United States Department of the Interior

FISH AND WILDLIFE SERVICE
6620 Southpoint Drive South
Suite 310
Jacksonville, Florida 32216-0958

IN REPLY REFER TO:
FWS/R4/ES-JAFL

January 19, 2000

Colonel Joe Miller
U.S. Army Corps of Engineers
Post Office Box 4970
Jacksonville, Florida 32232-0019

Dear Colonel Miller:

This document transmits the Fish and Wildlife Service's biological opinion based on our review of the proposed Victoria Park (199707347 [IP-SS], Service Log No: 99-769) located in Volusia County, Florida, and its effects on the Florida scrub-jay (*Aphelocoma coerulescens*) and eastern indigo snake (*Drymarchon corais couperi*) in accordance with section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act). Your September 13, 1999, letter, requesting formal consultation was received on September 16, 1999. The Service responded with a letter dated September 29, 1999, requesting more information from the applicant. Formal consultation was initiated on December 16, 1999.

This biological opinion is based on information provided in your September 13, 1999, letter; field inspections; and other sources of information. A complete administrative record of this consultation is on file in the Jacksonville Field Office.

CONSULTATION HISTORY

The U.S. Fish and Wildlife Service (Service) involvement in this project began on May 18, 1998, with a letter requesting more information regarding Florida scrub-jays on the project site. On March 9, 1999, Service biologists met with the applicant's consultant at the project site. On September 13, 1999, the Corps sent a letter requesting initiation of formal consultation pursuant to their review of a permit application for wetland impacts. On September 29, 1999, the Service sent a letter to the Corp requesting more information on the proposed project. On November 4, 1999, the Service and Corp met with the applicant's consultant to discuss what information we needed to complete the biological opinion. On December 16, 1999, the Service sent a letter to the Corp initiating formal consultation.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

St. Joe/Arvida Group is proposing to impact 32.5 acres of wetlands for the development of the proposed Victoria Park project. The 1860-acre development will consist of single family and multi-family residential units, commercial units, a golf course, and conservation areas that will be restored and managed. The proposed project will impact 55.3 acres of the 112.4 acres occupied Florida scrub-jay habitat. There are two families of scrub-jays located within the proposed project site.

The project site is located in Sections 22, 23, 24, 25, 26, 34, 35, and 36, Township 17 South, Range 30 East within Deland, Volusia County, Florida. The Project site is bounded or intersected by County Road 4101 (Martin Luther King, Jr. Beltway), Orange Camp Road, Taylor Road, State Road 472, Blue Lake Road, and Interstate 4.

The scrub conservation area is composed of 57.1 acres of occupied habitat and 53.6 acres of presently unoccupied, but restorable habitat. This 110.7 acre area will be restored and managed, long term, to provide optimal scrub-jay habitat for the two scrub-jay territories. This area will be managed with various techniques including mechanical and prescribed fire management actions for restoration.

STATUS OF THE SPECIES/CRITICAL HABITAT

This section summarizes Florida scrub-jay and eastern indigo snake biology and ecology as well as information regarding the status and trends of the Florida scrub-jay throughout its entire range. The Service uses this information to assess whether a Federal action is likely to jeopardize the continued existence of the Florida scrub-jay and eastern indigo snake. The "Environmental Baseline" section summarizes information on status and trends of the Florida scrub-jay and eastern indigo snake specifically within the action area. These summaries provide the foundation for the Service's assessment of the effects of the proposed action, as presented in the "Effects of the Action" section.

Species/critical habitat description

Florida scrub-jay (*Aphelocoma coerulescens*)

Florida scrub-jays are about 10 to 12 inches long and weigh about 3 ounces. They are similar in size and shape to the blue jay (*Cyanocitta cristata*), but differ significantly in coloration (Woolfenden and Fitzpatrick 1996a). Unlike the blue jay, scrub-jays do not have a crest. They also lack the conspicuous white-tipped wing and tail feathers, black barring and bridle of the blue jay. The Florida scrub-jay's head, nape, wings, and tail are pale blue, and it is pale grey on its back and belly. Its throat and upper breast are lightly striped and bordered by a pale blue-grey

"bib". The sexes of the scrub-jay are not distinguishable by plumage, and males average only slightly larger than females (Woolfenden 1978). The sexes may be differentiated by a distinct "hiccup" call vocalized only by females (Woolfenden and Fitzpatrick 1986). Scrub-jays less than about five months of age are easily distinguishable from adults; their plumage is smokey grey on the head and back, and they lack the blue crown and nape of the adults. Molting occurs between early June and late November, and peaks between mid-July and late September (Bancroft and Woolfenden 1982). During late summer and early fall, when the first basic molt is nearly complete, fledgling scrub-jays may be indistinguishable from adults in the field (Woolfenden and Fitzpatrick 1984). The wide variety of vocalizations of the scrub-jay are described in detail in Woolfenden and Fitzpatrick (1996b).

Scrub-jays are non-migratory, extremely sedentary, and have very specific habitat requirements (Woolfenden 1978). They usually reside in oak scrub vegetated with sand live oak, myrtle oak, inopine oak, and Chapman oak, along with saw palmetto, scrub palmetto, scattered sand pine, and rosemary. Such habitat occurs only on fine, white, drained sand, along the coastlines in Florida, and in dunes deposited during the Pleistocene, when sea levels were much higher than at present (Laessle 1958, 1968). Scrub-jays are rarely found in habitats with more than 50 percent canopy cover over three meters in height (U.S. Fish and Wildlife Service 1990). The habitat required for the scrub-jay greatly restricts the bird's distribution. Active management either through burning or mechanical clearing is necessary to maintain optimum conditions. In general, scrub-jay habitat consists of dense thickets of scrub oaks less than nine feet tall, interspersed with bare sand used for foraging and storing of acorns (U.S. Fish and Wildlife Service 1990).

The Florida scrub-jay was federally listed as threatened in 1987 primarily because of habitat fragmentation, degradation, and loss (52 FR 20719). Scrub habitats associated with Florida's barrier islands, mainland coasts, and Lake Wales Ridge are some of the most imperiled natural communities in the United States, with estimates of habitat loss since presettlement time ranging from 70 to more than 80 percent (Bergen 1994, Fitzpatrick et al. 1991). Historically, this vegetative community type occurred as large, contiguous patches, some of them over hundreds of miles (Cox 1987). Today only relict patches of xeric oak scrub remains. Throughout the northern part of the range, population declines of the Florida scrub-jay are attributed to scrub fragmentation and degradation, due primarily to widespread fire suppression. Citrus conversion and residential development continues to be the most important factors causing the decline of the scrub-jay populations in the southern extremes of their range (Fernald 1989, Fitzpatrick et al. 1991). No "critical habitat" has been designated for this species.

