGEMENT GUIDELINES FOR THE WOOD STORK IN THE SOUTHEAST REGION

Introduction

A number of Federal and state laws and/or regulations prohibit, cumulatively, such acts as harrassing, disturbing, harming, molesting, pursuing, etc., wood storks, or destroying their nests (see Section VII). Although advisory in nature, these guidelines represent a biological interpretation of what would constitute violations of one or more of such prohibited acts. Their purpose is to mainain and/or improve the environmental conditions that are required for the survival and well-being of wood storks in the southeastern United States, and are designed essentially for application in wood stork/human activity conflicts (principally land development and human intrusion into stork use sites). The emphasis is to avoid or minimize detrimental human-related impacts on wood storks. These guidelines were prepared in consultations with state wildlife agencies and wood stork experts in the four southeastern states where the wood stork is listed as Endangered (Alabama, Florida, Georgia, South Carolina).

General

The wood stork is a gregarious species, which nests in colonies (rookeries), and roosts and feeds in flocks, often in association with other species of long-legged water birds. Storks that nest in the southeastern United States appear to represent a distinct population, separate from the nearest breeding population in Mexico. Storks in the southeastern U.S. population have recently (since 1980) nested in colonies scattered throughout Florida, and at several central-southern Georgia and coastal South Carolina sites. Banded and color-marked storks from central and southern Florida colonies have dispersed during non-breeding seasons as far north as southern Georgia, and the coastal counties in South Carolina and southeastern North Carolina, and as far west as central Alabama and northeastern Mississippi. Storks from a colony in south-central Georgia have wintered between southern Georgia and southern Florida. This U.S. nesting population of wood storks was listed as endangered by the U.S. Fish and Wildlife Service on February 28, 1984 (*Federal Register* 49(4):7332-7335).

Wood storks use freshwater and estuarine wetlands as feeding, nesting, and roosting sites. Although storks are not habitat specialists, their needs are exacting enough, and available habitat is limited enough, so that nesting success and the size of regional populations are closely regulated by year-to-year differences in the quality and quantity of suitable habitat. Storks are especially sensitive to environmental conditions at feeding sites; thus, birds may fly relatively long distances either daily or between regions annually, seeking adequate food resources.

All available evidence suggests that regional declines in wood stork numbers have been largely due to the loss or degradation of essential wetland habitat. An understanding of the qualities of good stork habitat should help to focus protection efforts on those sites

that are seasonally important to regional populations of wood storks. Characteristics of feeding, nesting, and roosting habitat, and management guidelines for each, are presented here by habitat type.

I. **Feeding habitat.**

A major reason for the wood stork decline has been the loss and degredation of feeding habitat. Storks are especially sensitive to any manipulation of a wetland site that results in either reduced amounts or changes in the timing of food availability.

Storks feed primarily (often almost exclusively) on small fish between 1 and 8 inches in length. Successful foraging sites are those where the water is between 2 and 15 inches deep. Good feeding conditions usually occur where water is relatively calm and uncluttered by dense thickets of aquatic vegetation. Often a dropping water level is necessary to concentrate fish at suitable densities. Conversely, a rise in water, especially when it occurs abruptly, disperses fish and reduces the value of a site as feeding habitat.

The types of wetland sites that provide good feeding conditions for storks include: drying marshes or stock ponds, shallow roadside or agricultural ditches, narrow tidal creeks or shallow tidal pools, and depressions in cypress heads or swamp sloughs. In fact, almost any shallow wetland depression where fish tend to become concentrated, either through local reproduction or the consequences of area drying, may be used by storks.

Nesting wood storks do most of their feeding in wetlands between 5 and 40 miles from the colony, and occasionally at distances as great as 75 miles. Within this colony foraging range and for the 110-150 day life of the colony, and depending on the size of the colony and the nature of the surrounding wetlands, anywhere from 50 to 200 different feeding sites may be used during the breeding season.

Non-breeding storks are free to travel much greater distances and remain in a region only for as long as sufficient food is available. Whether used by breeders or non-breeders, any single feeding site may at one time have small or large numbers of storks (1 to 100+), and be used for one to many days, depending on the quality and quantity of available food. Obviously, feeding sites used by relatively large numbers of storks, and/or frequently used areas, potentially are the more important sites necessary for the maintenance of a regional population of birds.

Differences between years in the seasonal distribution and amount of rainfall usually mean that storks will differ between years in where and when they feed. Successful nesting colonies are those that have a large number of feeding site options, including sites that may be suitable only in years of rainfall extremes. To maintain the wide range of feeding site options requires that many different wetlands, with both relatively short and long annual hydroperiods, be preserved. For example, protecting only the larger wetlands, or those with longer annual hydroperiods, will result in the eventual loss of smaller, seemingly less important wetlands. However, these small scale wetlands are crucial as the only available feeding sites during the wetter periods when the larger habitats are too deeply flooded to be used by storks.

II. **Nesting habitat.**

Wood storks nest in colonies, and will return to the same colony site for many years so long as that site and surrounding feeding habitat continue to supply the needs of the birds. Storks require between 110 and 150 days for the annual nesting cycle, from the period of courtship until the nestlings become independent. Nesting activity may begin as early as December or as late as March in southern Florida colonies, and between late February and April in colonies located between central Florida and South Carolina. Thus, full term colonies may be active until June-July in south Florida, and as late as July-August at more northern sites. Colony sites may also be used for roosting by storks during other times of the year.

Almost all recent nesting colonies in the southeastern U.S. have been located either in woody vegetation over standing water, or on islands surrounded by broad expanses of open water. The most dominant vegetation in swamp colonies has been cypress, although storks also nest in swamp hardwoods and willows. Nests in island colonies may be in more diverse vegetation, including mangroves (coastal), exotic species such as Australian pine (*Casuarina*) and Brazilian Pepper (*Schinus*), or in low thickets of cactus (*Opuntia*). Nests are usually located 15-75 feet above ground, but may be much lower, especially on island sites when vegetation is low.

