United States Department of the Interior

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

November 6, 2014

Memorandum

To: Leopoldo Miranda, Assistant Regional Director, Ecological Services, Southeast Region

From: Donald (Bob) Progulske, Everglades Program Supervisor, South Florida Ecological Services Office

Subject: Biological and Conference Opinions for the proposed issuance of a Section 10(a)(1)(B) permit to Charlotte County for incidental take of the Florida scrub-jay and eastern indigo snake, and impacts to the Florida bonneted bat and gopher tortoise

This document transmits the Fish and Wildlife Service's (Service) biological and conference opinions based on our review of the proposed issuance of a section 10(a)(1)(B) incidental take permit (Permit) to Charlotte County Board of County Commissioners (Applicant) for construction and development permitted and/or conducted by the Applicant in buffer areas around confirmed scrub-jay observations, and scrub habitat management activities conducted or authorized by the Applicant on conservation lands in Charlotte County, Florida (Project), and its effects on the threatened Florida scrub-jay (*Aphelocoma coerulescens*) (scrub-jay), threatened eastern indigo snake (*Drymarchon corais couperi*), endangered Florida bonneted bat (*Eumops floridanus*) (FBB), and candidate gopher tortoise (*Gopherus polyphemus*) per section 7 of the Endangered Species Act of 1973, as amended (Act) (16 United States Code [U.S.C.] 1531 *et seq.*).

These Biological and Conference Opinions are based on information provided in the Applicant's Habitat Conservation Plan (HCP), letters, email correspondence, site visits, and the Service's South Florida Multi-species recovery plan (Service 1999). A complete record of this consultation is maintained and available for review at the Service's South Florida Ecological Services Office, Vero Beach, Florida.

More than three-quarters of the Project area is within the consultation area for the FBB, and the remaining one-quarter is in a focal area; however, there are no known locations of this bat in the Project area. Some bat houses in the portion of Babcock-Webb Wildlife Management Area (WMA) located in south central Charlotte County are used by the FBB, and one historic account of a FBB roost in a cavity tree near the Babcock-Webb WMA was recorded in 1979 when the tree was cut to facilitate construction on Interstate 75. Neither the historic roost tree location nor the WMA are in the Project area. Although it has not been confirmed, this species may also occur at Charlotte Harbor Preserve State Park (P. Small, personal communication 2012). Little is known about the FBB's roosting requirements; however, the occupied cavity documented in

1979 appeared to be an old red-cockaded woodpecker cavity that was later enlarged by another woodpecker before FBB occupancy. Many of these mature pine trees in the Project area, especially cavity trees, were heavily damaged or knocked down by Hurricane Charley in 2004.

The Applicant has not requested coverage for impacts to the FBB in their Permit application, but has voluntarily incorporated the minimization measure of surveying for the presence of Florida bonneted bats before conducting any habitat management activities on reserve lands that could result in damage to potential natural roost sites. If bonneted bats are discovered, the roost site will be protected by use of one or more of the following methods:

1. Conducting small preparation burns of the cluster or areas surrounding individual roost sites before conducting the larger burn.
2. Raking of fuels far enough from the trunk to prevent roost site ignition.
3. Mowing or weed-whipping to prevent roost site ignition.
4. Lightly scraping off the loose bark of living pine trees from ground to breast height to improve the effectiveness of other methods such as raking and mowing.
5. A solution of water and foaming agent applied to the base of cavity trees to protect the roost tree. Foam may be especially effective in combination with mowing or raking.
6. Dead palm fronds should not be trimmed from palm trees found to have roosting bats.
7. Conduct controlled burns carefully in areas known or suspected to be occupied by Florida bonneted bats, especially during this species' breeding seasons (January through March and June through October).

Given the low likelihood of the FBB being encountered on the Project sites and the implementation of the protection measures listed above, the Service has determined that the Project "may affect, but is not likely to adversely affect" the FBB. Critical Habitat has not yet been designated for this species, so none will be affected. The Applicant is aware that as more information pertaining to the life history and locations of the FBB is gained, or if critical habitat is designated, the HCP and associated decision documents may need to be amended to include this species in the future.

The Applicant has chosen not to include the gopher tortoise as a covered species in the HCP. Although the gopher tortoise can be reasonably expected to occur in upland areas throughout Charlotte County, the Applicant believes development impacts to the gopher tortoise will be minimized through implementation of the Florida Fish and Wildlife Conservation Commission's (FWC) *Gopher Tortoise Permitting Guidelines (Gopherus Polyphemus)* (FWC 2013). The guidelines were established to support the objectives contained in FWC's *Gopher Tortoise Management Plan* (FWC 2012):

1. Minimize the loss of gopher tortoises;
2. Increase and improve gopher tortoise habitat;
3. Enhance and restore gopher tortoise populations; and
4. Maintain the gopher tortoise's function as a keystone species.

To help achieve these objectives, the FWC's gopher tortoise permit system has been designed to provide:

1. Incentives to landowners to manage their habitat for gopher tortoises, tortoise commensals, and other native wildlife species;
2. Incentives to responsibly relocate and restock tortoises to protected, managed lands rather than unprotected sites;
3. A new permitting system that does not allow entombment of tortoises; and
4. A permitting system with regulation and enforcement sufficient to ensure compliance with FWC guidelines and rules.

The guidelines will be enforced on all proposed development parcels throughout the Project area, and the County will not issue development permits until all gopher tortoise permits from the FWC are received. Although land management activities are exempted from FWC permitting regulations, the County will ensure that direct effects will be avoided and minimized to the greatest extent feasible while conducting land management activities that will ultimately improve habitat for the species. The Applicant is aware that if the gopher tortoise is federally-listed, the HCP and associated decision documents may need to be amended to include this species in the future.

Consultation History

In June of 1991, the Service sent a letter to the Applicant informing it of the potential impacts of development on scrub-jays, interim measures that could minimize those impacts, and a recommendation that Charlotte County seek an incidental take permit to cover development activities throughout the county.

Between 1991 and 2007, Charlotte County staff worked with the Service to implement review processes to identify specific projects that, if permitted and constructed, could result in take of scrub-jays, and to refer the projects' proponents to the Service so they could apply for individual Permits.

In 2007, the Applicant applied for a section 6 Habitat Conservation Planning Grant, and the Service awarded a $260,390 to the Applicant.

From 2008 through 2012 Service staff communicated in person, by telephone, in public meetings, and through email exchanges with County staff, Quest Ecology, Incorporated (Consultant), and the Technical Advisory Committee to provide guidance and expertise during the planning and development of the HCP and mitigation options.

In May 2012, the Applicant's Permit application was certified as complete.

The Service received draft HCPs in October 2012, and March and May 2014.

On February 21, 2014, the Notice of Availability of the HCP and National Environmental Policy Act (NEPA) documents was announced in the Federal Register; the public comment period closed on April 15, 2014.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The Service proposes to issue a Permit to the Applicant under section 10(a)(1)(B) of the Act. The Permit would authorize take of the scrub-jay and eastern indigo snake incidental to Project implementation over a period of 30 years.

The Project area totals 7,552 acres, primarily in the western two-thirds of Charlotte County. The impact area contains about 3,056 acres of undeveloped lands that are located wholly or partially in scrub-jay buffers in Charlotte County (Figure 1). The 4,496-acre Reserve (Figure 2) contains: 3,160 acres of public lands currently managed for scrub-jay conservation, and 1,336 acres of private lands the Applicant would like to acquire from willing sellers or have placed under conservation easements for management as scrub habitat.

The purpose of the proposed Federal action is to authorize the incidental take of 136 families of scrub-jays (the exact number of individual scrub-jays is not known, but assuming at least 2 individuals per family, this would be a minimum of 272 individuals) and 80 individual eastern indigo snakes in connection with otherwise lawful development and subsequent permanent habitat alteration of 3,056 acres of occupied scrub-jay habitat, and scrub management activities on 4,496 acres of Reserve lands as described in the HCP. Service issuance of such an authorization must be accomplished within the statutory and regulatory framework identified in section 10 of the Act and its implementing regulations found in 50 Code of Federal Regulations §17. Further, such authorization is necessary because activities associated with the proposed action may result in take of federally listed species, despite the mitigation and minimization measures proposed by the Applicant in the HCP.

The Applicant's HCP and the Service's EA provide more detailed descriptions of the proposed action, including measures the Applicant proposes to minimize and mitigate adverse effects to scrub-jays and eastern indigo snakes. These are summarized below.

Development impact on scrub-jay groups will be minimized by limiting the take of occupied habitat during the breeding season where scrub-jays are nesting. Clearing of occupied scrub habitat will not occur during the scrub-jay nesting season (March 1 – June 30). For parcels of 3 acres or greater in size, where development will occur on 50 percent or less of the parcel, avoidance and minimization will take place where feasible. The development of parcels 3 acres or greater in size will be reviewed on a case by case basis within the context of the surrounding landscape to determine the level of feasible avoidance and minimization measures, which may take place in the form of preservation of remaining native habitat, supplemental planting of native scrub oak species where landscaping is required by the County, and the potential for conservation easements on larger parcels.

Development impacts to the eastern indigo snake will be avoided and minimized based on the implementation of the *Standard Protection Measures for the Eastern Indigo Snake (Drymarchon corais couperi)* (Service 2004; and subsequent versions as they become available). These guidelines will be enforced on all proposed development parcels throughout the Project area, and the County will provide the guidelines to all recipients of land development permits. The County will also ensure these guidelines are implemented on all of the conservation areas for which it is responsible, and whenever possible, equipment used for mechanical vegetation reduction, maintenance of fire breaks, and conducting prescribed burns will have rubber tires. Burrows will be protected and unburned stumps and occasional debris piles will be retained to provide refugia for this species during land management activities.

While some properties in the Project area may be large enough for adequate on-site mitigation, the majority of parcel owners will mitigate impacts to the covered species by contributing fees to the Applicant. The fees will be collected by the Applicant from landowners applying for County permits to develop vacant properties in the Project area. About 78.4 percent of the collected fees will be dedicated to the acquisition, restoration, and management of the proposed 1,336 acres of additional conservation lands, and may supplement scrub habitat management activities on existing County-owned conservation lands. Based on estimates of the magnitude of ongoing management costs and the expected return on investment, the Applicant will use about 21.6 percent of the collected fees to establish a non-wasting endowment to cover the costs of monitoring and managing the 1,336 acres of conservation land in perpetuity after the 30-year permit term.

The action area is defined as all areas to be affected directly or indirectly by the proposed Project and not merely the immediate area involved in the action. The proposed Projects are spread across three scrub-jay metapopulations in the western two-thirds of Charlotte County: the southern part of the Sarasota-Western Charlotte Metapopulation (M5), the Northwestern Charlotte Metapopulation (M6), and the Central Charlotte Metapopulation (M7) (Stith 1999). Accordingly, the action area for this Biological Opinion is considered the area encompassing the southern part of M5, all of M6, and all of M7 (Figure 3).

STATUS OF THE SPECIES/CRITICAL HABITAT

Florida scrub-jay

Species/critical habitat description

Scrub-jays are about 10 to 12 inches long and weigh about 3 ounces. They are similar in size and shape to blue jays (*Cyanocitta cristata*), but differ significantly in coloration (Woolfenden and Fitzpatrick 1996a). Unlike the blue jay, the scrub-jay lacks a crest. It also lacks the conspicuous white-tipped wing and tail feathers, black barring, and bridle of the blue jay. The scrub-jay's head, nape, wings, and tail are pale blue, and its body is pale gray on its back and belly. Its throat and upper breast are lightly striped and bordered by a pale blue-gray "bib" (Woolfenden and Fitzpatrick 1996a). Scrub-jay sexes are not distinguishable by plumage (Woolfenden and Fitzpatrick 1984), and males, on the average are only slightly larger than females (Woolfenden

1978). The sexes may be identified by a distinct "hiccup" call made only by females (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1986). Scrub-jays that are less than about 5 months of age are easily distinguishable from adults; their plumage is smoky gray on the head and back, and they lack the blue crown and nape of 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 done, fledgling scrub-jays may be indistinguishable from adults in the field (Woolfenden and Fitzpatrick 1984). The wide variety of vocalizations of scrub-jays is described in Woolfenden and Fitzpatrick (1996b).

Scrub-jays are in the order Passeriformes and the family Corvidae. They have been called a "superspecies complex" and described in four groups that differ in geographic distribution within the United States and Mexico: *Aphelocoma californica*, from southwestern Washington through Baja California; *A. insularis*, on Santa Cruz in the Channel Islands, California; *A. woodhousii*, from southeastern Oregon and the Rocky Mountains and Great Plains to Oaxaca, Mexico; and *A. coerulescens* in peninsular Florida (American Ornithologists' Union [AOU] 1983). Other jays of the same genus include the Mexican jay or gray-breasted jay (*A. ultramarina*) and the unicolored jay (*A. unicolor*) of Central America and southwest North America (Woolfenden and Fitzpatrick 1996b).