Life history/Population Dynamics

Florida scrub-jays are monogamous and remain mated throughout the year (Sprunt 1946, Woolfenden 1978). Scrub-jays have a social structure that involves cooperative breeding, a trait that the western North American populations of scrub-jays do not exhibit (Woolfenden and Fitzpatrick 1984). The offspring generally stay with the parents for at least one year, forming a family group consisting of three or more family members. These "helpers" assist the breeding pair

in all territorial and breeding activities except nest construction, egg-laying, and incubation. The family group resides in a territory with a well-defined boundary, defended year-round by all group members (Woolfenden and Fitzpatrick 1984). A well-developed intra-familial dominance hierarchy exists with breeding males being the most dominant, followed by helper males, breeding females, and finally, helper females (Woolfenden and Fitzpatrick 1977). Helpers participate in sentinel duties (McGowan and Woolfenden 1989), territorial defense, predator mobbing, and feeding both nestlings (Stallcup and Woolfenden 1978) and fledglings (McGowan and Woolfenden 1990). The presence of helpers generally increases reproductive success and survival within the group, which naturally causes family size to increase (Woolfenden and Fitzpatrick 1978). However, the presence of humans near populations of scrub-jays results in a variety of incidental encounters that usually increase the mortality of both juveniles and adults (Fitzpatrick et al. 1991).

Florida scrub-jay pairs occupy year-round, multi-purpose territories (Woolfenden and Fitzpatrick 1984, Fitzpatrick et al. 1991, Fitzpatrick et al. 1994). Territory size averages 22 to 25 acres, with a minimum size of about 12 acres. Territories are a limiting factor for scrub-jay populations. Because of this limitation, non-breeding males may remain in their natal territory as helpers for up to five years, waiting for either a mate or territory to become available (Fitzpatrick et al. 1991). New territories are established several ways: by replacing a lost breeder on a territory (Woolfenden and Fitzpatrick 1984); through "territorial budding", where a helper male becomes a breeder in a segment of his natal territory (Woolfenden and Fitzpatrick 1978); by inheriting a natal territory following the death of a breeder; or by establishing a new territory between existing territories (Woolfenden and Fitzpatrick 1984). Territories can also be obtained by creating suitable habitat in areas that were previously unsuitable through effective habitat management (Thaxton and Hingtgen 1994).

To become a breeder, a scrub-jay must acquire a territory as well as a mate. Evidence presented by Woolfenden and Fitzpatrick (1984) suggests that scrub-jays are permanently monogamous and occupy the same territory year after year. Courtship to form the pair is lengthy and ritualized, and involves posturing and vocalizations made by the male to the female (Woolfenden and Fitzpatrick 1996b). Copulation between the pair is generally out of the sight of other jays (Woolfenden and Fitzpatrick 1984). These authors also reported never observing copulation between unpaired jays, nor courtship behavior between a female and a jay other than her mate. Age at first breeding varies from one to seven years, although most breed between two and four years of age (Fitzpatrick and Woolfenden 1988). Persistent breeding populations of scrub-jays exist only where there are scrub oaks in sufficient quantities to provide an ample winter acorn supply, cover from predators, and nest sites during spring (Woolfenden and Fitzpatrick 1996a).

Nesting is synchronous, normally occurring from March through June (Woolfenden and Fitzpatrick 1990, Fitzpatrick et al. 1991). In the suburban habitats, nesting is consistently initiated earlier (March and April) than in natural scrub habitat (Fleischer 1996). Clutch size ranges from 1 to 5 eggs, but is usually 3 or 4 eggs. Clutch sizes are generally larger (up to 6 eggs) in suburban habitats, and the birds attempt to rear more broods (Fleischer 1996). Eggs are incubated for 17 to

18 days, and fledging occurs 16 to 21 days after hatching (Woolfenden 1974, 1978, Fitzpatrick et al. 1991). Only the breeding female broods the eggs and nestlings (Woolfenden and Fitzpatrick 1984). Average survival is two fledglings per pair per year (Woolfenden and Fitzpatrick 1990, Fitzpatrick et al. 1991), and the presence of helpers improves success (Mumme 1992). Annual productivity must average at least 2 young per pair for a pair to maintain long term stability (Fitzpatrick et al. 1991). Data from Indian River County shows that mean annual productivity declines in suburban areas. Toland (1991) reported that productivity averaged 2.2 young fledged per pair in contiguous, optimal scrub, 1.8 young fledged per pair in fragmented, moderately developed scrub, 1.2 young per pair in suboptimal and only about 0.5 young fledged per pair in residential lawns.

Nesting failures are almost always caused by predation, most frequently by ground-based predators including eastern coach whip (*Masticophis flagellum*), eastern indigo snake (*Drymarchon corais couperi*), rat snake (*Elaphe obsoleta*), corn snake (*E. guttata*), raccoon (*Procyon lotor*), and domestic cat (*Felis catus*) (Fitzpatrick et al. 1991, Schaub et al. 1992).

Fledglings remain nutritionally dependent for about 10 weeks, during which time they are fed by both parents and helpers (Woolfenden 1975, McGowan and Woolfenden 1990). Survival of scrub-jay fledglings to yearling class averages about 35 percent, while annual survival of adult males and females is around 80 percent (Fitzpatrick et al. 1991). The maximum observed lifespan of a Florida scrub-jay is 15.5 years (Woolfenden and Fitzpatrick 1996b).

Juveniles remain in their natal territory for up to five years before dispersing (Woolfenden and Fitzpatrick 1984). Once they pair and become breeders, generally within two territories of their natal grounds, they remain in their breeding territory until death. In suitable habitat, fewer than five percent of scrub-jays disperse more than five miles (Fitzpatrick et al. 1991). All documented long distance dispersals have been in unsuitable habitat such as woodland, pasture, or suburban plantations. Scrub-jay dispersal behavior is affected by intervening landscape matrix. Protected scrub habitats will most effectively sustain scrub-jay populations if they are located within a matrix that can be utilized and traversed by scrub-jays. Brushy pastures, scrubby corridors along railways, and county road right-of-ways, and open burned flatwoods provide links for colonization among scrub-jay subpopulations. Stith et al. (1996) believed that a dispersal distance of five miles is closer to biological maximum for scrub-jays.

Scrub-jays forage on or near the ground, often along the edge of natural or man-made openings. Insects, particularly, orthopteran and lepidopteran larvae, comprise the majority of the animal diet throughout most of the year (Woolfenden and Fitzpatrick 1984). Acorns are by far the most important plant food and from August to November scrub-jays harvest and cache thousands of scrub oak acorns throughout their territory (Fitzpatrick et al. 1991). It is estimated that 1/3 of these acorns are later recovered and eaten. Caching allows scrub-jays to eat acorns every month of the year. This reliance on acorns and caching may constitute a major reason for the scrub-jay's restriction to the oak scrub and sandy ridges within Florida (Fitzpatrick et al. 1991).