Since at least the early 1970's, many colonies in the southeastern U.S. have been located in swamps where water has been impounded due to the construction of levees or roadways. Storks have also nested in dead and dying trees in flooded phosphate surface mines, or in low, woody vegetation on mounded, dredge islands. The use of these altered wetlands or completely "artificial" sites suggests that in some regions or years storks are unable to locate natural nesting habitat that is adequately flooded during the normal breeding season. The readiness with which storks will utilize water impoundments for nesting also suggests that colony sites could be intentionally created and maintained through long-term site management plans. Almost all impoundment sites used by storks become suitable for nesting only fortuitously, and therefore, these sites often do not remain available to storks for many years.

In addition to the irreversible impacts of drainage and destruction of nesting habitat, the greatest threats to colony sites are from human disturbance and predation. Nesting storks show some variation in the levels of human activity they will tolerate near a colony. In general, nesting storks are more tolerant of low levels of human activity near a colony when nests are high in trees than when they are low, and when nests contain partially or completely feathered young than during the period between nest construction and the early nestling period (adults still brooding). When adult storks are forced to leave their nests, eggs or downy young may die quickly (<20 minutes) when exposed to direct sun or rain.

Colonies located in flooded environments must remain flooded if they are to be successful. Often water is between 3 and 5 feet deep in successful colonies during the nesting season. Storks rarely form colonies, even in traditional nesting sites, when they are dry, and may abandon nests if sites become dry during the nesting period. Flooding in colonies may be most important as a defense against mammalian predators. Studies of stork colonies in Georgia and

Florida have shown high rates of raccoon predation when sites dried during the nesting period. A reasonably high water level in an active colony is also a deterrent against both human and domestic animal intrusions.

Although nesting wood storks usually do most feeding away from the colony site (>5 miles), considerable stork activity does occur close to the colony during two periods in the nesting cycle. Adult storks collect almost all nesting material in and near the colony, usually within 2500 feet. Newly fledged storks, near the end of the nesting cycle, spend from 1-4 weeks during the fledging process flying locally in the colony area, and perched in nearby trees or marshy spots on the ground. These birds return daily to their nests to be fed. It is essential that these fledging birds have little or no disturbance as far our as one-half mile within at least one or two quadrants from the colony. Both the adults, while collecting nesting material, and the inexperienced fledglings, do much low, flapping flight within this radius of the colony. At these times, storks potentially are much more likely to strike nearby towers or utility lines.

Colony sites are not necessarily used annually. Regional populations of storks shift nesting locations between years, in response to year-to-year differences in food resources. Thus, regional populations require a range of options for nesting sites, in order to successfully respond to food availability. Protection of colony sites should continue, therefore, for sites that are not used in a given year.

III. Roosting habitat.

Although wood storks tend to roost at sites that are similar to those used for nesting, they also use a wider range of site types for roosting than for nesting. Non-breeding storks, for example, may frequently change roosting sites in response to changing feeding locations, and in the process, are inclined to accept a broad range of relatively temporary roosting sites. Included in the list of frequently used roosting locations are cypress "heads" or swamps (not necessarily flooded if trees are tall), mangrove islands, expansive willow thickets or small, isolated willow "islands" in broad marshes, and on the ground either on levees or in open marshes.

Daily activity patterns at a roost vary depending on the status of the storks using the site. Non-breeding adults or immature birds may remain in roosts during major portions of some days. When storks are feeding close to a roost, they may remain on the feeding grounds until almost dark before making the short flight. Nesting storks traveling long distances (>40 miles) to feeding sites may roost at or near the latter, and return to the colony the next morning. Storks leaving roosts, especially when going long distances, tend to wait for mid-morning thermals to develop before departing.

IV. Management zones and guidelines for feeding sites.

To the maximum extent possible, feeding sites should be protected by adherence to the following protection zones and guidelines:

A. There should be no human intrusion into feeding sites when storks are present. Depending upon the amount of screening vegetation, human activity should be no closer than between 300 feet (where solid vegetation screens exist) and 750 feet (no vegetation screen).

B. Feeding sites should not be subjected to water management practices that alter traditional water levels or the seasonally normal drying patterns and rates. Sharp rises in water levels are especially disruptive to feeding storks.

C. The introduction of contaminants, fertilizers, or herbicides into wetlands that contain stork feeding sites should be avoided, especially those compounds that could adversely alter the diversity and numbers of native fishes, or that could substantially change the characteristics of aquatic vegetation. Increase in the density and height of emergent vegetation can degrade or destroy sites as feeding habitat.

D. Construction of tall towers (especially with guy wires) within three miles, or high power lines (especially across long stretches of open country) within one mile of major feeding sites should be avoided.

V. Management zones and guidelines for nesting colonies.

A. Primary zone: This is the most critical area, and must be managed according to recommended guidelines to insure that a colony site survives.

1. Size: The primary zone must extend between 1000 and 1500 feet in all directions from the actual colony boundaries when there are no visual or broad aquatic barriers, and never less than 500 feet even when there are strong visual or aquatic barriers. The exact width of the primary zone in each direction from the colony can vary within this range, depending on the amount of visual screen (tall trees) surrounding the colony, the amount of relatively deep, open water between the colony and the nearest human activity, and the nature of the nearest human activity. In general, storks forming new colonies are more tolerant of existing human activity, than they will be of new human activity that begins after the colony has formed.

2. Recommended Restrictions:

a. Any of the following activities within the primary zone, at any time of the year, are likely to be detrimental to the colony:

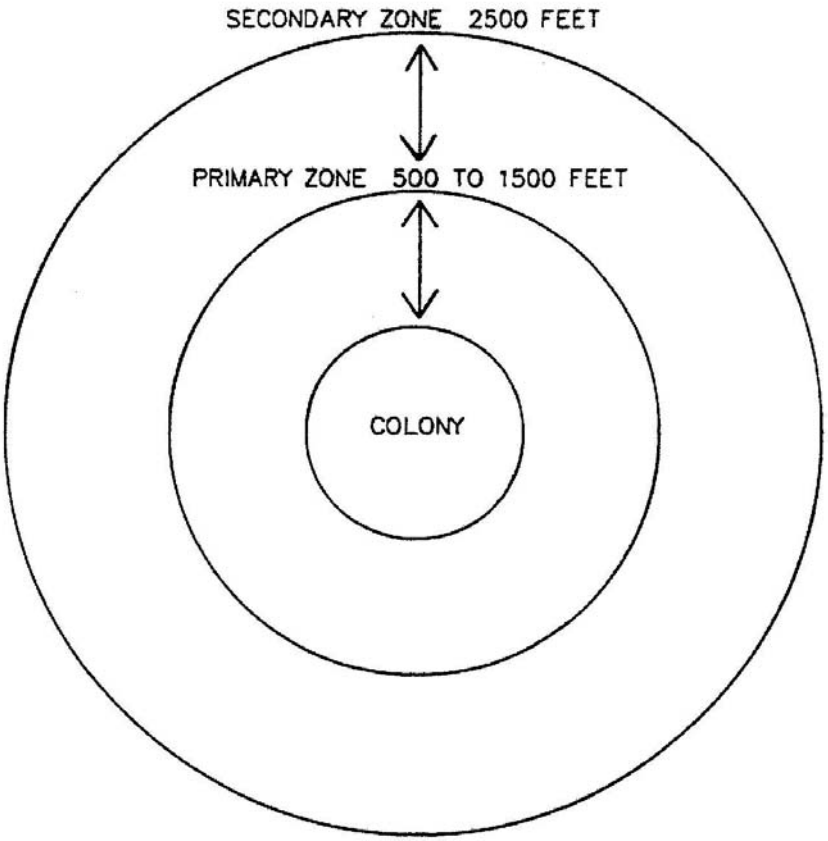
(1) Any lumbering or other removal of vegetation, and

(2) Any activity that reduces the area, depth, or length of flooding in wetlands under and surrounding the colony, except where periodic (less than annual) water control may be required to maintain the health of the aquatic, woody vegetation, and

(3) The construction of any building, roadway, tower, power line, canal, etc.

b. The following activities within the primary zone are likely to be detrimental to a colony if they occur when the colony is active:

(1) Any unauthorized human entry closer than 300 feet of the colony, and


SECONDARY ZONE 2500 FEET
PRIMARY ZONE 500 TO 1500 FEET
COLONY

(2) Any increase or irregular pattern in human activity anywhere in the primary zone, and

(3) Any increase or irregular pattern in activity by animals, including livestock or pets, in the colony, and

(4) Any aircraft operation closer than 500 feet of the colony.

B. Secondary Zone: Restrictions in this zone are needed to minimize disturbances that might impact the primary zone, and to protect essential areas outside of the primary zone. The secondary zone may be used by storks for collecting nesting material, for roosting, loafing, and feeding (especially important to newly fledged young), and may be important as a screen between the colony and areas of relatively intense human activities.

1. Size: The secondary zone should range outward from the primary zone 1000-2000 feet, or to a radius of 2500 feet of the outer edge of the colony.

2. Recommended Restrictions:

a. Activities in the secondary zone which may be detrimental to nesting wood storks include:

(1) Any increase in human activities above the level that existed in the year when the colony first formed, especially when visual screens are lacking, and

(2) Any alteration in the area's hydrology that might cause changes in the primary zone, and

(3) Any substantial (>20 percent) decrease in the area of wetlands and woods of potential value to storks for roosting and feeding.

b. In addition, the probability that low flying storks, or inexperienced, newly-fledged young will strike tall obstructions, requires that high-tension power lines be no closer than one mile (especially across open country or in wetlands) and tall trans-mission towers no closer than 3 miles from active colonies. Other activities, including busy highways and commercial and residential buildings may be present in limited portions of the secondary zone at the time that a new colony first forms. Although storks may tolerate existing levels of human activities, it is important that these human activities not expand substantially.

VI. Roosting site guidelines.

The general characteristics and temporary use-patterns of many stork roosting sites limit the number of specific management recommendations that are possible:

A. Avoid human activities within 500-1000 feet of roost sites during seasons of the year and times of the day when storks may be present. Nocturnal activities in active roosts may be especially disruptive.

B. Protect the vegetative and hydrological characteristics of the more important roosting sites--those used annually and/or used by flocks of 25 or more storks. Potentially, roosting sites may, some day, become nesting sites.

VII. Legal Considerations.

A. Federal Statutes

The U.S. breeding population of the wood stork is protected by the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.)(Act). The population was listed as endangered on February 28, 1984 (49 Federal *Register* 7332); wood storks breeding in Alabama, Florida, Georgia, and South Carolina are protected by the Act.

Section 9 of the Endangered Species Act of 1973, as amended, states that it is unlawful for any person subject to the jurisdiction of the United States to take (defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.") any listed species anywhere within the United States.

The wood stork is also federally protected by its listing (50 CFR 10.13) under the Migratory Bird Treaty Act (167 U.S.C. 703-711), which prohibits the taking, killing or possession of migratory birds except as permitted.

B. State Statutes

1. State of Alabama

Section 9-11-232 of Alabama's Fish, Game, and Wildlife regulations curtails the possession, sale, and purchase of wild birds. "Any person, firm, association, or corporation who takes, catches, kills or has in possession at any time, living or dead, any protected wild bird not a game bird or who sells or offers for sale, buys, purchases or offers to buy or purchase any such bird or exchange same for anything of value or who shall sell or expose for sale or buy any part of the plumage, skin, or body of any bird protected by the laws of this state or who shall take or willfully destroy the nests of any wild bird or who shall have such nests or eggs of such birds in his possession, except as otherwise provided by law, shall be guilty of a misdemeanor...

Section 1 of the Alabama Nongame Species Regulation (Regulation 87-GF-7) includes the wood stork in the list of nongame species covered by paragraph (4). " It shall be unlawful to take, capture, kill, possess, sell, trade for anything of monetary value, or offer to sell or trade for anything of monetary value, the following nongame wildlife species (or any parts or reproductive products of such species) without a scientific collection permit and written permission from the Commissioner, Department of Conservation and Natural Resources,..."

2. State of Florida

Rule 39-4.001 of the Florida Wildlife Code prohibits "taking, attempting to take, pursuing, hunting, molesting, capturing, or killing (collectively defined as "taking"), transporting, storing, serving, buying, selling,

possessing, or wantonly or willingly wasting any wildlife or freshwater fish or their nests, eggs, young, homes, or dens except as specifically provided for in other rules of Chapter 39, Florida Administrative Code.

Rule 39-27.011 of the Florida Wildlife Code prohibits "killing, attempting to kill, or wounding any endangered species." The "Official Lists of Endangered and Potentially Endangered Fauna and Flora in Florida" dated 1 July 1988, includes the wood stork, listed as "endangered" by the Florida Game and Fresh Water Fish Commission.