The Florida scrub-jay, which was originally named *Corvus coerulescens* by Bosc in 1795, was transferred to the genus *Aphelocoma* in 1851 by Cabanis. In 1858, Baird made *coerulescens* the type species for the genus, and it has been considered a subspecies (*A. c. coerulescens*) for the past several decades (AOU 1957). It recently regained recognition as a full species (Florida scrub-jay, *Aphelocoma coerulescens*) from the AOU (AOU 1995) because of genetic, morphological, and behavioral differences from other members of this group: the western scrub-jay (*A. californica)* and the island scrub-jay (*A. insularis*). The group name is retained for species in this complex; however, it is now hyphenated to "scrub-jay" (AOU 1995). From here on in the document, Florida scrub-jays will be referred to as scrub-jays.

This species account references the full species name, *A. coerulescens*, as listed in the Federal Register (Service 1987). No critical habitat has been designated for this species; therefore, none will be affected.

Life history/Population dynamics

The scrub-jay has specific habitat needs. It is endemic to peninsular Florida's ancient dune ecosystems or scrubs, which occur on well-drained to excessively well-drained sandy soils (Laessle 1958; Laessle 1968; Myers 1990). This relict oak-dominated scrub, or xeric oak scrub, is essential habitat to the scrub-jay. This community type is adapted to nutrient-poor soils, periodic drought, and frequent fires (Abrahamson 1984). Xeric (dry) oak scrub on the Lake Wales Ridge is predominantly made up of four species of stunted, low-growing oaks: sand live oak (*Quercus geminata*), Chapman oak (*Q. chapmanii*), myrtle oak (*Q. myrtifolia*), and scrub oak (*Q. inopina*) (Myers 1990). In optimal habitat for scrub-jays on the Lake Wales Ridge, these oaks are 3 to 10 feet high, interspersed with 10 to 50 percent unvegetated, sandy openings, and a

sand pine (*Pinus clausa*) canopy of less than 20 percent (Woolfenden and Fitzpatrick 1991). Trees and dense herbaceous vegetation is rare. Other vegetation noted along with the oaks includes saw palmetto (*Serenoa repens)* and scrub palmetto *(Sabal etonia*), as well as woody shrubs such as Florida rosemary (*Ceratiola ericoides*) and rusty lyonia (*Lyonia ferruginea*).

Scrub-jays occupy areas with less scrub oak cover and fewer openings on the Merritt Island-Cape Canaveral Complex and in southwest Florida than typical of xeric oak scrub habitat on the Lake Wales Ridge (Schmalzer and Hinkle 1992b; Breininger et al. 1995; Thaxton and Hingtgen 1996). The predominant communities here are oak scrub and scrubby flatwoods. Scrubby flatwoods differ from scrub by having a sparse canopy of slash pine (*Pinus elliottii*); sand pine is rare. The shrub species mentioned above are common, except for scrub oak and scrub palmetto, which are more often found on the Lake Wales Ridge. Runner oak (*Q. minima*), turkey oak (*Q. laevis*), bluejack oak (*Q. incana*), and longleaf pine (*Pinus palustris*) also have been reported. The Kennedy Space Center located in Brevard County, supports one of the largest contiguous populations of scrub-jays. Studies conducted there give good descriptions of this habitat type (Schmalzer and Hinkle 1992b).

Optimal scrub-jay habitat occurs as patches with the following attributes:

1. Ten to 50 percent of the oak scrub made up of bare sand or sparse herbaceous vegetation;
2. Greater than 50 percent of the shrub layer made up of scrub oaks;
3. A mosaic of oak scrubs that occur in optimal height (4 to 6 feet) and shorter;
4. Less than 15 percent canopy cover; and
5. Greater than 984 feet from a forest (Breininger et al. 1998).

Much potential scrub-jay habitat occurs as patches of oak scrub within a matrix of little-used habitat of saw palmetto and herbaceous swale marshes (Breininger et al. 1991, Breininger et al. 1995). These native matrix habitats supply prey for scrub-jays and habitat for other species of conservation concern. The flammability of native matrix habitats is important for spreading fires into oak scrub (Breininger et al. 1995; Breininger et al. 2002). Degradation or replacement of native matrix habitats with habitat fragments and industrial areas attract predators of scrub-jays, such as fish crows (*Corvus ossifragus*), that are rare in most regularly burned native matrix habitats (Breininger and Schmalzer 1990; Woolfenden and Fitzpatrick 1991). Matrix habitats often develop into woodlands and forests when there is a disruption of fire regimes. These woodlands and forests are not suitable for scrub-jays, decrease the habitat suitability of nearby scrub, attract predators, and further disrupt fire patterns.

Scrub-jays have a social structure that involves cooperative breeding, a trait that the other North American species of scrub-jays do not show (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1990). Scrub-jays live in families ranging from two birds (a single-mated pair) to extended families of eight adults (Woolfenden and Fitzpatrick 1984) and one to four juveniles. Fledgling scrub-jays stay with the breeding pair in their natal (birth) territory as "helpers," forming a closely-knit, cooperative family group. Prebreeding numbers are generally reduced to either a pair with no helpers or families of three or four individuals (a pair plus one or two helpers) (Woolfenden and Fitzpatrick 1996a).

Scrub-jays have a well-developed intrafamilial dominance hierarchy with breeder males most dominant, followed by helper males, breeder females, and, finally, female helpers (Woolfenden and Fitzpatrick 1977; Woolfenden and Fitzpatrick 1984). Helpers take part in sentinel duties (Woolfenden and Fitzpatrick 1984; McGowan and Woolfenden 1989), territorial defense (Woolfenden and Fitzpatrick 1984), predator-mobbing, and the feeding of both nestlings (Stallcup and Woolfenden 1978) and fledglings (Woolfenden and Fitzpatrick 1984; McGowan and Woolfenden 1990). The well-developed sentinel system involves having one individual occupying an exposed perch watching for predators or territory intruders. When a predator is seen, the sentinel scrub-jay gives a distinctive warning call (McGowan and Woolfenden 1989; McGowan and Woolfenden 1990), and all family members seek cover in dense shrub vegetation (Fitzpatrick et al. 1991).

Scrub-jay pairs occupy year-round, multipurpose territories (Woolfenden and Fitzpatrick 1978; Woolfenden and Fitzpatrick 1984; Fitzpatrick et al. 1991). Territory size averages 22 to 25 acres (Woolfenden and Fitzpatrick 1990; Fitzpatrick et al. 1991), with a minimum size of about 12 acres (Woolfenden and Fitzpatrick 1984; Fitzpatrick et al. 1991). The availability of territories is a limiting factor for scrub-jay populations (Woolfenden and Fitzpatrick 1984). Because of this limitation, nonbreeding adult males may stay at the natal territory as helpers for up to 6 years, waiting for either a mate or territory to become available (Woolfenden and Fitzpatrick 1984). Scrub-jays may become breeders in several ways:

1. By replacing a lost breeder on a non-natal territory (Woolfenden and Fitzpatrick 1984);
2. Through "territorial budding," where a helper male becomes a breeder in a segment of its natal territory (Woolfenden and Fitzpatrick 1978);
3. By inheriting a natal territory following the death of a breeder;
4. By establishing a new territory between existing territories (Woolfenden and Fitzpatrick 1984); or
5. Through "adoption" of an unrelated helper by a neighboring family followed by resident mate replacement (Woolfenden and Fitzpatrick 1984). Territories also can be created by restoring habitat through effective habitat management efforts in areas that are overgrown (Thaxton and Hingtgen 1994).

To become a breeder, a scrub-jay must find a territory and a mate. Evidence presented by Woolfenden and Fitzpatrick (1984) suggests that scrub-jays are monogamous. The pair retains ownership and sole breeding privileges in its particular 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 sight of other scrub-jays (Woolfenden and Fitzpatrick 1984). These authors also reported never observing copulation between unpaired scrub-jays or courtship behavior between a female and a scrub-jay other than her mate. Age at first breeding in the scrub-jay varies from 1 to 7 years, although most individuals become breeders between 2 and 4 years of age (Fitzpatrick and Woolfenden 1988). Persistent breeding populations of scrub-jays exist only where there are scrub oaks in sufficient quantity and form to provide an ample winter acorn supply, cover from predators, and nest sites during the spring (Woolfenden and Fitzpatrick 1996b).

Scrub-jay nests are typically constructed in shrubby oaks, at a height of 1.6 to 8.2 feet (Woolfenden 1974). Sand live oak and scrub oak are the preferred shrubs on the Lake Wales Ridge (Woolfenden and Fitzpatrick 1996b), and myrtle oak is favored on the Atlantic Coastal Ridge (Toland 1991) and southern Gulf coast (Thaxton 1998). In suburban areas, scrub-jays nest in the same evergreen oak species as well as in introduced or exotic trees; however, they build their nests in a significantly higher position in these oaks than when in natural scrub habitat (Bowman et al. 1996). Scrub-jay nests are an open cup, about 7 to 8 inches outside diameter and 3 to 4 inches inside diameter. The outer basket is bulky and built of coarse twigs from oaks and other vegetation, and the inside is lined with tightly wound palmetto or cabbage palm (*Sabal palmetto*) fibers. There is no foreign material as may be present in a blue jay nest (Woolfenden and Fitzpatrick 1996b).

Nesting is synchronous, normally occurring from March 1 through June 30 (Woolfenden and Fitzpatrick 1984). On the Atlantic Coastal Ridge and southern Gulf coast, nesting may be protracted through the end of July. In suburban habitats, nesting is consistently started earlier (March) than in natural scrub habitat (Fleischer 1996), although the reason for this is unknown.

Clutch size ranges from one to five eggs, but is typically three or four eggs (Woolfenden and Fitzpatrick 1990). Clutch size is generally larger in suburban habitats, and the birds try to rear more broods per year (Fleischer 1996). Double brooding by as much as 20 percent has been documented on the Atlantic Coastal Ridge and in suburban habitat within the southern Gulf coast, compared to about 2 percent on the Lake Wales Ridge (Thaxton 1998). Scrub-jay eggs measure 1.1 inches in length by 0.8 inch in breadth (Woolfenden and Fitzpatrick 1996b), and coloration "varies from pea green to pale glaucous green... blotched and spotted with irregularly shaped markings of cinnamon rufous and vinaceous cinnamon, these being generally heaviest about the larger end" (Bendire 1895). Eggs are incubated for 17 to 19 days (Woolfenden 1974), and fledging occurs 15 to 21 days after hatching (Woolfenden 1978). Only the breeding female incubates and broods eggs and nestlings (Woolfenden and Fitzpatrick 1984). Average production of young is two fledglings per pair, per year (Woolfenden and Fitzpatrick 1990; Fitzpatrick et al. 1991), and the presence of helpers improves fledging success (Woolfenden and Fitzpatrick 1990; Mumme 1992). Annual productivity must average at least two young fledged per pair for a population of scrub-jays to support long-term stability (Fitzpatrick et al. 1991).

Fledglings depend upon adults for food for about ten weeks, during which time they are fed by both breeders and helpers (Woolfenden 1975; McGowan and Woolfenden 1990). Survival of scrub-jay fledglings to yearling age class averages about 35 percent in optimal scrub; while annual survival of both adult males and females averages around 80 percent (Woolfenden and Fitzpatrick 1996b). Data from Archbold Biological Station, however, suggest survival and reproductive success of scrub-jays in suboptimal habitat is lower (Woolfenden and Fitzpatrick 1991). These data help explain why local populations inhabiting unburned, late successional habitats become extirpated. Similarly, data from Indian River County show mean annual productivity declines significantly in suburban areas where Toland (1991) reported productivity averaged 2.2 young fledged per pair in contiguous optimal scrub, 1.8 young fledged per pair in fragmented moderately-developed scrub, and 1.2 young per pair fledged in very fragmented suboptimal scrub. The longest observed lifespan of a scrub-jay is 15.5 years at Archbold Biological Station in Highlands County (Woolfenden and Fitzpatrick 1996b).

Scrub-jays are nonmigratory and permanently territorial. Juveniles stay in their natal territory for up to 6 years before dispersing to become breeders (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1986). Once scrub-jays pair and become breeders, generally within two territories of their natal area, they stay on their breeding territory until death. In suitable habitat, fewer than 5 percent of scrub-jays disperse more than 5 miles (Fitzpatrick et al. unpublished data). All documented long-distance dispersals have been in unsuitable habitat such as woodland, pasture, or suburban plantations. Scrub-jay dispersal behavior is affected by the intervening land uses. Protected scrub habitats will most effectively sustain scrub-jay populations if they are located within surrounding habitat types that can be used and traversed by scrub-jays. Brushy pastures, scrubby corridors along railway and road rights-of-way, and open burned flatwoods offer links for colonization among scrub-jay populations. Stith et al. (1996) believe that a dispersal distance of 5 miles is close to the biological maximum for scrub-jays.