Eastern Indigo Snake (*Drymarchon corias couperi*)

The eastern indigo snake is one of eight subspecies of a primarily tropical species; only the eastern indigo and the Texas indigo (*Drymarchon corais erebennus*) occur within the United States (U.S. Fish and Wildlife Service 1982). The eastern indigo snake is isolated from the Texas indigo snake by more than 600 miles (Moler 1992). The eastern indigo snake is the longest snake in North America, obtaining lengths of up to 104 inches (Ashton and Ashton 1981). Its color is uniformly lustrous-black, dorsally and ventrally, except for a red or cream-colored suffusion of the chin, throat, and sometimes the cheeks. Its scales are large and smooth (central 3-5 scale rows are lightly keeled in adult males) in 17 scale rows at midbody. Its anal plate is undivided. Its antepenultimate supralabial scale does not contact the temporal postocular scales.

Historically, the eastern indigo snake occurred throughout Florida and into the coastal plain of Georgia, Alabama, and Mississippi (Loding 1922, Haltom 1931, Carr 1940, Cook 1954, Diemer and Speake 1983, Moler 1985a). It may have occurred in South Carolina, but its occurrence there cannot be confirmed. Georgia and Florida currently support the remaining, endemic populations of eastern indigo snake (Lawler 1977). In 1982, only a few populations remained in the Florida panhandle and the species was considered rare in that region. Nevertheless, based on museum specimens and field sightings, the eastern indigo snake still occurs throughout Florida even though they are not commonly seen (Moler 1985a).

In south Florida the eastern indigo snake is thought to be widely distributed and probably more abundant than in the northern limits of the range, especially compared to the low densities found in the panhandle of Florida. Given their preference for upland habitats, indigos are not found in great numbers in wetland complexes of the Everglades region, even though they are found in pinelands and tropical hardwood hammocks in extreme south Florida (Steiner *et al.* 1983).

Indigo snakes also occur in the Florida Keys. They have been collected from Big Pine and Middle Torch Keys, and are reliably reported from Big Torch, Little Torch, Summerland, Cudjoe, Sugarloaf, and Boca Chica Keys (Lazell 1989). Given the ubiquitous nature of the eastern indigo throughout the remainder of its range, it is likely that it also occurs on other Keys.

No critical habitat has been designated for the eastern indigo snake.

Life history/Population Dynamics

Over most of its range, the eastern indigo snake frequents a diversity of habitat types such as pine flatwoods, scrubby flatwoods, xeric sandhill communities, tropical hardwood hammocks, edges of freshwater marshes, agricultural fields, coastal dunes, and human altered habitats. Eastern indigo snakes need a mosaic of habitats to complete their annual cycle. Interspersion of tortoise inhabited sandhills and wetlands improves habitat quality for the indigo snakes (Landers and Speake 1980, Auffenberg and Franz 1982). Eastern indigo snakes require sheltered "retreats" from winter cold and desiccation (Bogert and Cowles 1947). Whenever the eastern indigo snake

occurs in xeric habitats, it is closely associated with the gopher tortoise (*Gopherus polyphemus*), the burrows of which shelter the indigo snakes from the winter cold and desiccating sandhills environment (Bogert and Cowles 1947, Speake *et al.* 1978, Layne and Steiner 1996). This dependence seems especially pronounced in Georgia, Alabama, and the panhandle of Florida, where the eastern indigo snake is largely restricted to the vicinity of the sandhill habitats occupied by gopher tortoises (Diemer and Speake 1981, Moler 1985b, Mount 1975). The high use of xeric sandhill habitats throughout the northern portion of the eastern indigo's range can be attributed primarily to the availability of thermal refuge afforded by gopher tortoise burrows in the winter. No such refugia is widely available off of the sandhills regions of southern Georgia and northern Florida. In wetter habitats that lack gopher tortoises, eastern indigo snakes may take shelter in hollowed root channels, hollow logs, or the burrow of rodents, armadillos, or crabs (Lawler 1977, Moler 1985b, Layne and Steiner 1996).

In the milder climates of central and southern Florida, eastern indigo snakes exist in a more stable thermal environment, where the availability of thermal refugia may not be as critical to the snakes survival, especially in extreme southern Florida. Throughout peninsular Florida, the eastern indigo snake can be found in all terrestrial habitats which have not suffered high urban development. They are especially common in hydric hammocks throughout this region (Moler 1985a). In central and coastal Florida, eastern indigo snakes are typically found in the State's high, sandy ridges. In extreme south Florida, these snakes are mainly found in pine flatwoods, pine rockland, and tropical hardwood hammock habitats, and in most other undeveloped areas (Kuntz 1977). Eastern indigo snakes also use some agricultural lands (e.g. citrus) and various types of wetlands (Layne and Steiner 1996).

Even though thermal stresses may not be a year round limiting factor in southern Florida, eastern indigo snakes seek and use underground refugia. On the sandy central and coastal ridges of south Florida, indigo snakes use gopher tortoise burrows (62 percent) more than other underground refugia (Layne and Steiner 1996). Other underground refugia used by indigo snakes include burrows of armadillos (*Dasypus novemcinctus*), cotton rats (*Sigmodon hispidus*), and land crabs; burrows of unknown origin; natural ground holes; hollows at the base of trees or shrubs; ground litter; trash piles; and in the crevices of rock-lined ditch walls (Layne and Steiner 1996). These refugia sites are used most frequently where tortoise burrows are not available, principally in the low-lying areas off of the central and coastal ridges.

Smith (1987) radio-tagged hatchling, yearling, and gravid eastern indigo snakes and released them in different habitat types on St. Marks National Wildlife Refuge in Wakulla County, Florida, in 1985 and 1986. Smith monitored the behavior, habitat use, and oviposition sites selected by gravid female snakes and concluded that the diverse habitats, including high pineland, pine-palmetto flatwoods, and permanent open ponds, were important for the eastern indigo snake's seasonal activity. In this study, habitat use also differed by age-class and season; adult indigo snakes often used gopher tortoise burrows during April and May, while juveniles used root and rodent holes. The indigo snakes used gopher tortoise burrows for oviposition sites in high pineland areas, but stumps were chosen in flatwoods and pond edge habitats (Smith 1987).

Monitoring of radio-fitted indigo snakes on the central ridge of south Florida indicate that snakes in this part of the state use a wide variety of natural, disturbed, and non-natural habitat types throughout the year. On the ridge itself, indigos favor mature oak phase scrub, turkey oak sandhill, and abandoned citrus grove habitats, while snakes found off the sandy ridges use flatwoods, seasonal ponds, improved pasture, and active and inactive agricultural lands. There was no apparent selection for one habitat type over another as the use of habitats closely reflected the relative availability and distribution of the vegetation types in these areas (Layne and Steiner 1996).