3. State of Georgia

Section 27-1-28 of the Conservation and Natural Resources Code states that "Except as otherwise provided by law, rule, or regulation, it shall be unlawful to hunt, trap, fish, take, possess, or transport any nongame species of wildlife..."

Section 27-1-30 states that, "Except as otherwise provided by law or regulation, it shall be unlawful to disturb, mutilate, or destroy the dens, holes, or homes of any wildlife;

Section 27-3-22 states, in part, "It shall be unlawful for any person to hunt, trap, take, possess, sell, purchase, ship, or transport any hawk, eagle, owl, or any other bird or any part, nest, or egg thereof...".

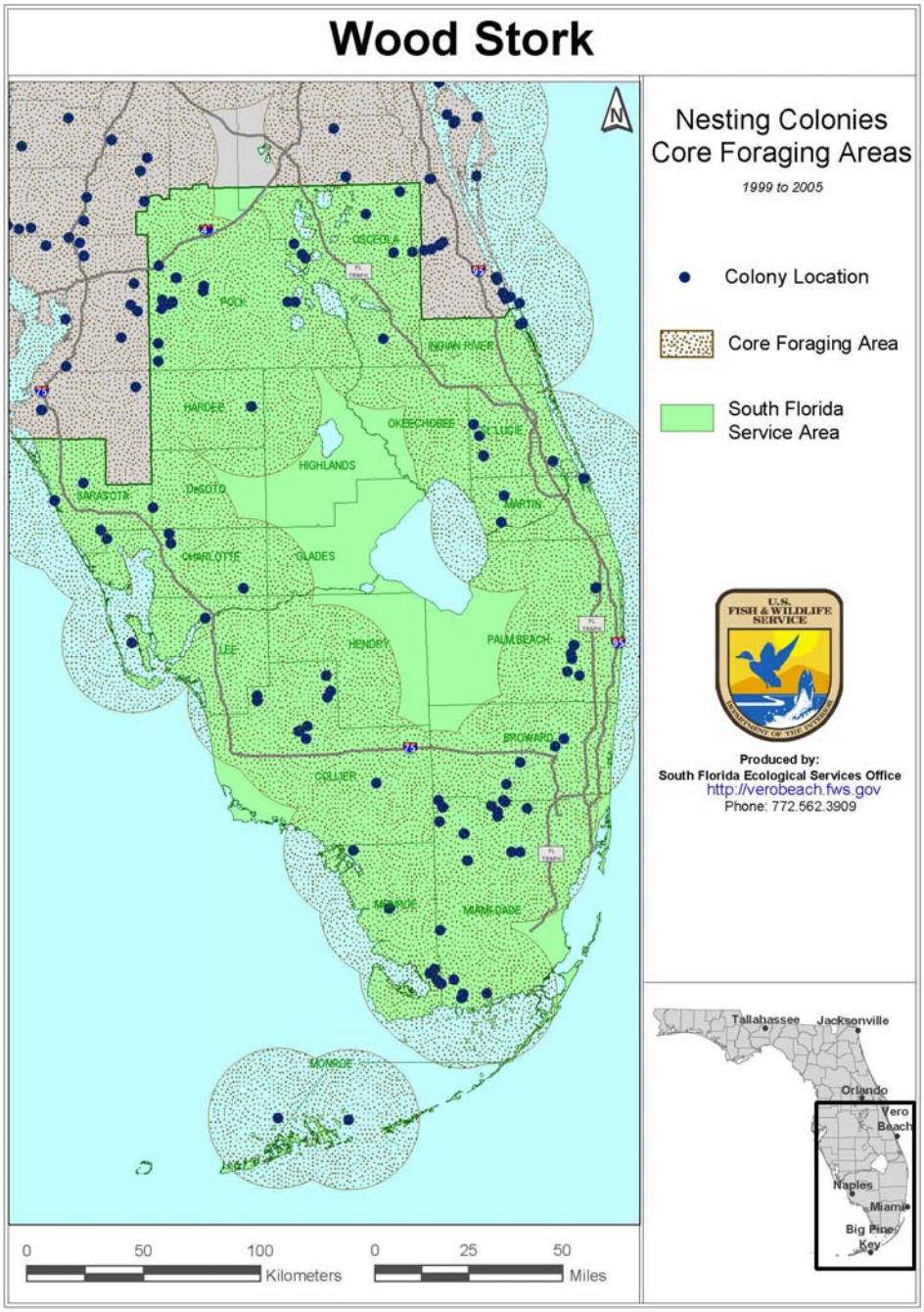
The wood stork is listed as endangered pursuant to the Endangered Wildlife Act of 1973 (Section 27-3-130 of the Code). Section 391-4-13-.06 of the Rules and Regulations of the Georgia Department of Natural Resources prohibits harassment, capture, sale, killing, or other actions which directly cause the death of animal species protected under the Endangered Wildlife Act. The destruction of habitat of protected species on public lands is also prohibited.

4. State of South Carolina

Section 50-15-40 of the South Carolina Nongame and Endangered Species Conservation Act states, "Except as otherwise provided in this chapter, it shall be unlawful for any person to take, possess, transport, export, process, sell, or offer of sale or ship, and for any common or contract carrier knowingly to transport or receive for shipment any species or subspecies of wildlife appearing on any of the following lists: (1) the list of wildlife indigenous to the State, determined to be endangered within the State...(2) the United States' List of Endangered Native Fish and Wildlife... (3) the United States' List of Endangered Foreign Fish and Wildlife ..."

Appendix 5

Active Colonies


Wood Stork
Nesting Colonies
Core Foraging Areas
1999 to 2005
Colony Location
Core Foraging Area
South Florida
Service Area
U.S.
FISH & WILDLIFE
SERVICE
Produced by:
South Florida Ecological Services Office
http://verobeach.fws.gov
Phone: 772.562.3909
OSCEOLA
POLK
INDIAN RIVER
HARDEE
OKEECHOBEE
ST LUCIE
HIGHLANDS
DeSOTO
SARASOTA
MARTIN
CHARLOTTE
GLADES
LEE
HENDRY
PALM BEACH
BROWARD
COLLIER
MONROE
MIAMI-DADE
MONROE
Tallahassee
Jacksonville
Orlando
Vero
Beach
Naples
Miami
Big Pine
Key
0 50 100
Kilometers
0 25 50
Miles

Appendix 6

Wood Stork Foraging Analysis Methodology

And

Examples

Wood Stork Foraging Analysis Methodology

Wood Stork Foraging Analysis: Excerpts of concepts and procedure as presented by the Service in our August 28, 2007, Biological Opinion for GL Homes (Terafina).