Scrub-jays forage mostly on or near the ground, often along the edges of natural or man-made openings. They visually search for food by hopping or running along the ground beneath the scrub or by jumping from shrub to shrub. Insects, particularly orthopterans (*e.g.*, locusts, crickets, grasshoppers, beetles) and lepidopteran (*e.g.,* butterfly and moth) larvae form most of the animal diet throughout most of the year (Woolfenden and Fitzpatrick 1984). Small vertebrates are eaten when encountered, including frogs and toads (*Hyla femoralis*, *H. squirella,* rarely *Bufo quercicus,* and unidentified tadpoles, lizards (*Anolis carolinensis*, *Cnemidophorus sexlineatus*, *Sceloporus woodi*, *Eumeces inexpectatus*, *Neoseps reynoldsi*, *Ophisaurus compressus*, *O. ventralis*), small snakes (*Thamnophis sauritus*, *Opheodrys aestivus*, *Diadophis punctatus*), small rodents (cotton rat [*Sigmodon hispidus*], *Peromyscus polionotus*, black rat [*Rattus rattus*] young), downy chicks of the bobwhite (*Colinus virginianus*), and fledgling common yellowthroat (*Geothlypis trichas*). In suburban areas, scrub-jays will accept supplemental foods once the scrub-jays have learned about them (Woolfenden and Fitzpatrick 1984).

Acorns are the principal plant food (Woolfenden and Fitzpatrick 1984; Fitzpatrick et al. 1991). From August to November each year, scrub-jays may harvest and cache 6,500 to 8,000 oak (*Quercus* spp.) acorns throughout their territory. Acorns are typically buried beneath the surface of bare sand patches in the scrub during fall, and retrieved and consumed year-round, though most are consumed in fall and winter (DeGange et al. 1989). On the Atlantic Coastal Ridge, acorns are often cached in pine trees, either in forks of branches, in distal pine boughs, under bark, or on epiphytic plants, between 1 to 30 feet in height. Other small nuts, fruits, and seeds also are eaten (Woolfenden and Fitzpatrick 1984).

Many scrub-jays occur in habitat conditions where their long-term persistence is doubtful, although their persistence in these areas can occur for many years (Swain et al. 1995; Stith et al. 1996; Root 1998; Breininger et al. 2001). A primary cause for scrub-jay decline is poor demographic success associated with reductions in fire frequency (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1991; Schaub et al. 1992; Stith et al. 1996; Breininger et al. 1999). The reduction in fire frequency is associated with increases in shrub height, decreases in open space, increases in tree densities, and the replacement of scrub and marshes by forests (Duncan and Breininger 1998; Schmalzer and Boyle 1998; Duncan et al. 1999). These habitat trajectories result in declines in habitat use and demographic success (Woolfenden and

Fitzpatrick 1984; Woolfenden and Fitzpatrick 1991). As a result, mean family size declines, and eventually the number of breeding pairs can decline by 50 percent every 5 to 10 years (Woolfenden and Fitzpatrick 1991; Breininger et al. 1999; Breininger et al. 2001).

Status and distribution

The scrub-jay was federally listed as threatened in 1987 primarily because of habitat fragmentation, degradation, and loss (Service 1987). Historically, oak scrub occurred as numerous isolated patches in peninsular Florida. These patches were concentrated along both the Atlantic and Gulf coasts and on the central ridges of the peninsula (Davis 1967). Probably until as recently as the 1950s, scrub-jay populations occurred in the scrub habitats of 39 of the 40 counties south of, and including Levy, Gilchrist, Alachua, Clay, and Duval Counties. Historically, most of these counties would have contained hundreds or even thousands of breeding pairs (Fitzpatrick et al. 1994). Only the southernmost county, Monroe, lacked scrub-jays (Woolfenden and Fitzpatrick 1996a). Although scrub-jay numbers probably began to decline when European settlement began in Florida (Cox 1987), the decline was first noted in the literature by Byrd (1928). After 40 years of personal observation of the Etonia scrub (now known as Ocala National Forest), Webber (1935) observed many changes to the previously-undisturbed scrub habitat found there, noting that "The advent of man has created a new environmental complex."

A statewide scrub-jay census was last conducted in 1992 and 1993, at which time there were an estimated 4,000 pairs of scrub-jays left in Florida (Fitzpatrick et al. 1994). At that time, the scrub-jay was considered extirpated in ten counties (Alachua, Broward, Clay, Duval, Gilchrist, Hernando, Hendry, Pinellas, and St. Johns), and were considered functionally extinct in an additional five counties (Flagler, Hardee, Levy, Orange, and Putnam), where 10 or fewer pairs remained. Recent information indicates there are at least 12 to 14 breeding pairs of scrub-jays located within Levy County, higher than previously thought (Miller 2004), and there is at least one breeding pair of scrub-jays remaining in Clay County (Miller 2004). A scrub-jay has been documented in St. Johns County as recently as 2003 (Miller 2003). Populations are close to becoming extirpated in Gulf coast counties (from Levy south to Collier) (Woolfenden and Fitzpatrick 1996a). In 1992 and 1993, population numbers in 21 of the counties were below 30 or fewer breeding pairs (Fitzpatrick et al. 1994). Based on the amount of destroyed scrub habitat, scrub-jay population loss along the Lake Wales Ridge is 80 percent or more since pre-European settlement (Fitzpatrick et al. 1991). Since the early 1980s, Fitzpatrick et al. (1994) estimated in the northern third of the species' range, the scrub-jay has declined somewhere between 25 and 50 percent. The species may have declined by as much as 25 to 50 percent in the last decade alone (Stith et al. 1996).

On protected lands, scrub-jays have continued to decline due to inadequate habitat management (Stith 1999; Boughton and Bowman 2011). However, over the last several years, steps to reverse this decline have occurred, and management of scrub habitat is continuing in many areas of Florida (Hastie and Eckl 1999; Stith 1999; The Nature Conservancy 2001; Turner et al. 2006). If the decline can be reversed, managed lands have the potential to support about twice the number of scrub-jay groups as in 2009-2010 (Boughton and Bowman 2011).

Stith (1999) used a spatially explicit individual-based population model developed specifically for the scrub-jay to complete a metapopulation viability analysis of the species. The species' range was divided into 21 metapopulations demographically isolated from each other. Metapopulations are defined as collections of relatively discrete demographic populations distributed over the landscape; these populations are connected within the metapopulations through dispersal or migration (Hanski and Gilpin 1991). A series of simulations were run for each of the 21 metapopulations based on different scenarios of reserve design ranging from the minimal configuration consisting of only currently protected patches of scrub (no acquisition option) to the maximum configuration, where all remaining significant scrub patches were acquired for protection (complete acquisition option) (Stith 1999). The assumption was made that all areas that were protected were also restored and properly managed.

Results from Stith's (1999) simulation model included estimates of extinction, quasi-extinction (the probability of a scrub-jay metapopulation falling below 10 pairs), and percent population decline. These were then used to rank the different statewide metapopulations by vulnerability. The model predicted that five metapopulations (Northeast Lake, Martin, Merritt Island, Ocala National Forest, and Lake Wales Ridge) have low risk of quasi-extinction. Two of the five (Martin and Northeast Lake), however, experienced significant population declines under the "no acquisition" option; the probability for survival of both of these metapopulations could be improved with more acquisitions.

Eleven of the remaining 21 metapopulations were shown to be highly vulnerable to quasi-extinction if no more habitat were acquired (Central Brevard, North Brevard, Central Charlotte, Northwest Charlotte, Citrus, Lee, Levy, Manatee, Pasco, Saint Lucie, and West Volusia). The model predicted that the risk of quasi-extinction would be greatly reduced for 7 of the 11 metapopulations (Central Brevard, North Brevard, Central Charlotte, Northwest Charlotte, Levy, Saint Lucie, and West Volusia) by acquiring all or most of the remaining scrub habitat. The model predicted that the remaining four metapopulations (Citrus, Lee, Manatee, and Pasco) would moderately benefit if more acquisitions were made.

Stith (1999) classified two metapopulations (South Brevard and Sarasota) as moderately vulnerable with a moderate potential for improvement; they both had one or more fairly stable subpopulations of scrub-jays under protection, but the model predicted population declines. The rest of the metapopulations could collapse without further acquisitions, making the protected subpopulations there vulnerable to epidemics or other catastrophes.

Three of the metapopulations evaluated by Stith (1999) (Flagler, Central Lake, and South Palm Beach) were classified as highly vulnerable to quasi-extinction and had low potential for improvement, since little or no habitat is available to acquire or restore.

Current threats

Research and monitoring of scrub-jays has revealed more information about threats to this species since the time the scrub-jay recovery plan was approved in 1990 (Service 1990). The following discussion is intended to give an up-to-date analysis:

Present or threatened destruction/modification/curtailment of habitat or range

Scrub habitats have continued to decline throughout peninsular Florida since listing occurred, and habitat destruction continues to be one of the main threats to the scrub-jay. Cox (1987) noted local extirpations and major decreases in numbers of scrub-jays and attributed them to the clearing of scrub for housing and citrus groves. Eighty percent or more of the scrub habitats have been destroyed along the Lake Wales Ridge since pre-European settlement (Fitzpatrick et al. 1991; Turner et al. 2006). Fernald (1989), Fitzpatrick et al. (1991), and Woolfenden and Fitzpatrick (1996a) noted habitat losses due to agriculture, silviculture, and commercial and residential development have continued to play a role in the decline in numbers of scrub-jays throughout the State. Statewide, estimates of scrub habitat loss range from 70 to 90 percent (Woolfenden and Fitzpatrick 1996a). Various populations of scrub-jays within the species' range have been monitored closely, and more precise estimates of habitat loss in these locations are available (Snodgrass et al. 1993; Thaxton and Hingtgen 1996).

Toland (1999) estimated about 70 to 78 percent of pre-European settlement scrub habitats had been converted to other uses in Brevard County. This is due mainly to development activity and citrus conversion, which were the most important factors that contributed to the scrub-jay decline between 1940 and 1990. A total of only 10,656 acres of scrub and scrubby flatwoods remain in Brevard County (excluding Federal ownership), of which only 1,600 acres (15 percent) is in public ownership for the purposes of conservation. Less than 1,977 acres of an estimated pre-European settlement of 14,826 acres of scrubby flatwoods habitat remain in Sarasota County, mostly occurring in patches averaging less than 2.5 acres in size (Thaxton and Hingtgen 1996). Only 10,673 acres of viable coastal scrub and scrubby flatwoods remained in the Treasure Coast region of Florida (Indian River, Saint Lucie, Martin, and Palm Beach Counties) according to Fernald (1989). He estimated that 95 percent of scrub had already been destroyed for development purposes in Palm Beach County.

Habitat destruction not only reduces the amount of area scrub-jays can occupy, but may also increase fragmentation of habitat. As more scrub habitat is altered, the habitat is cut into smaller and smaller pieces, separated from other patches by larger distances; such fragmentation increases the probability of inbreeding and genetic isolation, which is likely to increase extinction probability (Fitzpatrick et al. 1991; Woolfenden and Fitzpatrick 1991; Stith et al. 1996; Thaxton and Hingtgen 1996). Dispersal distances of scrub-jays in fragmented habitat are further than in optimal unfragmented habitats, and demographic success is poor (Thaxton and Hingtgen 1996; Breininger 1999).

Disease and predation

Most scrub-jay mortality probably is from predation (Woolfenden and Fitzpatrick 1996b). The second most frequent cause may be disease, or predation on disease-weakened scrub-jays (Woolfenden and Fitzpatrick 1996b). Known predators of scrub-jays are listed by Woolfenden and Fitzpatrick (1990), Fitzpatrick et al. (1991), Schaub et al. (1992), Woolfenden and Fitzpatrick (1996a, 1996b), Breininger (1999), and Miller (2004); the list includes eastern coachwhip (*Masticophis flagellum*, known to eat adults, nestlings, and fledglings), eastern indigo

snake (*Drymarchon corais couperi*, known to eat adults and fledglings), black racer (*Coluber constrictor*, known to eat eggs), pine snake (*Pituophis melanoleucus*), and corn snake (*Elaphe guttata*). Mammalian predators include bobcats (*Lynx rufus*), raccoons (*Procyon lotor*), sometimes cotton rats (known to eat eggs), black rats, and domestic cats (*Felis catus*, known to eat adults). Franzreb and Puschock (2004) also have documented spotted skunks (*Spilogale putorius*) and grey fox (*Urocyon cinereoargenteus*) as mammalian predators of scrub-jay nests. Fitzpatrick et al. (1991) postulated that populations of domestic cats are able to eliminate small populations of scrub-jays. Avian nest predators include the great horned owl (*Bubo virginianus*), eastern screech-owl (*Otus asio*), red-tailed hawk (*Buteo jamaicensis*), northern harrier (*Circus cyaneus*), fish crow, boat-tailed grackle (*Quiscalus major*), common grackle (*Q. quiscula*), American crow (*Corvus brachyrhynchos*), blue jay, and swallow-tailed kites (*Elanoides forficatus*).