In extreme south Florida (the Everglades and Florida Keys), indigo snakes are found in tropical hardwood hammocks, freshwater marshes, abandoned agricultural lands, coastal prairie, mangrove swamps, and human altered habitats (Steiner *et al.* 1983). It is suspected that they prefer hammocks and pine forests since most observations occur there and use of these areas are disproportionate compared to the relatively small total area of these habitats (Steiner *et al.* 1983).

Reproduction

Most information on the reproductive cycle of the eastern indigo snake is from data collected in northern Florida. Here, breeding occurs between November and April, and females deposit four to twelve eggs during May or June (Moler 1992). Speake (1993) reported an average clutch size of 9.4 for 20 captive bred females. Young hatch in approximately three months, from late May through August. Peak hatching activity occurs during August and September, while yearling activity peaks in April and May (Groves 1960, Smith 1987). Limited information on the reproductive cycle in south-central Florida suggests that the breeding and egg laying season may be extended in south-central and south Florida. In this region, breeding extends from June to January, laying occurs from April to July, and hatching occurs during mid-summer to early fall (Layne and Steiner 1996).

Female indigo snakes can store sperm and delay fertilization of eggs; there is a single record of a captive snake laying five eggs (at least one of which was fertilized) after being isolated for more than four years (Carson 1945). There is no information on how long eastern indigo snakes live in the wild; in captivity, the longest an eastern indigo snake lived was 25 years, 11 months (Shaw 1959).

Feeding

The eastern indigo snake is an active terrestrial and fossorial predator that will eat any vertebrate small enough to be overpowered. Layne and Steiner (1996) documented several instances of indigos flushing prey from cover and then chasing it. Though unusual, indigo snakes may also climb shrubs or trees in search of prey. An adult eastern indigo snake's diet may include fish, frogs, toads, snakes (venomous and nonvenomous), lizards, turtles, turtle eggs, juvenile gopher tortoises, small alligators, birds, and small mammals (Keegan 1944, Babis 1949, Kochman 1978,

Steiner *et al.* 1983). Juvenile indigo snakes eat mostly invertebrates (Layne and Steiner 1996).

Movements

Indigo snakes range over large areas and into various habitats throughout the year, with most activity occurring during summer and fall (Smith 1987, Moler 1985b, Speake 1993). The average range of an eastern indigo snake is 12 acres during the winter (December - April), 106 acres during late spring early summer (May - July), and 241 acres during late summer and fall (August - November) (Speake *et al.* 1978). Adult male eastern indigo snakes have larger home ranges than adult females and juveniles; their home range may encompass as much as 553 acres in the summer (Moler 1985b, Speake 1993). By contrast, a gravid female may use from 4 to 106 acres (Smith 1987). These estimates are comparable to those found by Layne and Stiener (1996) in south central Florida, who determined adult male home ranges average about 183, while adult females average about 42 acres.

Status and Distribution

Florida scrub-jay (*Aphelocoma coerulescens*)

The Florida scrub-jay is geographically isolated from other subspecies of scrub-jays found in Mexico and the Western United States. The scrub-jay is found almost exclusively in peninsular Florida, and is restricted to scrub habitat (U.S. Fish and Wildlife Service 1990). The estimated population is between 7,000 and 11,000 individuals (Breininger 1989, Fitzpatrick et al. 1991). There are three major concentrations of scrub-jays in Florida:

- Lake Wales Ridge (Polk and Highlands Counties) 1,092 breeding pairs, with 2,569 individual scrub-jays censussed in 1992-1993 (Fitzpatrick et al. 1994). Archbold Biological Station, a private research facility in Highlands County, currently contains 120 breeding pairs of scrub-jays (Glen Woolfenden, Archbold Biological Station, pers. comm., 1998), and is actively managed for that species. The Lake Wales Ridge National Wildlife Refuge has been established on the Lake Wales Ridge, and land acquisition through the state's Conservation and Recreation Lands program and purchases by The Nature Conservancy (TNC) are proceeding. Outside of existing holdings (Avon Park Bombing Range, Archbold Biological Station, Lake Arbuckle State Forest and Preserve, and Highlands Hammock State Park), over 37,000 acres of land has been purchased for conservation in the area (B. Needham, TNC, pers. comm., 1996).

- Private lands in Brevard County contain an estimated 364 breeding pairs of scrub-jays (Swain et al. 1995) and an additional 500 breeding pairs on Federal lands (see discussion below). The scrub-jays found on non-Federal lands are distributed in six spatial groups or populations which are partly to completely isolated: south Brevard (mainland between

Melbourne and the county line, 175 families), central Brevard (mainland between Melbourne and Cocoa, 50 families), north Brevard (between Cocoa and Mims, 101 families), south beaches (barrier island between Satellite Beach and Coconut Point, 10-12 families, updated per D. Breininger, pers. comm. 1998), and Cape Canaveral (16 families) and Merritt Island (3 families).

- The Ocala National Forest (ONF) contains 702 breeding pairs, with an estimate of 2,017 individual scrub-jays (Laura Lowery, ONF, pers. comm., 1996). ONF contains 200,000 acres of sand pine scrub; at any one time, 40,000 acres are suitable scrub-jay habitat in a contiguous block. The population there is considered to be secure.

Scrub has been significantly reduced by development activity and now typically occurs only in scattered and often small patches of scrub in peninsular Florida (Fitzpatrick et al. 1991). Scrub-jays are extirpated in Broward, Dade, Duval, Pinellas, and St. Johns counties, and their numbers are greatly reduced in Brevard, Highlands, Orange, Palm Beach, and Seminole counties (Cox 1984), where development activity is highest. It has been estimated that the scrub-jay population has been reduced by at least half in the last 100 years (52 FR 20719). Because of habitat loss, the species was listed as threatened in 1987. The sites most likely to be destroyed by development in the near future are concentrated in Brevard, Highlands, and Palm Beach Counties, due to accelerated residential and commercial growth.

Eastern Indigo Snake (*Drymarchon corias couperi*)

As stated earlier, the eastern indigo snake was listed based on population decline caused by habitat loss, over collection for the pet trade, and mortality from gassing gopher tortoise burrows to collect rattlesnakes (Speake and Mount 1973, Speake and McGlincy 1981). At the time of listing, the main factor in the decline of the eastern indigo snake was attributed to exploitation for the pet trade. As a result of effective law enforcement, the pressure from collectors has declined, but still remains a concern (Moler 1992).

The eastern indigo snake utilizes a majority of habitats available, but tends to prefer open, undeveloped areas (Kuntz 1977). Because of its relatively large home range, this snake is especially vulnerable to habitat loss, degradation, and fragmentation (Lawler 1977, Moler 1985b). Lawler (1977) noted that eastern indigo snake habitat had been destroyed by residential and commercial construction, agriculture, and timbering. He stated that the loss of natural habitat is increasing because of these threats in Florida and that indigo snake habitat is being lost at a rate of five percent per year. Low density residential housing is also a potential threat to the species, increasing the likelihood that the snake will be killed by property owners and domestic pets. Extensive tracts of wild land are the most important refuge for large numbers of eastern indigo snakes (Diemer and Speake 1981, Moler 1985b).