Foraging Habitat

Researchers have shown wood storks forage most efficiently and effectively in habitats where prey densities are high, and the water shallow and canopy open enough to hunt successfully (Ogden et al. 1978; Browder 1984; Coulter 1987). Prey availability to wood storks is dependent on a composite variable consisting of density (number or biomass/m^2) and the vulnerability of the prey items to capture (Gawlik 2002). For wood storks, prey vulnerability appears to be largely controlled by physical access to the foraging site, water depth, the density of submerged vegetation, and the species-specific characteristics of the prey. For example, fish populations may be very dense, but not available (vulnerable) because the water depth is too great (>30 cm) for storks or the tree canopy at the site is too dense for storks to land. Calm water, about 5 to 40 cm (2 to 16 in) in depth, and free of dense aquatic vegetation is ideal (Coulter and Bryan 1993).

Coulter and Bryan's (1993) study suggested wood storks preferred ponds and marshes, and visited areas with little or no canopy more frequently. Even in foraging sites in swamps, the canopy tended to be sparse. They suggested open canopies may have contributed to detection of the sites and more importantly may have allowed the storks to negotiate landing more easily than at closed-canopy sites. In their study the median amount of canopy cover where wood stork foraging was observed was 32 percent. Other researchers (Frederick, personnel communication, 2006 and Rodgers, personnel communication, 2006) also confirm wood storks will forage in woodlands, though the woodlands have to be fairly open and vegetation not very dense. Furthermore, the canopies must be open enough for wood storks to quickly take flight to avoid predators. In south Florida, they agree wood storks will forage in melaleuca-dominated wetlands when the trees are noncontinuous, in broken stands (blowdowns), in small islands, or sparsely distributed. They will not forage in melaleuca where the stem density is high and the canopy closed (Frederick, personnel communication, 2006).

Melaleuca-infested Wetlands: As discussed previously, wetland suitability for wood stork foraging is partially dependent on vegetation density. Melaleuca is a dense-stand growth plant species, effectively producing a closed canopy and dense understory growth pattern that generally limits a site's accessibility to foraging by wading birds. However, O'Hare and Dalrymple (1997) suggest moderate infestations of melaleuca may have little effect on some species' productivity (*i.e.*, amphibians and reptiles) as long as critical abiotic factors such as hydrology remain. They also note as the levels of infestation increase, usage by wetland dependent species decreases. Their studies also showed that the number of fish species present in a wetland system remain stable at certain levels of melaleuca. However, the availability of the prey base for wood storks and other foraging wading birds is reduced by the restriction of access caused from dense and thick exotic vegetation. Wood storks and other wading birds can forage in these systems in open area pockets (*e.g.*, wind blow-downs), provided multiple conditions are optimal (*e.g.*, water depth, prey

density). In O'Hare and Dalrmyple's study (1997), they identify five cover types (Table 1) and provide information on the number of wading bird species and the number of individuals observed within each of these vegetation classes (Table 2).

Table 1: Vegetation classes

DMM:	75 to 100 percent mature dense melaleuca coverage
DMS:	75 to 100 percent sapling dense melaleuca coverage
P75:	50 to 75 percent melaleuca coverage
P50:	0 to 50 percent melaleuca coverage
MAR (Marsh):	0 to 10 percent coverage

The number of wading bird (wetland-dependent) species and individuals observed per cover type is shown below in columns 1, 2, and 3 (Table 2). To develop an estimate of the importance a particular wetland type may have (based on density and aerial coverage by exotic species) to wetland dependent species, we developed a foraging suitability value using observational data from O'Hare and Dalrymple (1997). The Foraging Suitability Value as shown in column 5 (Table 2) is calculated by multiplying the number of species by the number of individuals and dividing this value by the maximum number of species and individuals combined (12*132=1584). The results are shown below for each of the cover types in O'Hare and Dalrymple (1997) study (Table 1). As an example, for the P50 cover type the foraging suitability is calculated by multiplying 11 species times' 92 individuals for a total of 1,012. Divide this value by 1,584, which is the maximum number of species time the maximum number of individuals (12*132 = 1,584). The resultant is 0.6389 or 64 percent (11*92=1012/1584*100=63.89).

Table 2: Habitat Foraging Suitability

Cover Type	# of Species(S)	# of Individuals (I)	S*I	Foraging Suitability
DMM	1	2	2	0
DMS	4	10	40	3
P75	10	59	590	37
P50	11	92	1012	64
MAR	12	132	1584	100

This approach was developed to provide us with a method of assessing wetland acreages and their relationship to prey densities and prey availability. We consider wading bird use to be a general index of food availability. Based on this assessment we developed an exotic foraging suitability index (Table 3):

Table 3: Exotic Foraging Suitability Index

Exotic Percentage	Foraging Suitability (Percent)
Between 0 and 25 percent exotics	100
Between 25 and 50 percent exotics	64
Between 50 and 75 percent exotics	37
Between 75 and 90 percent exotics	3
Between 90 and 100 percent exotics	0

In our assessment however, we consider DMM to represent all exotic species densities between 90 and 100 percent and DMS to represent all exotic species densities between 75 and 90 percent. In our evaluation of a habitat's suitability, the field distinction between an exotic coverage of 90 percent and 100 percent in many situations is not definable, therefore unless otherwise noted in the field reports and in our analysis; we consider a suitability value of 3 percent to represent both densities.

Fish Prey Density per Hydroperiod*:* Prey densities can be affected by the density and types of vegetation present in a wetland and by the hydroperiod of the wetland. In the O'Hare and Dalrymple (1997) study, the authors suggest that moderate infestations of melaleuca may have little effect on some species' productivity as long as critical abiotic factors such as hydrology remain, although dense melaleuca (greater than 75 percent canopy densities) do show a gradual reduction in prey bases. However, fish densities do vary with duration of hydroperiod and can have a significant effect on wood stork foraging and nest productivity. For instance, research on Everglades fish populations using a variety of quantitative sampling techniques (pull traps, throw traps, block nets) have shown that the density of small forage fish increases with hydroperiod: marshes inundated for <120 days average ± 4 fish/m^2; whereas those flooded for >340 days of the year average ± 25 fish/m^2 (Loftus and Eklund 1994; Trexler et al. 2002).