Fitzpatrick et al. (1991) reported overgrown scrub habitats are often occupied by the blue jay, which may be one factor limiting scrub-jay populations in such areas. Raptors which seem to be important predators of adult scrub-jays are merlin (*Falco columbarius*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*A. cooperii*), and northern harrier. During migration and winter, these four raptor species are present in areas which contain scrub habitat, and scrub-jays may experience frequent confrontations (as many as one pursuit a day) with them (Woolfenden and Fitzpatrick 1990). In coastal scrub, Woolfenden and Fitzpatrick (1996b) report that scrub-jays are vulnerable to predation by raptors in October, March, and April, when high densities of migrating accipiters and falcons are present. Woolfenden and Fitzpatrick (1996b) and Toland (1999) suggest that in overgrown scrub habitats, hunting efficiency for scrub-jay predators is increased. Bowman and Averill (1993) noted scrub-jays occupying fragments of scrub found in or near housing developments were more prone to predation by free-roaming cats and competition from blue jays and mockingbirds. Woolfenden and Fitzpatrick (1996a, 1996b) stated proximity to housing developments (and increased exposure to free-roaming cats) needs to be taken into consideration when designing scrub preserves. Young scrub-jays are especially vulnerable to ground predators (*e.g.*, snakes and mammals) before they are fully capable of sustained flight.

The scrub-jay hosts two protozoan blood parasites (*Plasmodium cathemerium* and *Haemoproteus danilewskyi*), but incidence is low (Woolfenden and Fitzpatrick 1996b). Several scrub-jays sick from these two agents in March 1992 survived to become breeders. The scrub-jay carries at least three types of mosquito-borne encephalitis (Saint Louis, eastern equine, and "Highlands jay") (Woolfenden and Fitzpatrick 1996b). Of particular concern is the arrival of West Nile virus (the agent of another type of encephalitis) in Florida during 2001 (Stark and Kazanis 2001); since corvids have been particularly susceptible to the disease in states north of Florida, it is expected that scrub-jays will be affected (Breininger et al. 2003).

Woolfenden and Fitzpatrick (1996b) noted three episodes of elevated mortality (especially among juveniles) in 26 years at Archbold Biological Station. Each of these incidents occurred in conjunction with elevated water levels following unusually heavy rains in the fall, although high mortality does not occur in all such years. During the most severe of these presumed epidemics (August 1979 through March 1980), all but one of the juvenile cohort and almost half of the breeding adults died (Woolfenden and Fitzpatrick 1984; Woolfenden and Fitzpatrick 1990). The

1979 through 1980 incident coincided with a known outbreak of eastern equine encephalitis among domestic birds in central Florida (Woolfenden and Fitzpatrick, 1996b). From the fall of 1997 through the spring of 1998, the continuing population decline of scrub-jays along the Atlantic coast and in central Florida may have been augmented by an epidemic of unknown origin (Breininger 1999).

At Cape Canaveral Air Force Station, Stevens and Hardesty (1999) noted a decline in juvenile survival from 60 to 70 percent in the preceding years to 22 percent in 1997 and 1998. It stayed low (only 25 percent) in 1998 and 1999 before again climbing into the mid-60 percent range. Also, adult survival dropped from 70 to 80 percent in the preceding years to 50 to 60 percent in 1997 and 1998. Overall, their annual surveys documented the largest one-year drop (pairs decreased by 17 percent and birds by 20 percent) in this population at the same time as the presumed statewide epidemic.

In the winter and summer of 1973, 15 species of intestinal parasitic fauna (including 8 nematodes, 5 trematodes, 1 cestode, and 1 acanthocephalan) were found in 45 scrub-jays collected in south-central Florida; the parasite load was attributed to a varied arthropod diet (Kinsella 1974). These naturally-occurring parasites are not believed to have a negative impact on scrub-jay population levels.

Larvae of the burrowing fly, *Philornis porteri*, occur irregularly on scrub-jay nestlings. The species pupates in the base of the nest; larvae locate in nasal openings, mouth flanges, bases of the flight feathers, and toes; apparently no serious effect on the scrub-jay host occurs (Woolfenden and Fitzpatrick 1996b). Additionally, one undescribed chewing louse (*Myrsidea* sp.) (Woolfenden and Fitzpatrick 1996b), one wing-feather mite (*Pterodectes* sp.), two chiggers (*Eutrombicula lipovskyana*), and the sticktight flea (*Echidnophaga gallinacea*; Woolfenden and Fitzpatrick 1996b) occur on some individuals, usually at low densities. Nymphs and larvae of four ticks (*Amblyomma americanum*, *A. tuberculatum*, *Haemaphysalis leporispalustris*, and *Ixodes scapularis*) are known to occur on scrub-jays, as well as the larvae of the tick *A. maculatum* (Woolfenden and Fitzpatrick 1996b). These naturally-occurring parasites were not believed to have a negative impact on scrub-jay population levels; however, a recent study of the impact of the sticktight flea on scrub-jays indicates that low fitness and death can be caused by this parasite (Boughton et al. 2006). The host vector for this flea was a domestic dog (*Canis familiaris*) suggesting introduction of human pets into scrub-jay areas may increase parasite loads and reduce fitness.

Inadequacy of existing regulatory mechanisms

Woolfenden and Fitzpatrick (1996a) state the importance of enforcing existing Federal laws on the management of Federal lands as natural ecosystems for the long-term survival of the scrub-jay. The Service consults regularly on activities on Federal lands which may affect scrub-jays and also works with private landowners through the section 10(a)(1)(B) incidental take permitting process of the Act when take is likely to occur and no Federal nexus is present. Florida's State Comprehensive Plan and Growth Management Act of 1985 is administered mostly by regional and local governments. Regional Planning Councils administer the law through Development of Regional Impact reviews; at the local level, although comprehensive

plans contain policy statements and natural resource protection objectives, they are only effective if counties and municipalities enact and enforce ordinances. As a general rule, counties have not enacted and enforced ordinances that are effective in protecting scrub-jays (Fernald 1989).

The Wildlife Code of the State of Florida (Chapter 68A, Florida Administrative Code) prohibits taking of individuals of threatened species, or parts thereof, or their nests or eggs, except as authorized. The statute does not prohibit clearing of habitat occupied by protected species, which limits the ability of the FWC to protect the scrub-jay and its habitat.

Other natural or man-made factors affecting continued existence

Human interference with natural fire regimes has continued to play a major part in the decline of the scrub-jay and today may exceed habitat loss as the single most important limiting factor (Woolfenden and Fitzpatrick 1991; Woolfenden and Fitzpatrick 1996a; Fitzpatrick et al. 1994). Lightning strikes cause all naturally-occurring fires in south Florida scrub habitat (Abrahamson 1984; Hofstetter 1984; Woolfenden and Fitzpatrick 1990). Fire has been noted to be important in maintenance of scrub habitat for decades (Nash 1895; Harper 1927; Webber 1935; Davis 1943; Laessle 1968; Abrahamson et al. 1984). Human efforts to prevent and control natural fires have allowed the scrub to become too dense and tall to support populations of scrub-jays, resulting in the decline of local populations of scrub-jays throughout the state (Fernald 1989; Fitzpatrick et al. 1994, Percival et al. 1995; Stith et al. 1996; Thaxton and Hingtgen 1996; Woolfenden and Fitzpatrick 1990; Woolfenden and Fitzpatrick 1996a; Toland 1999). Woolfenden and Fitzpatrick (1996a) cautioned, however, that fire applied too often to scrub habitat also can result in local extirpations. Data from Archbold Biological Station show that fire-return intervals varying between 8 and 15 years are optimal for long-term maintenance of productive scrub-jay populations in central Florida (Woolfenden and Fitzpatrick 1996b). These intervals also correspond with those yielding healthy populations of listed scrub plants (Menges and Kohfeldt 1995; Menges and Hawkes 1998). Optimal fire-return intervals may, however, be shorter in coastal habitats (Schmalzer and Hinkle 1992a; Schmalzer and Hinkle 1992b).

Stith et al. (1996) estimated at least 2,100 breeding pairs of scrub-jays were living in overgrown habitat. Toland (1999) reported that most of Brevard County's remaining scrub (estimated to be 15 percent of the original acreage) is overgrown due to fire suppression. He further suggests the overgrowth of scrub habitats reduces the number and size of sand openings which are crucial not only to scrub-jays, but also many other scrub plants and animals. Reduction in the number of potential scrub-jay nesting sites, acorn cache sites, and foraging sites presents a problem for scrub-jays. Fernald (1989) reported that overgrowth of scrub results not only in the decline of species diversity and abundance but also a reduction in the percentage of open sandy patches (Fernald 1989; Woolfenden and Fitzpatrick 1996b). Fitzpatrick et al. (1994) believed that fire suppression was just as responsible as habitat loss in the decline of the scrub-jay, especially in the northern third of its range. Likewise, the continued population decline of scrub-jays within Brevard County between 1991 and 1999 has been attributed mainly to the overgrowth of remaining habitat patches (Breininger et al. 2001). Breininger et al. (1999) concluded optimal habitat management is essential in fragmented ecosystems maintained by periodic fire, especially to lessen risks of decline and extinction resulting from epidemics and hurricanes.

Fitzpatrick et al. (1991), Fitzpatrick et al. (1994), and Woolfenden and Fitzpatrick (1996a) expressed concern for the management practices taking place on Federal lands at Ocala National Forest, Merritt Island National Wildlife Refuge at the Kennedy Space Center, and Cape Canaveral Air Force Station, all supporting large contiguous populations of scrub-jays. They predicted that fire suppression or too frequent fires (on the latter two) and silvicultural activities involving the cultivation of sand pine on Ocala National Forest, would be responsible for declines of scrub-jays in these large contiguous areas of scrub. These areas should be those where populations are most secure because of Federal agencies' responsibilities under section 7(a)(1) of the Act. Monitoring of scrub-jay populations, demography, and nesting success is ongoing on all of these properties to assess the effectiveness of management practices in meeting scrub-jay recovery objectives.

Housing and commercial developments within scrub habitats are accompanied by the development of roads. Since scrub-jays often forage along roadsides and other openings in the scrub, they are often killed by passing cars. Research by Mumme et al. (2000) along a two-lane paved road indicated that clusters of scrub-jay territories found next to the roadside represented population sinks (breeder mortality exceeds production of breeding-age recruits), which could be supported only by immigration. Since this species may be attracted to roadsides because of their open habitat characteristics, vehicular mortality presents a significant and growing management problem throughout the remaining range of the scrub-jay (Dreschel et al. 1990; Mumme et al. 2000), and proximity to high-speed, paved roads needs to be considered when designing scrub preserves (Woolfenden and Fitzpatrick 1996a).

Another potential problem in suburban areas supporting scrub-jays is supplemental feeding by humans (Bowman and Averill 1993; Woolfenden and Fitzpatrick 1996a; Bowman 1998). The presence of additional food may allow scrub-jays to persist in fragmented habitats, but recruitment in these populations is lower than in native habitats. However, even though human feeding may postpone local extirpations, long-term survival cannot be ensured in the absence of protecting native oak scrub habitat necessary for nesting.

Scrub-jays in suburban settings often nest high in tall shrubbery. During March winds, these nests tend to be susceptible to destruction (Woolfenden and Fitzpatrick 1996b; Bowman 1998). Hurricanes also pose a potential risk for scrub-jays, although the exact impact of such catastrophic events is unknown. Breininger et al. (1999) modeled the effects of epidemics and hurricanes on scrub-jay populations in varying levels of habitat quality. Small populations of scrub-jays are more vulnerable to extirpation where epidemics and hurricanes are common. Storm surge from a Category Three to Five hurricanes could inundate entire small populations of scrub-jays, and existing habitat fragmentation could prevent repopulation of affected areas. However, this model also predicted that long-term habitat degradation had greater influence on extinction risk than hurricanes or epidemics. Preliminary results of the impact of Hurricane Charley on the Charlotte County scrub-jay populations indicates that at least one member of all 20 family groups surveyed after the storm had survived (Miller 2006).

Fernald (1989) reported that many of the relatively few remaining patches of scrub within the Treasure Coast region of Florida had been degraded by trails created by off-road vehicles, illegal

dumping of construction debris, abandoned cars and appliances, or household waste. The invasion of these areas by exotic species, including Brazilian pepper (*Schinus terebinthifolius*), white cypress-pine (*Callitris glaucophylla*), and Australian pine (*Casuarina equisetifolia*) also was a problem. Other human-induced impacts identified by Fernald (1989) include the introduction of domestic dogs and cats, black rats, greenhouse frogs (*Eleutherodactylus planirostris*), giant toads (*Bufo marinus*), Cuban tree frogs (*Osteopilus septentrionalis*), brown anoles (*Anolis sagrei*), and other exotic animal species. These exotic species may compete with scrub-jays for space and food.