Additional human population growth will increase the risk of direct mortality of the eastern indigo snake from property owners and domestic animals. Pesticides that bioaccumulate through the

food chain may present a potential hazard to the snake as well pesticide use on crops or for forestry/silviculture would propose a pulse effect to the indigo snake (Speake 1993). Direct exposure to treated areas and secondary exposure by ingestion of contaminated prey could occur. Secondary exposure to rodentacides used to control black rats may also occur (Speake 1993) Mortality from roads is also a pulse effect on this species.

The wide distribution and territory size requirements of the eastern indigo snake makes evaluation of status and trends very difficult. We believe that activities such as collecting and gassing have been largely abated through effective enforcement and protective laws. However, despite these apparent gains in indigo snake conservation, we believe that the threats described above are acting individually and collectively against the eastern indigo snake. Though we have no quantitative data with which to evaluate trends of the eastern indigo snake in Florida, we surmise that the population as a whole is declining because of continued habitat destruction and degradation. Natural communities continue to be altered for agriculture, residential, and commercial purposes, most of which are incompatible with the habitat needs of the eastern indigo snake (Kautz 1993). Habitat destruction and alteration is probably most substantial along the coasts, Keys and high central ridges of southcentral Florida where human population growth is expected to continue to accelerate. Agricultural interests (principally citrus) continue to destroy large expanses of suitable natural habitat in south Florida.

Even with continued habitat destruction and alterations, indigo snakes will probably persist in most localities where small, fragmented pieces of natural habitat remain. Tracts of appropriate habitat of a few hundred to several thousand acres may be sufficient to support a small number of snakes. Unfortunately, we believe that current and anticipated habitat fragmentation will result in a large number of isolated, small groups of indigo snakes. Fragmented habitat patches probably cannot support a sufficient number of indigo snakes to ensure viable populations.

One of the primary reasons for listing of the species was the pressure on wild populations caused by over-collecting for the pet trade and commerce. Since the listing of the species, private collectors have engaged in a very active captive breeding program to fulfill the desires of individuals wanting specimens for personal pets. The Service controls the interstate commerce of the species via a permit program. The Service believes that this has significantly reduced the collection pressures on the species.

Analysis of the Species/Critical Habitat Likely to be Affected

The Service has identified the following broad categories of factors that ultimately affect the status and distribution of the Florida scrub-jay and eastern indigo snake in the Action Area.

Habitat Conservation - As previously reviewed above, the Service believes that upland habitats used by the Florida scrub-jay and eastern indigo snake are rapidly being converted to commercial, residential, and other uses to support a growing human population in the State of Florida.

Demographic Concerns - Small isolated populations remaining on habitat patches can be expected to continue decreasing, largely due to demographic isolation, stochastic events acting on these small populations, increased predation, increased close contact with human populations, and/or continuing degradation of nesting and foraging habitat.

Habitat Loss/Habitat Degradation - By far the most threatening issue facing the survival and recovery of the Florida scrub-jay and eastern indigo snake is habitat loss resulting from the conversion of scrub habitats to residential/commercial uses, and degradation resulting from successional processes affecting the habitat suitability of xeric oak habitats. The natural progression of this vegetative community to xeric oak hammocks, either through neglect and or lack of suitable management regimes (such as periodic prescribed burns and management of exotics) have and will result in localized extirpations of the species across the state.

Human-induced Effects - Indirect adverse effects on the Florida scrub-jay is likely to occur in populations adjacent to or near human habitations. For example, Fitzpatrick et al. (1991) noted that individual encounters between humans and Florida scrub-jays are likely to result in increased mortality rates of both juveniles and adults. Further, as remaining habitat patches are either lost or degraded, the probability of success of dispersing Florida scrub-jays to interact with adjacent territories will likely be reduced. This reduction in dispersal success will result from decreased probability that dispersing Florida scrub-jays will encounter smaller scrub patches. The exact extent of this reduction is not quantifiable; however, past studies (Breininger 1995) of a small population of scrub-jays on the barrier island of Brevard County have revealed that the species has demonstrated the abilities to disperse over longer distances as compared to Florida scrub-jays occupying optimal habitat on the Lake Wales Ridge. As fragmentation of scrub habitat continues, however, increased pressure will be placed on resident scrub-jays, by increased vehicular mortality, increased predation due to poor habitat (through increased edge effect and larger home ranges), and vegetative succession on remaining scrub patches from a lack of management activity (Fitzpatrick et al. 1991).

In addition to the habitat fragmentation factors described above, even very low density development can impact indigo snake populations, since the eastern indigo snake is wide-ranging and requires relatively large tracts of suitable habitat to persist. In situations where development occurs around this species, they are especially vulnerable to vehicles, domestic dogs, and insensitive land owners (Moler 1992).

ENVIRONMENTAL BASELINE

Action Area

Historically, wild fires maintained large contiguous areas of low, open scrub oak habitats throughout the central and coastal ridges in peninsular Florida. Human occupation over time, however, has fragmented the continuous habitat into patches, separating the existing populations

of Florida scrub-jays. Conversion of land for agricultural, residential/commercial development, and fire suppression have combined to greatly diminish the amount of available preferred habitat. Along with habitat destruction and fire suppression, the cumulative impacts of historical development has placed intense survival pressure on the Florida scrub-jays living there. Based on the 1992-93 state-wide Florida scrub-jay survey results, scrub-jays appear in three general locations in Volusia County. The numbers provided below reflect the number of scrub-jays and scrub-jay family groups within the metapopulations being described, not the total number of scrub-jays and scrub-jay groups in Volusia County.

- The northeast metapopulation occurs in Flagler and Volusia Counties. In Volusia County there are approximately 15 family groups consisting of approximately 33 individuals. This metapopulation extends from Ormond Beach, including the Peninsula State Park, and extends north of the Volusia/Flagler County line.

- The southeast metapopulation occurs in Brevard and Volusia Counties. In Volusia County there are approximately 33 family groups consisting of approximately 85 individuals. This metapopulation primarily extends from the City of Edgewater, south to the Canaveral Seashore State Park.

- The southwest metapopulation contains 58 family groups containing 139 scrub-jays. This metapopulation extends from just south of DeLand, south to about Deltona, Florida.

- The last census of Volusia County was conducted during the 1992-93 state-wide survey. This survey documented a significant decline in scrub-jay numbers when compared to the state-wide survey conducted by Cox in 1984. The Service believes that scrub-jay numbers have further declined within Volusia County due to the scrub-jay epidemic suffered during the spring/summer 1998 (D. Breininger, pers. com. 1998, R. Bowman, pers. com. 1998), unchecked residential and commercial development within the County, and continued absence of fire management.