The Service (1999) described a short hydroperiod wetland as wetlands with between 0 and 180-day inundation, and long hydroperiod wetlands as greater than 180-day inundation. However, Trexler et al. (2002) defined short hydroperiod wetlands as systems with less than 300 days per year inundation. In our discussion of hydroperiods, we are considering short hydroperiod wetlands to be those that have an inundation of 180 days or fewer.

The most current information on hydroperiods in the action area was developed by the South Florida Water Management District (District) for evaluation of various restoration projects throughout the Everglades Protection Area. In their modeling efforts, they identified seven hydroperiods (Table 4):

Table 4 Everglades Protection Area Hydroperiods

- Class 1 (0-60 days inundation)
- Class 2 (60-120 days inundation)
- Class 3 (120-180 days inundation)
- Class 4 (180-240 days inundation)
- Class 5 (240-300 days inundation)
- Class 6 (300-330 days inundation)
- Class 7 (330-365 days inundation)

Trexler et al. (2002) in studies in the Everglades provided densities, as the square-root of the number of fish per square-meter for only six hydroperiods, although covering the same range of hydroperiods developed by the District. Trexler et al.'s (2002) hydroperiods and square-root fish densities are (Table 5):

Table 5 Trexler et al Hydroperiod and Square-root Fish Densities

- Class 1 (0-120 days inundation) = 2.0
- Class 2 (120-180 days inundation) = 3.0
- Class 3 (180-240 days inundation) = 4.0
- Class 4 (240-300 days inundation) = 4.5
- Class 5 (300-330 days inundation) = 4.8
- Class 6 (330-365 days inundation) = 5.0

Trexler et al. (2002) fish densities are provide as the square-root of the number of fish per square-meter. For our assessment, we squared these numbers to provide fish per square-meter, a simpler calculation when other prey density factors are included in our evaluation of adverse effects to listed species from the proposed action and also extrapolated the densities over seven hydroperiods, which is the District's number. For example Trexler's et al. (2002) square-root density of a class 2 wetland with 3 fish would equate to a District model class 3 wetland with 9 fish. Based on the above discussion, the following mean annual fish densities were extrapolated to the seven District Model hydroperiods (Table 6):

Table 6 Fish Densities per District Model Hydroperiods

- Class 1 (0-60 days) = 2 fish/m^2
- Class 2 (60-120 days) = 4 fish/m^2
- Class 3 (120-180 days) = 9 fish/m^2
- Class 4 (180-240 days) =16 fish/m^2
- Class 5 (240-300 days) = 20 fish/m^2
- Class 6 (300-330 days) = 23 fish/m^2
- Class 7 (330-365 days) = 25 fish/m^2

Fish Biomass per Hydroperiod: However, a more important parameter than fish per square-meter in defining fish densities is the biomass these fish provide. In the ENP and WCA-3 studies by Turner et al. (1999) and Trexler et al. (2002), the standing stock (biomass) of large and small fishes combined in unenriched Class 5 and 6 hydroperiod wetlands averaged between 5.5-6.5 g wet mass/m^2. However, in short hydroperiod wet prairies in Corkscrew Swamp biomass values were estimated between 2 to 2.5 g wet mass/m^2 (wet mass represents between 2 and 2.5 times dry mass [Kushlan et al. 1986]). A value of 0.5 g dry mass/m^2 was reported by Turner et al. (1999) for Carlson and Duever (1979) wet prairies in Corkscrew Swamp. Relating this information to the hydroperiod classes developed by the District, we estimated the mean annual biomass densities per hydroperiod. For our assessment, we considered Class 7 hydroperiod wetlands based on Turner et al. (1999) and Trexler et al. (2002) studies to have a mean annual biomass of 6.5 g wet mass/m^2. The remaining biomass weights were determined as a direct proportion of the number of fish per total weight of fish for a Class 7 hydroperiod (6.5 grams divided by 25 fish equals 0.26 grams per fish).

For example, a class 3 hydroperiod has 9 fish and with an average weight of 0.26 grams per fish, the biomass of a class 3 hydroperiod would be 2.3 grams (9*0.26=2.3). Based on the above discussion, the biomass per hydroperiod class is (Table 7):

Table 7 Fish Biomass per District Model Hydroperiods

- Class 1 (0-60 days) = 0.5 grams/m^2
- Class 2 (60-120 days) = 1.0 grams/m^2
- Class 3 (120-180 days) = 2.3 grams/m^2
- Class 4 (180-240 days) = 4.2 grams/m^2
- Class 5 (240-300 days) = 5.2 grams/m^2
- Class 6 (300-330 days) = 6.0 grams/m^2
- Class 7 (330-365 days) = 6.5 grams/m^2

Wood Stork Suitable Prey Size per Hydroperiod: Wood storks are highly selective in their feeding habits and in studies on fish consumed by wood storks, primarily sunfish and four other species of fish comprised over 85 percent of the number and 84 percent of the biomass of over 3,000 prey items collected from adult and nestling wood storks (Ogden et al. 1976). Ogden et al. (1976, 1978) noted that the key species consumed by wood storks included:

> Sunfishes (*Centrarchidae*; 14 percent of individuals, 44 percent of biomass);
> Yellow Bullhead (*Italurus natalis*; 2 percent of individuals, 12 percent of biomass);
> Marsh killfish (*Fundulus confluentus*; 18 percent of individuals, 11 percent of biomass);
> Flagfish (*Jordenella floridae*, 32 percent of individuals, 7 percent of biomass);
> Sailfin Molly (*Poecilia latipinna*, 20 percent of individuals, 11 percent of biomass).

These species were also observed to be consumed in much greater proportions than they occur at feeding sites, and abundant smaller species (*e.g.*, mosquitofish, least killfish, bluefin killfish) are under-represented, which the researchers believed was probably because their small size does not elicit a bill-snapping reflex in these tactile feeders (Coulter et al. 1999). Their studies also showed that in addition to selecting larger species of fish, wood storks consumed individuals that are significantly larger (>3.5 cm) than the mean size available (2.5 cm), and many were greater than one-year old (Ogden et al. 1976; Coulter et al. 1999). Ogden et al.'s (1976 – Figure 4) also showed that wood storks also generally consumed fish that were between 1.5 and 9.0 cm in length.