Analysis of the species/critical habitat likely to be affected

For the reasons cited in previous sections of this biological opinion, the scrub-jay's status since its listing in 1987 has not improved. The status and trends that we discussed above identify two items essential for recovery of this species: (1) additional purchase of scrub habitat for preservation in key areas, and (2) restoration and management of publicly-owned scrub habitat already under preservation. No critical habitat has been designated for this species; therefore, none will be affected.

Eastern indigo snake

In addition to the assessment below, a 5-year review was completed in 2008 resulting in no change to the species designation (Service 2008). No critical habitat has been designated for this species.

Species/critical habitat description

The eastern indigo snake is one of the largest non-venomous snakes in North America, obtaining lengths of up to 8.5 feet (Moler 1992). 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 (the central 3 to 5 scale rows are lightly keeled in adult males) in 17 scale rows at mid-body. Its anal plate is undivided. In the Florida Keys, adult eastern indigo snakes seem to have less red on their faces or throats compared to most mainland specimens (Lazell 1989). Several researchers have informally suggested that Lower Keys eastern indigo snakes may differ from mainland snakes in ways other than color. Critical habitat has not been designated for this species.

Life history/Population dynamics

In south-central Florida, limited information on the reproductive cycle suggests eastern indigo snake breeding extends from June to January, egg laying occurs from April to July, and hatching occurs from mid-summer to early fall (Layne and Steiner 1996). Young hatch approximately 3 months after egg-laying and there is no evidence of parental care. Eastern indigo snakes in captivity take 3 to 4 years to reach sexual maturity (Speake et al. 1987). Female eastern indigo snakes can store sperm and delay fertilization of eggs. There is a single record of a captive eastern indigo snake laying five eggs (at least one of which was fertile) after being isolated for more than 4 years (Carson 1945). However, there have been several recent reports of parthenogenetic reproduction by virginal

snakes. Hence, sperm storage may not have been involved in Carson's (1945) example (Moler 1998). There is no information on the eastern indigo snake lifespan in the wild, although one captive individual lived 25 years, 11 months (Shaw 1959).

Eastern indigo snakes are active and spend a great deal of time foraging and searching for mates. They are one of the few snake species that are active during the day and rest at night. The eastern indigo snake is a generalized predator and will eat any vertebrate small enough to be overpowered. They swallow their prey alive. Food items include fish, frogs, toads, snakes (venomous, as well as non-venomous), lizards, turtles, turtle eggs, small alligators, birds, and small mammals (Keegan 1944; Babis 1949; Kochman 1978; Steiner et al. 1983).

Eastern indigo snakes need a mosaic of habitats to complete their annual life cycle. 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. Eastern indigo snakes also use some agricultural lands (such as citrus) and various types of wetlands (Service 1999). A study in southern Georgia found that interspersion of tortoise-inhabited sandhills and wetlands improve habitat quality for the eastern indigo snake (Landers and Speake 1980). Eastern indigo snakes shelter in gopher tortoise burrows, hollowed root channels, hollow logs, or the burrows of rodents, armadillos, or land crabs (Lawler 1977; Moler 1985a; Layne and Steiner 1996).

Throughout peninsular Florida, this species may be found in all terrestrial habitats which have not experienced high density urban development. They are especially common in the hydric hammocks throughout this region (Service 1999). In central and coastal Florida, indigo snakes are mainly found within many of the State's high, sandy ridges. In extreme south Florida (*i.e.*, 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; Service 1999). Underground refugia used by this species include 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). It is thought they prefer hammocks and pine forests since most observations occur there and use of these areas is disproportionate compared to the relatively small total area of these habitats (Steiner et al. 1983). Observations over the last 50 years made by maintenance workers in citrus groves in east-central Florida indicate eastern indigo snakes are occasionally observed on the ground in the tree rows and more frequently near the canals, roads, and wet ditches (Zeigler 2006). In the sugar cane fields at the A-1 Reservoir Project site in the Everglades Agriculture Area, eastern indigo snakes have been observed (including one mortality) during earthmoving and other construction-related activities.

Eastern indigo snakes range over large areas and use various habitats throughout the year, with most activity occurring in the summer and fall (Smith 1987; Moler 1985a). Adult males have larger home ranges than adult females and juveniles; their ranges average 554 acres, decreasing to 390 acres in the summer (Moler 1985b). In contrast, a gravid female may use from 3.5 to 106 acres (Smith 1987). In Florida, home ranges for females and males range from 5 to 371 acres and 4 to

805 acres, respectively (Smith 2003). At Archbold Biological Station, average home range size for females was determined to be 47 acres and overlapping male home ranges to be 185 acres (Layne and Steiner 1996).

Status and distribution

The eastern indigo snake was listed as threatened on January 31, 1978 (43 FR 4028), due to population declines caused by habitat loss, over-collecting for the domestic and international pet trade, and mortality caused by rattlesnake collectors who gas gopher tortoise burrows to collect snakes. The indigo snake (*Drymarchon corais*) ranges from the southeastern United States to northern Argentina (Conant and Collins 1998). This species has eight recognized subspecies, two of which occur in the United States: the eastern indigo and the Texas indigo (*D. c. erebennus*). In the United States, the eastern indigo snake historically occurred throughout Florida and in the coastal plain of Georgia and has been recorded in Alabama and Mississippi (Diemer and Speake 1983; Moler 1985b). It may have occurred in southern South Carolina, but its occurrence there cannot be confirmed. Georgia and Florida currently support the remaining endemic populations of the eastern indigo snake (Lawler 1977). The eastern indigo snake occurs throughout most of Florida and is absent only from the Dry Tortugas and Marquesas Keys, and regions of north Florida where cold temperatures and deeper clay soils exist (Cox and Kautz 2000).

Current threats

Effective law enforcement has reduced pressure on the species from the pet trade. However, because of its relatively large home range, the eastern indigo snake is vulnerable to habitat loss, degradation, and fragmentation (Lawler 1977; Moler 1985a). The primary threat to the eastern indigo snake is habitat loss due to development and fragmentation. In the interface areas between urban and native habitats, residential housing is also a threat because it increases the likelihood of snakes being killed by property owners and domestic pets. Extensive tracts of undeveloped land are important for maintaining eastern indigo snakes. In citrus groves, eastern indigo snake mortality occurs from vehicular traffic and management techniques such as pesticide usage, lawn mowers, and heavy equipment usage (Zeigler 2006). Within the 2000 to 2005 timeframe, since the spread of citrus canker, Zeigler (2006) reported seeing at least 12 dead eastern indigo snakes that were killed by heavy equipment operators in the act of clearing infected trees.

Analysis of species/critical habitat likely to be affected

To protect and manage this species for recovery, Breininger et al. (2004) concluded the greatest eastern indigo snake conservation benefit would be accrued by conserving snake populations in the largest upland systems that connect to other large reserves while keeping edge to area ratios low. Management of these lands should be directed towards maintaining and enhancing the diversity of plant and animal assemblages within these properties. Where these goals are achieved, eastern indigo snakes will directly benefit because of improved habitat conditions. Land managers should be encouraged to utilize fire as a tool to maintain biodiversity in fire-dependent ecosystems. No critical habitat has been designated; therefore, none will be affected.

Gopher tortoise

The following discussion is summarized from the 12-month finding (Service 2011), as well as from recent research publications and monitoring reports.

Species/Critical habitat description

The gopher tortoise is the only tortoise (family Testudinidae) east of the Mississippi River. It is larger than any of the other terrestrial turtles in this region, with a domed, dark-brown to grayish-black shell (carapace) up to 14.6 inches long, weighing up to 13 pounds. The lower shell (plastron) is yellowish and hingeless. Tortoises cannot completely withdraw their limbs, which remain visible when folded and retracted. The hind feet are elephantine or stumpy, and the forelimbs are shovel-like, with claws used for digging. In comparison to females, males are smaller, usually have a larger gland under the chin, a longer gular projection, and more concave plastron. Hatchlings are up to 2 inches in length, with a somewhat soft, yellow-orange shell. As with other chelonians, gopher tortoises possess a keratinized beak, and lack teeth. No critical habitat has been designated for the gopher tortoise.

Life history/Population dynamics

The gopher tortoise is a long-lived, native, burrowing species of the open, fire-maintained, longleaf pine ecosystem. Historically, typical gopher tortoise habitat consisted of open, frequently burned, longleaf pine or longleaf pine/scrub oak uplands, and flatwoods on moderately well drained to xeric soils. Such habitat provided adequate sunlight reaching the forest floor to stimulate the growth and development of the herbaceous plant stratum for forage, with sufficient warmth for basking and the incubation of eggs.

The burrows of a gopher tortoise are the habitat and center of normal feeding, breeding, and sheltering activity. Gopher tortoises excavate and use more than one burrow for shelter beneath the ground surface. Burrows, which may extend for more than 30 feet, provide shelter from canid predators, fire, winter cold, and summer heat. Dogs and large canids are the most common predator of adult tortoises (Causey and Cude 1978).

In stable populations with fire-maintained, open longleaf pine habitat, females may use an average of 5 burrows each while males occupy an average of 10 burrows (Eubanks et al. 2003). In poor habitat due to encroaching, fire intolerant shrubs and hardwoods, gopher tortoises tend to excavate and use fewer burrows, probably because of limited sites that are sufficiently open. Males tend to use more burrows and move more frequently among their different burrows than females as they seek breeding opportunities with females (McRae et al. 1981; Diemer 1992a, 1992b; Smith 1995; Tuma 1996; Boglioli et al. 2000; Eubanks et al. 2003). The term "active burrow" is applied to burrows exhibiting indications it is likely inhabited by a gopher tortoise. Characteristics of active burrows include fresh soil excavated from the interior of the burrow and deposited on the apron at the burrow entrance, tortoise feces on the apron or near the burrow entrance, eggshells, and tracks. Inactive burrows, which display conditions of recent

use and occupancy by a tortoise, are considered to be used as part of the annual home range of one or more tortoises, but are not currently occupied by a tortoise. Indicators of inactive burrows include suitable size and shape of the burrow entrance, a recognizable apron of bare soil without encroachment of grasses or shrubs, and small amounts of leaf litter in the entrance that have not been moved by a tortoise. Abandoned burrows are unlikely to be used by a tortoise and normally exhibit indications of erosion, a loss of shape and structure, vegetative overgrowth, and no apron.

Tortoises spend most of their time within burrows and emerge during the day to bask in sunlight, feed, and reproduce. Tortoises are active above ground during the growing season when daytime temperatures range from 75 to 87 degrees F (McRae et al. 1981; Butler et al. 1995). Daily active periods usually are unimodal in spring, followed by bimodal periods (early to mid-morning, middle to late afternoon) during the hotter temperatures of summer (McRae et al. 1981). Daily activity above ground becomes significantly reduced by the end of the growing season during October with cooler temperatures. Tortoises take shelter within their burrows during the dormant season, become torpid, do not eat, and rarely emerge except during periods of warm days to bask in sunlight at the burrow entrance. Except for those tortoises in southern peninsular Florida that do not have an overwintering period, most tortoises become active again during early spring.

Tortoises mostly forage on foliage, seeds, and fruits of grasses and forbs, generally in an area of about 150 feet surrounding each burrow (McRae et al. 1981; Diemer 1992b). The diet of adults resembles that of a generalist herbivore, with at least some preference for some plants over others, and may also include insects and carrion (MacDonald and Mushinsky 1988; Birkhead 2001). Juvenile tortoises tend to forage on fewer plant species, eat fewer grasses, and select more forbs, including legumes, than adults (Mushinsky et al. 2003).

Burrows are not randomly located in the environment. Tortoises select and prefer burrow sites in open sunny areas (Boglioli et al. 2000; Rostal and Jones 2002). Such sites reflect areas where herbaceous plants for food are more abundant on the forest floor and, for females, sunlight and soil temperatures for egg incubation are more suitable. Also, males select sites and burrows that increase their proximity to females and breeding opportunities (Boglioli et al. 2000; Eubanks et al. 2003). The repeated use and travel to the same burrows by individual tortoises in stable habitat reveal that tortoises know the geography of their home range, burrows, and the location of neighboring tortoises (Eubanks et al. 2003).

Tortoises breed from May through October (Landers et al. 1980; McRae et al. 1981; Taylor 1982; Wright 1982; Service 1987; Diemer 1992a; Eubanks et al. 2003). Females ovulate during spring, but likely store sperm so active breeding during ovulation may not always be required for fertilization. Males travel to female burrows and copulation occurs above ground at the burrow entrance, more frequently during July to September, a period of peak sex and adrenal steroid hormones (Ott et al. 2000; Eubanks et al. 2003). In earlier work by Douglass (1986), he described gopher tortoise "colonial" tendencies with aggregations of burrows in which dominant males competitively and behaviorally exclude other males at female burrows to

maintain a loose female harem as a mating system. More recent studies do not indicate the clear existence of an exclusive dominance hierarchy. Also, aggregations of burrows in some habitat and study sites probably is an artifact of fragmentation and the concentration of burrows in the available remaining suitable habitat (Mushinsky and McCoy 1994; Boglioli et al. 2003).