Although, the entire southwest metapopulation would be considered one population, habitat fragmentation in some portions of this area has occurred to such a degree that some of the family groups have become surrounded by residential and commercial construction, impairing their ability to interact with other scrub-jays. The Service has determined that the Action Area for this Biological Opinion is defined as the entire southwestern metapopulation of Florida scrub-jays occurring within Volusia County.

The eastern indigo snake has not been observed on the project site; however, the project site does contain potentially suitable habitat. Because the presence of this species can go unnoticed and surveys are often inconclusive, the applicant will be covered for incidental take should the species be present.

Status of the Species in the Action Area

Quality of the Site's Scrub

The Victoria Park project site consists of overgrown, unburned scrub, of which 112.4 acres is considered occupied by Florida scrub-jays. Most of the habitat on the project site is unmanaged. However, 112.4 acres is a suitable xeric oak community dominated by a stand of semi-mature oaks in the subcanopy. The subcanopy is thick with sand live oak (*Quercus geminata*), myrtle oak (*Quercus myrtifolia*), live oak (*Quercus virginiana*), staggerbush (*Lyonia ferruginea*), and wax myrtle (*Myrica cerifera*), and the groundcover consists of broomsedge (*Andropogon virginicus*), saw palmetto (*Serenoa repens*), Yaupon holly (*Ilex vomitoria*), and juvenile subcanopy species. The rest of scrub management area consists of pine flatwood/xeric oak communities that will be managed and restored to a suitable xeric oak community. However, no active management has taken place on the project site to maintain the scrub at the appropriate successional stage.

Scrub-jay and Eastern Indigo Snake Utilization of the Site

Using aerial photography and ground truthing, Service biologists determined that 112.4 acres of the project site are currently occupied by two families (approximately five individuals in the North family and three individuals in the South family) of Florida scrub-jays. Encroachment from surrounding development on adjacent properties has reduced the amount of available habitat and increased the number of people present in the area. In its current state, the project site lacks habitat adequate for long-term support of scrub-jays (Fitzpatrick *et al.* 1991). However, the survivability of the scrub-jays on the project site is good due to the management plan that will be implemented on 110.7 acres of existing and potential scrub habitat.

As previously noted, the eastern indigo snake has not been observed on the project site; however, the project site does contain potentially suitable habitat.

Relationship of the Site to the Action Area

Based on the 1992-93 state-wide survey results, there were at least 26 families of Florida scrub-jays observed within the action area. During that same survey, 18 families were identified within one mile of the project site. The Service believes that the numbers provided by the 1992-93 state-wide survey may overstate the current population of scrub-jays within the action area due to unchecked residential and commercial development in this area since this survey was conducted, continued habitat fragmentation, and a possible disease epidemic during the spring/summer 1998 (D. Breininger, pers. comm. 1998, R. Bowman, pers. comm. 1998).

By restoring and managing the scrub habitat on-site the accompanying scrub-jay family should be able to continue to occupy and increase their territory into the restored scrub habitat. This should prolong the potential fitness of the metapopulation of which they are a part.

Factors affecting species environment within the action area

Additional habitat losses are expected to occur within the Action area as a result of commercial and residential development; however, the Service is currently in consultation with Volusia County to establish procedures to ensure that scrub habitat is not being indiscriminately impacted and that County and local municipalities are in compliance with the Act, with regard to Florida scrub-jays.

EFFECTS OF THE ACTION

This section includes an analysis of the direct and indirect effects of the proposed action on the species and critical habitat and its interrelated and interdependent activities. To determine whether the proposed action is likely to jeopardize the continued existence of threatened or endangered species in the action area, we focus on consequences of the proposed action that affect rates of birth, death, immigration, and emigration because the probability of extinction in plant and animal populations is most sensitive to changes in these rates.

Factors to be considered

Loss of habitat is one of the primary threats to the scrub-jay population in Volusia County. The proposed residential and commercial development will result in the direct, permanent loss of 55.3 acres of the 112.4 acres of on-site habitat occupied by two families of scrub-jays and any eastern indigo snakes. The proposed project includes a scrub management area that will provide 110.7 acres of scrub habitat that will be restored and managed, in long term, to two scrub-jay territory. The management area is composed of 57.1 acres of occupied habitat and 53.6 acres of presently unoccupied habitat.

Another significant threat to scrub-jays recovery is fire suppression and/or lack of management in scrub habitat (D. Breininger pers. comm.). Mechanical techniques will be used once the permits are obtained and then prescribed burns of the first management units (MU) will be completed. The burn cycle will avoid burning during the nesting season to avoid interference with the nesting and foraging requirements of the scrub-jays. The affected scrub-jay group will hopefully move into the current unoccupied scrub habitat that will be restored in the conservation area. This will provide additional habitat within the action area. The scrub management area will be managed by both mechanical and fire management actions. An annual monitoring program for the management area will assess the success of the restoration and management treatments.

During the construction phase of the project, the potential exists for scrub-jays to be injured or killed and for nests and eggs to be destroyed by site clearing and heavy equipment. Post construction human-related affects include predation by domestic cats and encroachment of exotic/ornamental vegetation into the preserved or adjacent land.

CUMULATIVE EFFECTS

Cumulative effects include the affects of future State, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act. The Service considered cumulative effects with respect to this project and determined they do not apply.

CONCLUSION

This project will result in the loss of 55.3 acres of occupied Florida scrub-jay habitat. In order to minimize the adverse effects, the applicant proposed to preserve 110.7 acres of on-site scrub habitat that will be restored and managed, in long term, to provide habitat for two families of scrub-jays. The Service has reviewed the best available scientific and commercial information, the current status of the Florida scrub-jay and eastern indigo snake, the environmental baseline for the action, the affects of the proposed action, and cumulative effects. Based upon this information, it is the Service's biological opinion that the above-reviewed adverse effects of the proposed project to the scrub-jay and eastern indigo snake are not likely to jeopardize the continued existence of the Florida scrub-jay or eastern indigo snake. No critical habitat has been designated for these species, therefore, none will be affected.

INCIDENTAL TAKE

Sections 4(d) and 9 of the Act, as amended, prohibit taking (harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect or to attempt to engage in any such conduct) of listed species of fish or wildlife without a special exemption. "Harm" and "harass" are further defined in Service regulations (50 CFR 17.3). "Harm" is defined to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing behavioral patterns such as breeding, feeding, or sheltering. "Harass" is defined as an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns, which include, but are not limited to, breeding, feeding or sheltering.

Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, in order for the exemption in section 7(o)(2) to apply.

The Federal agency has a continuing responsibility to regulate the activity that is covered by this incidental take statement. If the agency (1) fails to require the applicant to adhere to the terms and

conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

The Service has reviewed the biological information for this species, information presented by the applicant's consultants, and other available information relevant to this action, and based on our review, incidental take, in the form of harm or harassment, is anticipated for the two families of Florida scrub-jays and any eastern indigo snakes on the project site. If during the course of this action, this level of take is exceeded, such take would represent new information requiring review of the reasonable and prudent measures provided. The Federal agency must immediately provide an explanation of the cause of the taking and review with the Service the need for possible modification of the reasonable and prudent measures.