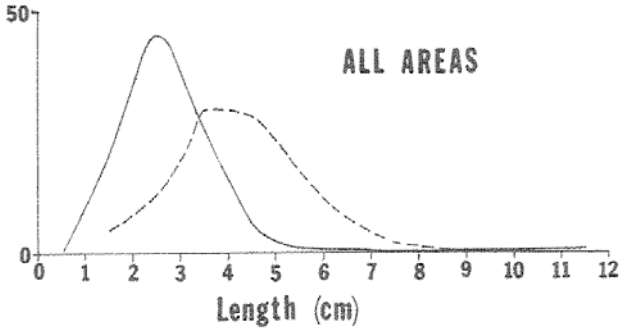


FIGURE 4. Length frequency distribution of fish available to and consumed by Wood Storks in different habitats.

In Ogden et al.'s (1979) Figure 4, the dotted line is the distribution of fish consumed and the solid line is the available fish. Straight interpretation of the area under the dotted line curve represents the size classes of fish likely consumed by wood storks and is the basis of our

determination of the amount of biomass that is within the size range of fish most likely consumed by wood storks, which in this example is a range size of 1.5 and 9.0 cm in length.

Fish Biomass Available for Wood Stork Consumption: To estimate that fraction of the available fish biomass that potentially might be consumed by wood storks, based on Ogden et al.'s (1979) Figure 4; the following analysis was conducted. Trexler et al.'s (2002) 2-year throw-trap of absolute and relative fish abundance distributed across 20 study sites in the ENP and the WCAs was assumed to be representative of the Everglades fish assemblage available to wood storks (n = 37,718 specimens of 33 species). The mean biomass of each species within this fish fauna that fell within the wood stork prey size limits of 1.5-9.0 cm was estimated from the length and wet mass relationships for Everglades's animals developed by Kushlan et al. (1986). The proportion of each species that was outside of this prey length and biomass range was estimated using the species mean and variance provided in Kushlan et al. in Table 1 (1986). These biomass estimates assumed the length and mass distributions of each species was normally distributed and the fish biomass could be estimated by eliminating that portion of each species outside of this size range. These biomass estimates of available fish prey were then standardized to a sum of 6.5 g/m^2 for Class 7 hydroperiod wetlands.

For example, in Appendix 1, in Kushlan et al. (1986) the warmouth (*Lepomis gulosus*) had an average biomass of 36.76 g and accounted for 0.048 percent of the freshwater Everglades ichthyofauna; after standardization, warmouth biomass would be about 0.5 g/m^2 of the total fish biomass in a 6.5 g/m^2 sample from long hydroperiod wetlands. However, the size frequency distribution (assumed normal) for warmouth indicate that 48 percent are too large for wood storks and 0.6 are too small (outside the 1.5 cm to 9 cm size likely consumed), so the warmouth biomass within the wood stork's preferred size range is only 0.25 g/m^2. Using this approach summed over all species, in long hydroperiod wetlands only about 3.54 g/m^2 of the 6.5 g/m^2 sample consists of fish within the size range preferred by wood storks or about 55 percent (3.54/6.5*100=54.5). Alternatively, the preferred sunfishes and four other species that accounted for 84 percent of the biomass eaten by wood storks (Ogden et al. 1976) would total 2.34 g/m^2 under this approach; adding another 16 percent (2.34*.16/.84=0.45) (the remaining biomass) would suggest that 2.79 g/m^2 (2.34+0.45=2.79) of fish are likely to be consumed by wood storks of the 6.5 g/m^2 that are available or about 42.9 percent (2.79/6.5*100=42.9).

The mean of these two estimates is 3.17 g/m^2 for long hydroperiod wetlands (3.54+2.79=6.33/2=3.17). This proportion of available fish prey of a suitable size (3.17 g/m^2/ 6.5 g/m^2 = 0.49 or 49 percent) was then multiplied by the total fish biomass in each hydroperiod class to provide an estimate of the total biomass of a hydroperiod that is the appropriate size and species composition most likely consumed by wood storks.

As an example a class 3 District model hydroperiod wetland with a biomass of 2.3 grams/m^2 adjusted by 49 percent for appropriate size and species composition, provides an available biomass of 1.13 grams/m^2. Following this approach, the biomass per hydroperiod potentially vulnerable to predation by wood storks based on size and species composition is (Table 8):

Table 8 Biomass of Fish Vulnerable to Predation Based on Size and Species Composition

- Class 1 (0-60 days) = 0.25 grams/m^2
- Class 2 (60-120 days) = 0.49 grams/m^2
- Class 3 (120-180 days) = 1.13 grams/m^2
- Class 4 (180-240 days) = 2.1 grams/m^2
- Class 5 (240-300 days) = 2.5 grams/m^2
- Class 6 (300-330 days) = 2.9 grams/m^2
- Class 7 (330-365 days) = 3.2 grams/m^2

<u>Wood Stork-Wading Bird Prey Consumption Competition</u>: Another factor in assessing wood stork foraging potential is the likelihood that wood storks will be the wading bird species that actually consumes the concentrated prey. Fleming et al. (1994b) provides an estimate of 10 percent of the total biomass in their studies of wood stork foraging as the amount that is actually consumed by the storks. However, the Fleming et al. (1994b) estimate also includes the suitability of the foraging site for wood storks and prey size selection, factors that we have calculated separately. In their assessment, these factors, competition, prey size selection, and habitat suitability, accounted for a 90 percent reduction in the biomass actually consumed by the storks. In the assessment above on prey size selection, we noted a reduction in biomass available to wood stork to average around 49 percent of the total biomass and we believe represent 45 percent of the 90 percent reduction. Since we have a separate reduction factor for habitat suitability in our approach, this 45 percent habitat reduction factor in Flemings et al.'s (1994b) estimate is doubling this prey base reduction factor. In consideration of this approach, Fleming et al.'s (1994) estimate that 10 percent of the biomass would actually be consumed by wood storks would be adjusted to an estimate of 55 percent (10 percent plus the 45 percent already accounted for) of the available biomass would actually be consumed by the storks and is the factor we believe represents the amount of the wood stork suitable prey base that is actually consumed by the wood stork.