Females do not reproduce every year. In the listed range, about 80 percent of the females at Marion County Wildlife Management Area (WMA) in Mississippi and 85 percent of the females at Ben's Creek WMA in Louisiana were gravid each year (Smith et al. 1997). Females excavate a shallow nest to lay and bury eggs, usually in the apron of soil at the mouth of the burrow, but they may lay elsewhere if the apron is excessively shaded (Landers and Buckner 1981). Range-wide, average clutch size varies from about 4 to 12 eggs per clutch. Average clutch size in the listed range, from 4.8 to 5.6 eggs per clutch, is comparably low (Seigel and Hurley 1993; Seigel and Smith 1995; Tuma 1996; Epperson and Heise 2003). Clutch size generally is positively correlated with adult female size (Diemer and Moore 1994; Smith 1995; Rostal and Jones 2002).

Females usually lay about five to seven eggs from mid-May through mid-July in the soil of the apron at the burrow entrance (Butler and Hull 1996; Smith et al. 1997) and egg incubation lasts 80 to 110 days (Diemer 1986; Smith et al. 1997). Incubation at temperatures from 81 to 90 degrees F is required for successful development and hatching (Spotila et al. 1994; Burke et al. 1996; DeMuth 2001; Rostal and Jones 2002; Noel and Qualls 2004). Egg hatching success at experimentally protected nests has ranged from 28 to 97 percent in Florida and Georgia (92 percent, Arata 1958; 86 percent, Landers et al. 1980; 28 percent, Linely 1986; 67 to 97 percent, Smith 1995; 80.6 percent, Butler and Hull 1996). In the listed range in Mississippi, mean hatching success from protected nests in the field has ranged from 28.8 to 56 percent (Epperson and Heise 2003; Noel and Qualls 2004). As in other species, sex determination is temperature dependent (Burke et al. 1996; DeMuth 2001).

Hatchlings excavate themselves from the nest and emerge from the middle of August through October (Ashton and Ashton 2008). Hatchlings and yearlings (0 to 1 year old) may temporarily use the adult burrow, bury under sand or leaf litter, or excavate a small burrow nearby (Douglass 1978; Wilson et al. 1994; Butler et al. 1995; Pike 2006). Growth is most rapid during the juvenile stage, becoming slower at the onset of adulthood and reproductive maturity, followed by little or no adult growth (Mushinsky et al. 1994; Aresco and Guyer 1998, 1999). Generally, tortoises become adults at about 20 years of age, although the minimal stage to reach reproductive maturity is determined by size rather than age. Growth rates and sizes at sexual maturity can vary among populations and habitat types (Landers et al. 1982; Mushinsky et al. 1994; Aresco and Guyer 1998, 1999).

Hatchlings and yearlings initially move up to about 50 feet from their nest to establish their first burrow, from which they will subsequently excavate and use about five burrows in a home range from 0.5 to 11.8 acres (Mushinsky et al. 1994; Butler et al. 1995; Epperson and Heise 2003; Pike 2006). Yearlings move, on average, relatively short distances to establish new burrows, although they are known to have traveled up to 1,485 feet to new burrows (Butler et

al. 1995; Epperson and Heise 2003). Hatchlings and yearlings may take shelter beneath litter and woody debris during longer distances or times encountered to move to a new burrow (Diemer 1992b; Butler et al. 1995). Yearlings and juveniles usually forage within about 23 feet of their burrow (McRae et al. 1981; Wilson et al. 1994; Butler et al. 1995; Epperson and Heise 2003).

Home range size and movements increase with age and body size. The burrows of a gopher tortoise represent the general boundaries of a home range, which is the area used for feeding, breeding, and sheltering. Home range area tends to vary with habitat quality, becoming larger in areas of poor habitat (Auffenberg and Iverson 1979). Males typically have larger home ranges than females. Mean home ranges of individual tortoises in Alabama, Florida, and Georgia outside the federally listed area have varied from 1.3 to 5.2 acres for males and 0.2 to 2.5 acres for females (McRae et al. 1981; Auffenberg and Franz 1982; Diemer 1992b; Tuma 1996; Ott 1999; Eubanks et al. 2003; Guyer 2003). In comparison to females, male tortoises use more burrows, and during breeding season, move among burrows more frequently over longer distances (McRae et al. 1981; Auffenberg and Franz 1982; Diemer 1992b; Smith 1995; Tuma 1996; Ott 1999; Eubanks et al. 2003; Guyer 2003).

A burrow may or may not be exclusively used by just one gopher tortoise. Two or more tortoises may share the same burrow, although the burrow is used at different times of the year by different individuals. Home ranges overlap when a burrow is used by more than one tortoise. About 50 percent of the area occupied by 123 tortoises was shared by two or more tortoises in relatively pristine, stable habitat in southwestern Georgia (Eubanks et al. 2002). At Camp Shelby, Mississippi, average home range varied from 7.3 to 10.4 acres for males and from 12.1 to 32.9 acres for females (Tuma 1996; Guyer 2003). At another population on timber industry land in Alabama, average home range was 10.4 acres for males and 32.9 acres for females. These home ranges are larger than those typically determined for tortoises at populations in Alabama, Georgia, and Florida outside the listed range. Since gopher tortoise movements and distance increase as herbaceous biomass and habitat quality decrease (Auffenberg and Iverson 1979; Auffenberg and Franz 1982), larger home ranges at these two study sites in the listed range probably reflect differences in habitat quality. Habitat conditions on the timber industry study site were highly heterogeneous, with patches and stands of suitable habitat mixed among patches of unsuitable habitat. These tortoises moved relatively long distances to different burrows located in suitable habitat patches within a matrix of poor and unsuitable habitat.

As distances increase between gopher tortoise burrows, isolation among tortoises also increases due to the decreasing rate of visitation and breeding (Boglioli et al. 2003; Guyer 2003). Using extensive data from individual tortoise interburrow movements and home range size, Eubanks et al. (2003) found that most colonies or breeding population segments would consist of burrows no greater than about 558 feet apart. Guyer (2003) found that males only rarely will move from their burrows up to 1,640 feet to a female burrow for mating opportunities, and females typically experience a visitation rate of near zero when their burrows are 460 to 623 feet from nearest neighbors. Demographically, tortoises located at distances of about 600 feet from

other tortoises are functionally isolated and subdivided as separate breeding populations. Thus, breeding populations or colonies likely consist of tortoises and burrows in suitable, unfragmented habitat within 600 feet or less from each other.

Gopher tortoises require well-drained, sandy soils for burrowing and nest construction, an abundance of herbaceous ground cover for food, and a generally open canopy that allows sunlight to reach the forest floor (Landers 1980; Auffenberg and Franz 1982). Longleaf pine and oak uplands, xeric hammock, sand pine and oak ridges (beach scrub), and ruderal (disturbed) habitat most often provide the conditions necessary to support gopher tortoises (Auffenberg and Franz 1982). Ruderal (*i.e.*, disturbed or atypical) habitats include roadsides and utility rights-of-way, grove/forest edges, fencerows, and clearing edges. In the western range, soils contain more silt, and xeric (dry) conditions are less common west of the Florida panhandle (Craul et al. 2005). Ground cover in this Coastal Plains area can be separated into two general regions, with the division in the central part of southern Alabama and northwest Florida. To the west, bluestem and panicum (*Panicum* spp.) grasses predominate; to the east, wiregrass (*Aristida stricta*) is most common (Boyer 1990). However, gopher tortoises do not necessarily respond to specific plants but rather the physical characteristics of habitat (Diemer 1986). Historic gopher tortoise habitats were open pine forests, savannahs, and xeric grasslands that covered the coastal plain from Mexico and Texas to Florida. Historic habitats might have had wetter soils at times and been somewhat cooler, but were generally xeric, open, and diverse (Ashton and Ashton 2008).

Gopher tortoises have a well-defined activity range where all feeding and reproduction take place and that is limited by the amount of herbaceous ground cover (Auffenberg and Iverson 1979). Tortoises are primarily herbivores eating mainly grasses, plants, fallen flowers, fruits, and leaves. Gopher tortoises prefer grassy, open-canopy microhabitats (Boglioli et al. 2000), and their population density directly relates to the density of herbaceous biomass (Auffenberg and Iverson 1979; Landers and Speake 1980; Wright 1982; Stewart et al. 1993) and a lack of canopy (Breininger et al. 1994; Boglioli et al. 2000). Grasses and grass-like plants are important in gopher tortoise diets (Auffenberg and Iverson 1979; Landers 1980; Wright 1982; MacDonald and Mushinsky 1988; Mushinsky et al. 2006). A lack of vegetative diversity may negatively impact the long-term sustainability of gopher tortoise populations (Ashton and Ashton 2008).

Gopher tortoises require a sparse canopy and litter-free ground not only for feeding, but also for nesting (Landers and Speake 1980). In Florida, McCoy and Mushinsky (1995) found the number of active burrows per tortoise was lower where canopy cover was high. Females require almost full sunlight for nesting (Landers and Buckner 1981) because eggs are often laid in the burrow apron or other sunny spot and require the warmth of the sun for appropriate incubation (Landers and Speake 1980). At one site in southwest Georgia, Boglioli (et al. 2000) found most tortoises in areas with 30 percent or less canopy cover. Diemer (1992a) found ecotones created by clearing were also favored by tortoises in north Florida. When canopies become too dense, usually due to fire suppression, tortoises tend to move into ruderal habitats such as roadsides with more herbaceous ground cover, lower tree cover, and significant sun

exposure (Garner and Landers 1981; McCoy et al. 1993; Baskaran et al. 2006). In Georgia, Hermann et al. (2002) found open pine areas (*e.g.*, pine forests with canopies that allow light to penetrate to the forest floor) were more likely to have burrows, support higher burrow densities, and have more burrows used by large, adult tortoises than closed-canopy forests. Historically, open-canopied pine forests were maintained by frequent, lightning-generated fires.

As long-lived animals, gopher tortoises naturally experience delayed sexual maturity, low reproductive rates, high mortality at young ages and small size-classes, and relatively low adult mortality. The growth and dynamics of populations are stochastically affected by natural variation due to demographic rates, the environment, catastrophes, and genetic drift (Shaffer 1981). Factors affecting population growth, decline, and dynamics include: the number or proportion of annually breeding and egg-laying females (breeding population size), clutch size, nest depredation rates, egg hatching success, mortality, the age or size at first reproduction, age- or stage-class population structure, maximum age of reproduction, immigration rates, and emigration rates.

These factors and data have been evaluated in several investigations of population viability to estimate the probabilities of gopher tortoise population extinction over time and the important factors affecting persistence. In the absence of field surveys and long-term monitoring, models may be used to project the status of populations in the future based on a specific set of assumptions and assignment of demographic parameters. There have been four substantive modeling efforts evaluating the long-term persistence of gopher tortoises (Tuberville et al. 2009). Two early modeling efforts focused on estimating the minimum number of tortoises needed for a population to persist for 200 years (Cox et al. 1987). Although relatively small population sizes (40 to 50 adults) were modeled to persist over the model duration, all populations declined and were projected to go extinct at some point in the future depending on model parameters.

Miller (2001) assessed the likelihood of tortoises being extirpated from Florida over a 100-year period when evaluating all known tortoise populations, or only those on public lands, considering a variety of assumptions regarding survivorship, carrying capacity constraints, disease, etc. (Miller 2001). The model results suggest gopher tortoises have greater than 80 percent chance of persisting in Florida over the next 100 years whether looking at all known populations or only those on public lands (Miller 2001). Furthermore, they concluded populations as small as 50 individuals can have conservation value under favorable conditions, but under less favorable habitat conditions, populations larger than 250 individuals would be necessary to protect against extinction due to stochastic factors that increase hatchling and adult mortality (Miller 2001).

The most recent modeling effort recognized the need to evaluate the viability of individual populations, rank populations most appropriate for in-situ protection, and determine if nonviable populations are more likely to contribute to conservation through augmentation or translocation (Tuberville et al. 2009). All model scenarios resulted in a population decline of one to three percent per year, which varied as a function of habitat quality and location within

the range (Tuberville et al. 2009). Only modeled populations with at least 250 tortoises were able to persist for 200 years, which is substantially different than earlier model results. Population dynamics of turtles, as long lived animals, have commonly been considered sensitive to demographic changes in adult survival and, in some cases, juvenile survival (Gibbons 1987; Congdon et al. 1993; Heppell and Crowder 1996). Likewise, models and simulations of gopher tortoise populations are most sensitive to adult, hatchling, and juvenile survival rates (Miller 2001; Epperson 2003; Wester 2004). For example, the small but positive population growth rates modeled for a stable base population became negative when mortality of the 3 to 4+ year age class increased from 3.0 to 5.0 percent, or the yearling (0 to 1 year age class) mortality increased from 95 to 97 percent (Miller 2001; McDearman 2006).