Effect of the Take

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

Reasonable and Prudent Measures

When providing an incidental take statement the Service is required to give reasonable and prudent measures it considers necessary or appropriate to minimize the take along with terms and conditions that must be complied with, to implement the reasonable and prudent measures. Furthermore, the Service must also specify procedures to be used to handle or dispose of any individuals taken. The Service believes the following reasonable and prudent measures are necessary and appropriate to reduce take:

Florida scrub-jay

1. The applicant should avoid the potential of Florida scrub-jays to be injured or killed by heavy equipment. Also avoid the destruction of active scrub-jay nest, with or without eggs.

2. Designation of a 110.7 acre scrub conservation area, containing scrub habitat that will be restored and managed, long term, to provide scrub habitat to two Florida scrub-jay territories.

3. A annual monitoring program should take place on the management area to assess the success of the proposed habitat restoration and management techniques.

4. The on-site conservation area should be placed in a conservation easement and the integrity of the preserve habitat protected.

5. The Service should be notified of any unauthorized take of Florida scrub-jays.

Eastern Indigo Snake

1. The applicant should avoid the potential of eastern indigo snakes to be injured or killed by heavy equipment. This can be avoided by following the standard protection measures for the indigo snake.

2. Only individuals with permits should attempt to capture the eastern indigo snakes.

3. If eastern indigo is held in captivity it should be released as soon as possible in release sites.

4. Appropriate monitoring should occur.

Terms and Conditions

To implement the above reasonable and prudent measure, the Service has outlined the following terms and conditions for incidental take. In accordance with the Interagency Cooperation Regulation (50 CFR 402), these terms and conditions must be complied with to implement the reasonable and prudent measure(s) for incidental take:

Florida scrub-jay

1a. No clearing of vegetation within and immediately adjacent to occupied territory on the project site will take place during the Florida scrub-jay nesting season (typically March 1 through June 30), removing the potential to destroy active nests and kill or injure nestlings. Scrub-jays are also less likely to display territorial/nest defense behavior during the non-nesting season and therefore more likely to stay away from heavy equipment within their territory.

1b. Mechanical and fire management can take place in the occupied territory during the scrub-jay nesting season, however the management area should be carefully inspected to locate any active nests and protect the nests from any kind of management that may occur to prevent "take" of scrub-jays.

2. The scrub management area will be restored and managed, long term, through mechanically thinning of the pine canopy by logging operations and clearing groundcover for open space. This will be followed by prescribed burn as detailed

in Management plan for the proposed project, submitted by the applicant on December 15, 1999.

3. A comprehensive monitoring program for the scrub management area will be implemented annually for five years to determine the distribution and status of the resident Florida scrub-jay populations and evaluate their responses to the vegetative communities after mechanical and fire management treatments have been applied.

4. The scrub conservation area is to be placed in a conservation easement and be maintained, in long term, as a natural area in perpetuity.

5. If a dead Florida scrub-jay is found on the project site, the specimen should be thoroughly soaked in water and frozen, and the applicant should notify the Jacksonville Field Office immediately, at 904-232-2580.

Eastern Indigo Snake

1. An eastern indigo snake protection/education plan shall be developed by the applicant 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 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, then frozen.

2. Only an individual who has been either authorized by a section 10(a)(1)(A) permit issued by the Service, or designated as an agent of the State of Florida by the Florida Fish and Wildlife Conservation Commission for such activities, is permitted to come in contact with or relocate an eastern indigo snake.

3. If necessary, eastern indigo snakes shall be held in captivity only long enough to transport them to a release site; at no time shall two snakes be kept in the same

container during transportation.

4. 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;
b. summaries of any relocated snakes if relocation was approved for the project (*e.g.*, locations of where and when they were found and relocated);
c. other obligations required by the Florida Fish and Wildlife Conservation Commission, as stipulated in the permit.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purpose of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. If the scrub management area is to be used for passive recreation (foot trails) signs should be placed at the entrance of the trails to inform and educate the residents of the primary purpose of the scrub management area, to protect the Florida scrub-jays and eastern indigo snake. This information should include how human-related disturbances such as domestic pets (particularly cats) and invasive exotic/ornamental vegetation has adverse affects on the scrub-jays. Also, signs explaining the fire management and what kind of benefits prescribed fires have on the habitat and in controlling wildfires.

2. If foot trails are to be placed in the scrub management area they should be left in the sandy state, not packed with clay or mulched.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation measures.

REINITIATION OF SECTION 7 CONSULTATION

This concludes formal consultation on the actions outlined in the request. As provided in 50 CFR §402.16, reinitiation of formal consultation is required when discretionary Federal agency involvement or control over the action has been retained and if: (1) New information reveals effects of the agency action that may effect listed species or critical habitat in a manner or to an extent not considered in this biological opinion, (2) the Corps' action is subsequently modified in

a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion, or (3) a new species is listed or critical habitat designated that may be effected by the action.

Sincerely,

/s/ PMB

For David L. Hankla
Field Supervisor

bcc: Ms. Barbara Samler
2033 Penncrest Ct.
Deland, FL 32724

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Literature Cited

Ashton, R.E. and P.S. Ashton. 1981. Handbook of Reptiles and Amphibians of Florida. Windward Publishing, Inc., Miami, FL. 176 pp.

Bancroft, G.T., and G.E. Woolfenden. 1982. The molt of scrub jays and blue jays in Florida. Ornithological Monograph Number 29. American Ornithologists' Union; Washington, D.C.

Bergen, S. 1994. Characterization of fragmentation in Florida scrub communities. Master of Science Thesis, Department of Biological Sciences, Florida Institute of Technology; Melbourne, Florida.

Breininger, D. 1989. A new population estimate for the Florida scrub jay on Merritt Island National Wildlife Refuge. Fla. Field Nat. 17:25-31.

Breininger, D. 1995. Florida scrub jay demography of an urban metapopulation along Florida's Atlantic coast. Final report submitted to U.S. Fish and Wildlife Service in fulfillment of contract. 14 pp.

Conant, R. 1975. A field guide to reptiles and amphibians of eastern and central North America. 2nd Ed. Houghton-Mifflin Co., Boston. 429 pp.

Cox, J.A. 1984. Conservation and ecology of the Florida scrub jay. Unpub. Ph.D. dissertation, University of Florida, Gainesville. 185 pp.

Cox, J.A. 1987. Status and distribution of the Florida scrub jay. Florida Ornithological Society Special Publication No. 3.

Diemer, J.E. and D. Speake. 1981. The status of the eastern indigo snake in Georgia. Pp. 52-61 in R.R. Odom and J.W. Guthrie, Ed., Proc. Nongame and End. Wildl. Symp., Georgia Dept. Nat. Res. Game and Fish Div. Tech. Bull. WL 5.