Following this approach, Table 8 has been adjusted to reflect the competition factor and represents the amount of biomass consumed by wood storks and is the basis of our effects assessments (A Class 1 hydroperiod with a biomass 0.25 g, multiplied by 0.55, results in a value of 0.14 g [0.25*.55=0.14]) (Table 9).

Table 9 Actual Biomass Consumed by Wood Storks

- Class 1 (0-60 days) = 0.14 grams/m^2
- Class 2 (60-120 days) = 0.27 grams/m^2
- Class 3 (120-180 days) = 0.62 grams/m^2
- Class 4 (180-240 days) = 1.16 grams/m^2
- Class 5 (240-300 days) = 1.38 grams/m^2
- Class 6 (300-330 days) = 1.6 grams/m^2
- Class 7 (330-365 days) = 1.8 grams/m^2

Sample Project of Biomass Calculations and Corresponding Concurrence Determination

Example 1:

An applicant is proposing to construct a residential development with unavoidable impacts to 5 acres of wetlands and is proposing to restore and preserve 3 acres of wetlands onsite. Data on the onsite wetlands classified these systems as exotic impacted wetlands with greater than 50 percent but less than 75 percent exotics (Table 3) with an average hydroperiod of 120-180 days of inundation.

The equation to calculate the biomass lost is: The number of acres, converted to square-meters, times the amount of actual biomass consumed by the wood stork (Table 9), times the exotic foraging suitability index (Table 3), equals the amount of grams lost, which is converted to kg.

Biomass lost (5*4,047*0.62 (Table 9)*.37 (Table 3)=4,641.9 grams or 4.6 kg)

In the example provided, the 5 acres of wetlands, converted to square-meters (1 acre= 4,047 m^2) would provide 4.6 kg of biomass (5*4,047*0.62 (Table 9)*.37 (Table 3)=4,641.9 grams or 4.6 kg), which would be lost from development.

The equation to calculate the biomass from the preserve is the same, except two calculations are needed. One for the existing biomass available and one for the biomass available after restoration.

Biomass Pre: (3*4,047*0.62(Table 9)*.37 (Table 3)=2,785.1 grams or 2.79 kg)

Biomass Post: (3*4,047*0.62 (Table 9)*1(Table 3)=7,527.4 grams or 7.53 kg)

Net increase: 7.53 kg-2.79 kg = 4.7kg

The compensation proposed is 3 acres, which is within the same hydroperiod and has the same level of exotics. Following the calculations for the 5 acres, the 3 acres in its current habitat state, provides 2.79 kg (3*4,047*0.62(Table 9)*.37 (Table 3)=2,785.1 grams or 2.79 kg) and following restoration provides 7.53 kg (3*4,047*0.62 (Table 9)*1(Table 3)=7,527.4 grams or 7.53 kg), a net increase in biomass of 4.7 kg (7.53-2.79=4.7).

Example 1: 5 acre wetland loss, 3 acre wetland enhanced – same hydroperiod - NLAA

Hydroperiod	Existing Footprint		On-site Preserve Area				Net Change*	
			Pre Enhancement		Post Enhancement			
	Acres	Kgrams	Acres	Kgrams	Acres	Kgrams	Acres	Kgrams
Class 1 - 0 to 60 Days								
Class 2 - 60 to 120 Days								
Class 3 - 120 to 180 Days	5	4.6	3	2.79	3	7.53	(5)	0.1
Class 4 - 180 to 240 Days								
Class 5 - 240 to 300 Days								
Class 6 - 300 to 330 Days								
Class 7 - 330 to 365 days								
TOTAL	**5**	**4.6**	**3**	**2.79**	**3**	**7.53**	**(5)**	**0.1**

*Since the net increase in biomass from the restoration provides 4.7 kg and the loss is 4.6 kg, there is a positive outcome (7.53-2.79-4.6=0.1) in the same hydroperiod and Service concurrence with a NLAA is appropriate.

Example 2:

In the above example, if the onsite preserve wetlands were a class 4 hydroperiod, which has a value of 1.16. grams/m^2 instead if a class 3 hydroperiod with a 0.62 grams/m^2 [Table 9]), there would be a loss of 4.6 kg of short hydroperiod wetlands (as above) and a net gain of 8.9 kg of long-hydroperiod wetlands.

Biomass lost: (5*4,047*0.62 (Table 9)*.37 (Table 3)=4,641.9 grams or 4.6 kg)

The current habitat state of the preserve provides 5.21 kg (3*4,047*1.16(Table 9)*.37 (Table 3)=5,210.9 grams or 5.21 kg) and following restoration the preserve provides 14.1 kg (3*4,047*1.16 (Table 9)*1(Table 3)=14,083.6 grams or 14.1 kg, thus providing a net increase in class 4 hydroperiod biomass of 8.89 kg (14.1-5.21=8.89).

Biomass Pre: (3*4,047*1.16(Table 9)*.37 (Table 3) = 5,210.9 grams or 5.21 kg)

Biomass Post: (3*4,047*1.16 (Table 9)*1(Table 3)=14,083.6 grams or 14.1 kg)

Net increase: 14.1 kg-5.21 kg = 8.9 kg

Example 2: 5 acre wetland loss, 3 acre wetland enhanced – different hydroperiod – May Affect

Hydroperiod	Existing Footprint		On-site Preserve Area				Net Change*	
			Pre Enhancement		Post Enhancement			
	Acres	Kgrams	Acres	Kgrams	Acres	Kgrams	Acres	Kgrams
Class 1 - 0 to 60 Days								
Class 2 - 60 to 120 Days								
Class 3 - 120 to 180 Days	5	4.6					(5)	(4.6)
Class 4 - 180 to 240 Days			3	5.21	3	14.1	0	8.89
Class 5 - 240 to 300 Days								
Class 6 - 300 to 330 Days								
Class 7 - 330 to 365 days								
TOTAL	**5**	**4.6**	**3**	**5.21**	**3**	**14.1**	**(5)**	**4.29**

In this second example, even though there is an overall increase in biomass, the biomass loss is a different hydroperiod than the biomass gain from restoration, therefore, the Service could not concur with a NLAA and further coordination with the Service is appropriate.

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