Recently, segmented regression models were developed to evaluate the relationship between area of habitat occupied by gopher tortoises and abundance of gopher tortoises to define how many individuals constitute a population and how much area is required for such a population. Data synthesized from 21 study sites in Alabama, Georgia, and Mississippi, with varying tortoise population numbers indicated, that an average gopher tortoise population consists of 444 burrows, covers 1,865 acres, and contains 240 tortoises (Styrsky et al. 2010). This average population contained a density of 0.1 per acre, which is below the threshold identified by Guyer (personal communication) for maintaining a persistent population. The authors noted this average tortoise population was calculated based on a variety of existing landscapes that differed in their current management and past land use history and, therefore, did not represent what a population of tortoises might be in areas that were all managed with frequent fire and contained the uneven-aged trees of old-growth longleaf pine forests. Thus, it is likely tortoises could persist on smaller parcels, but only if habitat were aggressively managed (Styrsky et al. 2010). Lack of prescribed fire or ineffective use of prescribed fire is known to be a substantial impediment to the restoration and maintenance of gopher tortoise habitat throughout much of its range. The model results depict a typical tortoise population as one occupying a large area. This seems congruent with existing habitat conditions that are reported throughout much of the tortoise's range. Therefore, the model results show that most existing conservation lands contain too few tortoises and too little suitable habitat to support persistent tortoise populations.

Status and distribution

The gopher tortoise is federally listed as a threatened species in the western part of its range, from the Tombigbee and Mobile Rivers in Alabama west to southeastern Louisiana on the lower Gulf Coastal Plain (Service 1987). The listed range of the gopher tortoise includes 3 counties in southeastern Alabama, 14 counties in southern Mississippi, and 3 parishes in Louisiana. Most gopher tortoise habitat is privately owned (70 percent), while about 20 percent is owned by the Forest Service, and 10 percent by other public agencies (Noss 1988).

Effectively assessing the status (*i.e.*, whether it is increasing, decreasing, or stable) of the gopher tortoise throughout its range requires evaluation of the distribution of tortoises, number of tortoises and populations, number of individuals in populations, and trends in population growth. As we indicated above, we do not have specific distribution data for most of the

tortoise's range, but we estimated where potential habitat existed and where tortoises may still be present. Below, we provide summaries of survey data about the sizes and, in some cases, trends of gopher tortoise populations. There is a noticeable disparity between the apparently large area (expressed in hectares or acres, or ha/ac) of potential gopher tortoise habitat reported above and actual numbers of individual tortoises known from populations that have been surveyed, as summarized below. Upon cursory examination, there seem to be few tortoises where there are millions of hectares of potential habitat. Many Federal and State agencies, non-governmental organizations (NGO), and timber owners have only recently begun to assess where and how many gopher tortoises are present on lands they own or manage.

Review of the literature indicates the status of an individual gopher tortoise population is dependent on the size of the population and its demographic performance. For comparative purposes, and as described in greater detail below, we considered tortoise populations to be large enough to persist in the future (*i.e.*, viable) if they contained 250 or more reproductively active individuals. Ideally, recruitment should exceed mortality, but few long-term studies provide this demographic information. In the absence of these data, burrow surveys that report hatchling- and juvenile-sized burrows indicate that recent recruitment occurred, but we still often lack information about whether the observed level of recruitment is sufficient to offset mortality. The amount of habitat necessary to support a population of at least 250 breeding individuals likely varies depending on habitat quality. Populations in poor-quality habitat, such as those in atypical vegetative communities and in areas not aggressively managed, will likely require more area than populations in high-quality soils where there would be sparse canopy cover, multi-aged pine forests with abundant ground cover, and where prescribed fire is used periodically to maintain habitat conditions. Because of these variations, the density of gopher tortoises in a population that is large and demographically viable will vary.

A wide variety of information is available on the number and density of gopher tortoises and their burrows from many areas throughout their range. These data resulted from numerous surveys and censuses using a variety of methodologies ranging from one-time censuses to repeated surveys over several decades. The diversity of data poses a challenge when trying to evaluate the status of a species from a landscape perspective. For example, in some areas we have more data (*e.g.*, Florida and in portions of the listed range), and we have higher confidence in drawing conclusions about status of tortoises in these areas. In other areas, where there is little or no data, our confidence in assessing the status of tortoises is lower. Because of disparities in the type of data collected, methodologies in collecting data, and differences in the scope of studies, it is not possible to simply combine datasets to evaluate the status of the gopher tortoise throughout its range. Instead, we considered each individual dataset in the context of all other best available science to form general conclusions about the status of the gopher tortoise.

In the western portion of their range, gopher tortoise populations are small and occur in fragmented habitat. The largest and most substantial gopher tortoise populations in the western portion of its range occur on the De Soto National Forest in southern Mississippi. Long-term monitoring here indicates a decline in population sizes, a tendency towards adult-dominated

populations, and a lack of, or very low, recruitment. Results of smaller-scale surveys of forest lands in Mississippi and public and private lands in Louisiana are largely consistent with findings on the De Soto National Forest. There are no known populations large enough (*e.g.*, greater than 250 individuals) to persist long-term based on projections resulting from recent modeling efforts.

The gopher tortoise is more widespread and abundant in parts of the eastern portion of its range, particularly southern Georgia and central and northern Florida. Long-term monitoring data indicate that many populations have declined and most are relatively small and fragmented. Smaller-scale, short-term, or one-time surveys throughout the unlisted portion of the range indicate that tortoise populations typically occur in fragmented and degraded habitat, are small, and densities of individuals are low within populations. Unlike the western portion of the range, there are several known populations of tortoises in the eastern portion of the range that appear to be sufficiently large to persist long-term (*e.g.*, Camp Blanding Joint Training Center, Chassahowitzka Wildlife Management Area, Fort White Wildlife and Environmental Area, Jennings Forest Wildlife Management Area, and Three Lakes Wildlife Management Area in Florida; and Fort Benning, Fort Stewart, River Creek Wildlife Management Area, and Townsend Wildlife Management Area in Georgia). There are about 80 other public parcels in Florida that contain a substantial amount of potential gopher tortoise habitat, but surveys or censuses of these areas have not been conducted to estimate the number of tortoises present (FWC 2011).

Current threats

The decline of the gopher tortoise has been linked primarily to the decline of the open, fire maintained, longleaf pine forest and ecosystem (Service 1990). About 80 percent of the original habitat for the gopher tortoise within its listed range has been lost due to urbanization and agriculture (McDearman 2005). In remaining forests, management practices involving dense pine stands for pulpwood production, the silvicultural conversion from longleaf to other pines, and fire exclusion or infrequently prescribed fire have further reduced habitat for the species. These practices eliminate the open, sunny forest with a well-developed groundcover of grasses and forbs needed by tortoises for burrowing, nesting, and feeding (Landers and Buckner 1981; Auffenberg and Franz 1982). Nest depredation by vertebrates has also been considered substantial, although little quantitative data is available. From studies in southern Georgia, Landers et al. (1980) estimated about 90 percent of nests were destroyed by predators. In a much smaller study from southern Alabama, about 46 percent of nests (n = 11) were destroyed by raccoons, opossums, and armadillos (Marshall 1987). Other threats and causes for decline include habitat fragmentation, fire ants, heavy equipment operations during forest site preparation and timber harvest, and vehicle-caused mortality of gopher tortoises crossing roads (Service 1990).

Analysis of species/Critical habitat likely to be affected

The Service's recovery plan (Service 1990) for the gopher tortoise establishes short-term and long-term criteria involving public and private lands to delist the species (U.S. Forest Service 1990). The DeSoto National Forest represents a core area where management actions are

required to prevent this threatened species from becoming endangered. This is the first and most immediate objective of the recovery plan. The long-term objective, delisting, involves substantial voluntary commitments from private landowners.

The short-term objective is to establish and maintain populations on the DeSoto National Forest, including Camp Shelby, on 18,144 acres at densities of 1.2 to 2.8 burrows per acre. This is the acreage estimated to consist of deep sandy soils, designated as priority soils, and at burrow densities indicative of large, stable populations on such soils in Florida. By these criteria, and using a 0.61 burrow occupancy rate, the Service's recovery plan estimates the total recovery population on DeSoto National Forest would consist of 13,437 to 31,354 tortoises. More recent data on the average percentage of active and inactive burrows inhabited by tortoises in the listed range reveals that the 0.61 burrow conversion factor is too large (Mann 1995; Wester 1995). Using Mann's (1995) correction factor of 0.414, then 9,120 to 21,280 tortoises would occur on this DeSoto National Forest acreage with burrow density criteria of 0.5 to 12 tortoises per acre. For a minimally viable population of at least 75 tortoises, the lower range of the recovery criterion of about 9,120 tortoises would represent up to 122 viable populations, or less with larger individual populations.

On July 26, 1990, the Forest Service and Service completed formal section 7 consultation on the effect of a proposed management plan for the gopher tortoise on DeSoto National Forest. The objective of the Forest Service's plan is to promote recovery by maintaining and improving gopher tortoise habitat. Management measures to attain these objectives included prescribed fire, timber thinning, and regeneration to longleaf pine. Because of recent surveys documenting a declining gopher tortoise population, primarily due to poor habitat associated with encroaching shrubs and hardwoods in response to infrequent fire, the Service and Forest Service have reinitiated an informal section 7 consultation phase to remedy management problems that have impaired successful habitat restoration and maintenance. The successful implementation of a modified gopher tortoise habitat management plan is crucial to stabilize declining populations and to prevent the species from becoming endangered. This will require an increase in the frequency of growing season prescribed fire, with thinning and selective herbicide treatment in some areas with inadequate ground fuels to restore and maintain habitat. Also, management needs to be prioritized and designated on core patches of priority soils as well as adjoining areas of suitable soils to establish and maintain habitat areas of sufficient size for future viable populations. Depending on burrow density and home range overlap, the minimal reserve size for a single minimally viable population may range from 50 to 200 acres (Eubanks et al. 2002).

On private lands, the long-term objective for recovery is the establishment of 1.2 gopher tortoise burrows per acre on 45,945 acres of sandhill communities, where such burrow densities are most likely (U.S. Forest Service 1990). This acreage represents the area of privately-owned upland forests on sandy soils estimated by Lohoefener and Lohmeier (1984) at about the time of listing, although recovery objectives for private lands are not necessarily restricted to priority soil types. Using the 0.414 burrow conversion factor, recovery on private lands would represent about 23,094 tortoises by these criteria, or about 300 or fewer individual populations, each with 75 or more tortoises with good, long-term habitat management commitments.

Most of the timberland in the listed range of gopher tortoise is privately owned. In south Mississippi, for example, only about 14 percent of upland pine forests are publicly-owned and managed (Kelly and Sims 1987). Recovery for the gopher tortoise on private lands will require substantial voluntary commitments. Private landowners are not required by the Act to implement voluntary management to restore or maintain habitat by preventing or controlling forest succession that leads to habitat degradation in the absence of frequently occurring natural fire. A primary limiting factor for the recovery of the gopher tortoise is the absence of habitat restoration, which includes frequent prescribed fire and other active management measures to control and eliminate encroaching hardwoods and shrubs.

About 400,500 acres of longleaf pine stands remained within the listed range of the gopher tortoise by the 1990's. Gopher tortoises are not restricted to longleaf pine stands, but the best opportunity for recovery on both public and private lands will be in managed longleaf stands. The normal silviculture for the production of longleaf pine timber for poles and sawlogs, with frequent prescribed fire, is highly compatible with gopher tortoise habitat. In the listed range, voluntary landowner programs and technical assistance to private landowners by the Service, state, and private organizations have recently been initiated or are being planned as further incentives to the economic and ecological benefits for longleaf pine habitat restoration. These programs include Partners for Wildlife, Mississippi Partners for Fish and Wildlife, the Healthy Forest Reserve Program, the Emergency Conservation Reserve Program, and the Safe Harbor Program. Currently, about 2,000 acres of longleaf pine and potential gopher tortoise habitat has been treated by some form of habitat restoration management. These and other efforts will have to increase substantially to achieve recovery on private lands.

The gopher tortoise is federally listed as a candidate species in the eastern part of its range, which is defined as east of the Mobile and Tombigbee Rivers in Alabama, Florida, Georgia, Louisiana, Mississippi, and South Carolina. Threats to the gopher tortoise, as identified in the Service's 12-month finding (Service 2011), include mortality associated with the unregulated harvest of rattlesnakes, diseases such as upper respiratory tract disease, nest depredation, inadequacy of regulatory mechanisms, herbicide application, road mortality, and climate change. In addition, the destruction, modification, or curtailment of its habitat or range was identified as the most significant threat. Even though recovery criteria have not been characterized for the gopher tortoise in this part of its range, specific actions that can be taken to reduce threats to this species were recommended in the 12-month finding (Service 2011). Measures to reduce destruction, modification, or curtailment of gopher tortoise habitat or range include restoring and managing appropriate habitat through techniques such as mechanical vegetation reduction and burning at short-term fire return intervals. Securing habitat that supports viable populations through land acquisition, conservation easements, and landowner incentive programs will also help alleviate this threat.