Fernald, R.T. 1989. Coastal xeric scrub communities of the Treasure Coast [legion, Florida: A summary of their distribution and ecology, with guidelines for their preservation and management. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Technical Report No. 6. Tallahassee, Florida.

Fitzpatrick, J.W., and G. E. Woolfenden. 1988. Components of lifetime reproductive success in the Florida scrub jay. Pages 305-320 in T.H. Clutton-Brock, ea., Reproductive Success. University of Chicago Press; Chicago, Illinois.

Fitzpatrick, J.W., G.E. Woolfenden, and M.T. Kopeny. 1991. Ecology and development-related habitat requirements of the Florida scrub jay (*Aphelocoma coerulescens coerulescens*). Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Technical Report No. 8. Tallahassee, FL. 49pp.

Fitzpatrick, J.W., B. Pranty, and B. Stith. 1994. Florida scrub jay statewide map, 1992-1993. Final report by Archbold Biological Station for U.S. Fish and Wildlife Service Cooperative Agreement 14-16-0004-91-950. 16 pp + appendices.

Fleischer, A.L., Jr. 1996. Pre-breeding time budgets of female Florida scrub-jays in natural and suburban habitats. Abstract, Archbold Biological Station 1996 Symposium. 12 September, 1996. Lake Placid, Florida.

Kuntz, G.C. 1977. Endangered species: Florida Indigo. Florida Naturalist:15-19.

Laessle, A.M. 1958. The origin and successional relationship of sandhill vegetation and sand-pine scrub. Ecol. Monogr. 28:36-387.

Laessle, A.M. 1968. Relationships of sand pine scrub to former shore lines. Quart. Jour. Florida Aca. Sci. 30-269-286.

McGowan, K.J., and G.E. Woolfenden. 1989. A sentinel system in the Florida scrub jay. Animal Behavior 37:1000-1006.

Lawler, H.E. 1977. The status of *Drymarchon corais couperi* (Holbrook), the eastern indigo snake, in the southeastern United States. Herp. Rev. 8(3):76-79.

McGowan, K.J., and G.E. Woolfenden. 1990. Contributions to fledgling feeding in the Florida scrub-jay. Journal of Animal Ecology 59:691-707.

Moler, P.E. 1985. Distribution of the eastern indigo snake, *Drymarchon corais couperi*, in Florida. Herp. Review 16(2):37-38.

Moler, P.E. 1986. Home range and seasonal activity of the eastern indigo snake, *Drymarchon corais couperi*, in northern Florida. Final Performance Report, Study E-1-06, III-A-5. Florida Game and Fresh Water Fish Comm., Tallahassee. 17pp.

Mumme, R.L. 1992. Do helpers increase reproductive success? An experimental analysis in the Florida scrub jay. Behavioral Ecology and Sociobiology 31:319-328.

Schaub, R., R.L. Mumme, and G.E. Woolfenden. 1992. Predation on the eggs and nestlings of Florida scrub jays. Auk. 109:585-593.

Smith, C.R. 1987. Ecology of juvenile and gravid eastern indigo snakes in north Florida. Unpublished MS thesis, Auburn Univ., Alabama. 129pp.

Sprunt, A., Jr. 1946. In Ben, A.C. (ed.) Life histories of North American jays, crows and titmice, part 1. U.S. Nat. Mus. Bull. 171:77-88.

Stallcup, J.A., and G.E. Woolfenden. 1978. Family status and contribution to breeding by Florida scrub jays. Animal Behavior 26: 1144- 1156.

Stith, B.M., J.W. Fitzpatrick, G.E. Woolfenden, and B. Pranty. 1996. Classification and conservation of metapopulations: a case study of the Florida scrub-jay. Pages 187-215 in Metepopulations and wildlife conservation. Island Press; Washington, D.C.

Swain, H., P. Schmalzer, D. Breininger, K. Root, S. Boyle, S. Bergen, and S. MacCaffree. 1995. Scrub conservation and development plan, Brevard County, Appendix B, Biological consultant's report draft, dated August 14, 1995. Department of Biological Sciences, Florida Institute of Technology, Melbourne, FL.

Thaxton, J.E. and T.M. Hingtgen. 1994. Responses of Florida scrub-jays to management of previously occupied habitat. District 4 Annual Research Report, Florida Park Service.

Toland, B.R. 1991. Nest site characteristics of a Florida scrub jay population in Indian River County. Abstract. Florida scrub jay Workshop. May 23, 1991. Ormond Beach, Florida.

U.S. Fish and Wildlife Service. 1982. Eastern indigo snake recovery plan. Atlanta, Ga. 23pp.

U.S. Fish and Wildlife Service. 1990. Recovery Plan for the Florida Scrub Jay, U.S. Fish and Wildlife Service, Atlanta, Georgia. 23 pp.

Woolfenden, G.E. 1974. Nesting and survival in a population of Florida scrub jays. Living Bird 12:25-49.

Woolfenden, G.E. 1975. Florida scrub jay helpers at the nest. Auk 92:1-15.

Woolfenden, G.E. 1978. Growth and survival of young Florida scrub-jays. Wilson Bulletin 90:1-1X.

Woolfenden, G.E., and J.W. Fitzpatrick. 1977. Dominance in the Florida scrub jay. Condor 79: 1-12.

Woolfenden, G.E., and J.W. Fitzpatrick. 1978. The inheritance of territory in group-breeding birds. BioScience 28:104-108.

Woolfenden, G.E., and J.W. Fitzpatrick. 1984. The Florida scrub jay: demography of a cooperative-breeding bird. Princeton University Press, Princeton, New Jersey.

Woolfenden, G.E., and J.W. Fitzpatrick. 1986. Sexual asymmetries in the life histories of the Florida scrub jay. Pages 97-107 *in* D. Rubenstrin and R.W. Wrangham, eds. Ecological aspects of social evolution: birds and mammals. Princeton University Press, Princeton, New Jersey.

Woolfenden, G.E., and J.W. Fitzpatrick. 1990. Florida scrub jays: A synopsis after 18 years of study. Pages 241-266 *in* P.B. Stacey, and W.B. Koenig, eds. Cooperative breeding in birds. Cambridge University Press.

Woolfenden, G.E. and J.W. Fitzpatrick. 1996a. Florida scrub jay. Pages 267-280 in J.A. Rodgers, H. W. Kale, and H. T. Smith, eds. Rare and Endangered Biota of Florida, Volume V. Birds. University Presses of Florida; Gainesville, Florida.

Woolfenden, G.E. and J.W. Fitzpatrick. 1996b. Florida scrub-jay. Pages 1-27 *in* A. Poole and F. Gill, eds. The birds of North America, No.228. The Academy of Natural Sciences, Philadelphia, and The American Ornithologists' Union; Washington, D.C.