Recovery for the gopher tortoise on private lands will require substantial voluntary commitments. Private landowners are not required by the Act to implement voluntary management to restore habitat. Likewise, the Act does not require private landowners to implement active management that would prevent the natural processes of forest succession,

leading to a further decline of habitat in the absence of a frequently occurring natural fire. A primary limiting factor for the recovery of the gopher tortoise is the absence of habitat restoration, with frequent prescribed fire and other active management measures to control and eliminate encroaching hardwoods and shrubs. The gopher tortoise will not be recovered simply by landowners complying with the prohibitions of section 9 of the Act to avoid incidental take. Active management to restore habitat is required, as well as active fire management to sustain existing suitable habitat.

ENVIRONMENTAL BASELINE

Climate change

According to the Intergovernmental Panel on Climate Change Report (IPCC) (2007), warming of the earth's climate is "unequivocal," as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level. The 2007 IPCC Report describes changes in natural ecosystems with potential wide-spread effects on many organisms, including marine mammals and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007).

Climate change at the global level drives changes in weather at the regional level, although weather is also strongly affected by season and local effects (*e.g.*, elevation, topography, latitude, proximity to the ocean, etcetera). Average temperature is predicted to rise from 36 to 41°F for North America by the end of this century (IPCC 2007). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing and distribution), storms (frequency and intensity), and sea level rise. However, the exact magnitude, direction, and distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Current models offer a wide range of predicted changes.

Climatic changes in south Florida could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006).

Status of the species within the action area

Scrub-jay

By 1993, 65 percent of all the scrub-jays that occurred along the entire west coast of Florida were restricted to Charlotte and Sarasota Counties (Fitzpatrick et al. 1994, Miller and Stith 2002). Since then some populations in Charlotte County have declined sharply. With about 419 individuals in 135 families, Charlotte County's scrub-jays are critically important for preservation of the species along the Gulf Coast (Miller and Stith 2002). Average family size in Charlotte County ranges from two to eight scrub-jays, with an average of 3.1 (Miller and Stith 2002).

Miller and Stith (2002) mapped a total of 11,169 acres of scrub habitat types in Charlotte County, or about 1 percent of the land area. About 1 percent of this habitat can be considered as having optimal conditions for scrub-jays, while the vast majority of the habitat is moderately to heavily overgrown. Scrub-jays are not expected to persist under such conditions (Miller and Stith 2002).

The Sarasota-West Charlotte metapopulation (M5) of scrub-jays benefits from having 56 percent of the metapopulation residing in areas that are protected (Stith 1999). The two large protected areas in M5 are Oscar Scherer State Park, and the Shamrock/Caspersen Beach County Park complex in Sarasota County. These parks were inhabited by a total of 32 scrub-jay groups in 2005 (Davison 2006). There are 18 conservation areas within the M5 area with 1,690 acres of scrub protected; however, the scrub-jays in the Charlotte County portion of M5 are suspected to be functionally isolated from those in the northern two-thirds of M5.

Stith (1999) identified the Northwestern Charlotte metapopulation (M6) between the Myakka and Peace Rivers. The western portion of M6 has 43 percent of the scrub-jays residing in protected areas (Stith 1999; Miller and Stith 2002). These protected areas include the Myakka River State Forest, Charlotte Harbor Buffer Preserve, and the Tippecanoe Scrub Park. These lands were inhabited by a total of 16 scrub-jay groups in 1993 (Stith 1999). By 2001 the scrub-jay groups had declined to 7 pairs on protected lands. Stith (1999) estimated 25 scrub-jay groups could inhabit all of the protected areas after restoration. There are eight conservation areas within the western portion of M6 area with 1,269 acres of scrub protected.

The eastern portion of M6 is believed to be relatively isolated, both geographically and reproductively, from the western portion of the metapopulation (Miller and Stith 2002). Most of the scrub-jays in this eastern portion are found in the Deep Creek/Harbour Heights area of Charlotte County. The landscape in this area is largely subdivided and urbanized. Of the 54 scrub-jay families (165 individuals) surveyed in Deep Creek/Harbour Heights in 2001, at most 3 families occur on conservation land (Miller and Stith 2002). Miller and Stith (2002) identify nearby habitats along Peace River as critical acquisition targets needed to maintain connectivity. There are four conservation areas within the M6 with 174 acres of scrub protected.

The Central Charlotte Metapopulation (M7) is east of the Peace River and Punta Gorda (Stith 1999). M7 was believed to be relatively isolated, both geographically and reproductively, from M6 (Miller and Stith 2002). However, a later study of scrub-jay genetics (Coulon et al, 2008)

showed M6 and M7 to be genetically the same, and some of the scrub-jays living in M7 had been banded in Deep Creek/Harbour Heights. The landscape where M7 occurs is largely rural, including sizeable areas of good quality scrub-jay habitat that is privately owned. Of the 36 scrub-jay families (130 individuals) surveyed in M7 in 2001, only 3 occur on publicly owned land (Miller and Stith 2002). Miller and Stith (2002) identify habitats north of Shell Creek near Washington Loop Road and Prairie Creek as "critical acquisition targets needed to maintain connectivity within" M7.

The statewide mapping project did not take into account the scrub-jays residing in suburban areas (Stith 1999). Scrub-jay habitat loss as development has increased has caused a decline in scrub-jay groups in suburban areas. While Charlotte County has submitted an HCP for scrub-jays, Sarasota County is only in the early stages of discussion about a comprehensive plan for scrub-jays. Countywide plans would not only address capital improvement projects, but also residential development that will be the greatest impact to scrub-jays. These plans would define how development, especially of single-family lots, is mitigated for and which areas should be targeted for acquisition in order to conserve a viable scrub-jay population in the county. To date, land acquisitions and other conservation measures within the action area have resulted in the protection of about 3,133 acres of habitat suitable for scrub-jays.

Eastern indigo snake

This species is difficult to observe even in locations where it is known to occur and thus difficult to survey or monitor, and the viability of existing populations is unknown (Service 2008). Occasional sightings have been reported in Charlotte County, but only one mortality has been recorded within the County according to FWC's database. Lack of observations combined with survey data indicate limited occurrence of this species within the County. Although habitat types suitable for the eastern indigo snake occur throughout the action area, the actual number of eastern indigo snakes is difficult to ascertain because of this species' large home range, secretive nature, and life history trait of spending much of their time either underground in animal burrows or natural cavities, or concealed in vegetation, tree stumps, rotten logs or other natural or artificial sheltering areas. Consequently, a reliable survey method to detect the eastern indigo snake has not been developed. The lack of practical survey methods makes it difficult to determine the exact number of indigo snakes that will be affected by the action; however, the size of the action area represents a small portion of the combined acreages of all habitats usable by eastern indigo snakes in south Florida.

A 26-year study conducted by Lane and Steiner (1996) at Archbold Biological Station (ABS), Lake Placid, Florida, estimated a population density of 2.6 eastern indigo snakes (1.9 males and 0.7 females) per 247 acres. The ABS study area was comprised of 60 percent xeric pine and oak uplands, and 40 percent pine flatwoods, bayheads, swale, and seasonal ponds). Eastern indigo snakes have been observed at ABS in all natural and man-altered habitats with no obvious habitat preferences (Layne and Steiner 1996). Using Layne and Steiner's (1996) estimates of densities at ABS, the Service estimates 80 eastern indigo snakes could occur in the Project area (2.6 snakes/247 acres x 7,552 acres = 79.5 (rounded to 80) snakes).

Gopher tortoise

This species has a broad range that includes Florida, Georgia, Alabama, Mississippi, and Louisiana. Gopher tortoises require well-drained, sandy soils for burrowing and nest construction, an abundance of herbaceous ground cover for food, and a generally open canopy that allows sunlight to reach the forest floor (Landers 1980; Auffenberg and Franz 1982). This species would likely occur throughout the uplands present in the action area; however, the actual number of gopher tortoises or their burrows in the action area is unknown. Likewise, the Applicant has identified gopher tortoises within the Project area, but has not estimated their numbers.

Factors affecting the species' environment within the action area

Over the last 50 years, human occupation of southwest Florida resulted in direct habitat loss through land clearing, habitat fragmentation, and habitat degradation through fire suppression. Although the distribution of eastern indigo snakes and gopher tortoises is largely unknown in the action area, it is likely their distribution and numbers have declined in response to these increasing agricultural and urban pressures just as the scrub-jay has. These same factors continue to act synergistically against these species in southwest Florida. In addition, as populations of these species become smaller and more isolated, the adverse demographic effects caused by urbanization may be magnified. Under these circumstances, small populations of both species are more susceptible to extirpation than larger populations. Further acquisition and appropriate management of habitat are expected to aid both species in increasing their numbers.

Demographic modeling by Stith (1999) indicates the M5 metapopulation is at moderate risk of "quasi-extinction" (falling below 10 pairs of scrub-jays) with no further land acquisition (Stith 1999). The metapopulation could be moved to low risk of quasi-extinction through a 30 percent increase in suitable habitat protected. The M6 and M7 metapopulations are highly vulnerable to quasi-extinction unless additional habitat is acquired (Stith 1999). However, if all or major portions of remaining scrub-jay habitat within M6 and M7 were acquired, the risk of quasi-extinction could be greatly reduced (Stith 1999). Land acquisition and management efforts by private, local, State, and Federal agencies have been undertaken in Charlotte County in recent years, and it is thought any acquisition and management that is beneficial for scrub-jays will also be ultimately beneficial for eastern indigo snakes and gopher tortoises.

Results of a survey conducted in 2010 (Boughton and Bowman 2011) indicated scrub-jay populations have increased on some managed public lands. The Prairie Creek Preserve did not have any family groups present when surveyed in 1992/93; however, 6 family groups were present in 2010. Population viability analyses conducted as part of the HCP planning process resulted in the County's decision to acquire additional lands adjacent to or within easy dispersal distance of existing conservation lands within the action area, and to focus these acquisition efforts on M7 as that area has the highest probability for the County to obtain enough property to sustain that metapopulation for at least 100 years.

Although we do not have the same quantity and quality of demographic information about eastern indigo snakes and gopher tortoises as we do for scrub-jays, we suspect the factors listed above also act against these species.

EFFECTS OF THE ACTION

This section includes an analysis of the beneficial, direct, and indirect effects of the proposed action on the species and/or critical habitat and its interrelated and interdependent activities.

Factors to be considered

The Project area encompasses habitat occupied by the scrub-jay, eastern indigo snake, and gopher tortoise. Critical habitat has not been designated for any of these species, so none will be considered. The pre-construction clearing of land in buffers around confirmed scrub-jay observations will be conducted before March 1 or after June 30 to reduce the risk of take of scrub-jays during nesting season. The Applicant will require property owners and its habitat management staff to implement the *Standard Protection Measures for the Eastern Indigo Snake (Drymarchon corais couperi)* (Service 2004; and subsequent versions as they become available) to reduce the risk of take of this species. The Applicant will also require property owners and its habitat management staff to follow the most recent guidelines established by the FWC and the Service, as they become available, concerning all activities affecting gopher tortoises to reduce the likelihood of take of this species.

Analyses for effects of the action

Florida scrub-jay

Beneficial Effects

The Applicant will conserve and maintain in perpetuity 4,496 acres of habitat suitable for scrub-jays. Current conservation lands account for 3,160 acres of this total, and the Applicant anticipates adding another 1,336 acres of sheltering, foraging, and potential nesting habitat for this species through implementation of the HCP. The majority of the 1,336 acres will be acquired in the M7 metapopulation because the acquisition of sufficient acreage to support scrub-jays for the next 100 years can be accomplished in the central part of the County, whereas population viability analyses have indicated acquisition of sufficient land to prevent eventual extinction in M6 and the southern portion of M5 is not feasible. The Applicant has designed a fee payment schedule, based on property size, to be paid by all owners of vacant land located partially or wholly in the buffer areas around confirmed scrub-jay observations when these properties are developed. These fees will be dedicated to acquisition and restoration of an additional 1,336 acres of scrub habitat, and management in perpetuity of current and future public lands for the benefit of scrub-jays.

Direct Effects

Direct effects to this species' ability to breed, feed or shelter will occur by the permanent alteration of occupied habitat during otherwise lawful activities associated with residential, commercial, or County development projects. Permanent alteration of scrub-jay habitat will include clearing of lots for development; installation of infrastructure and impervious surfaces; and construction of buildings and ancillary structures. It is estimated that 46 groups of scrub-jays in M5, 14 groups in M6, and 76 groups in M7 will be directly affected. The total estimate of currently occupied scrub-jay habitat has the potential to be impacted by development is 3,056 acres.

Additional direct effects may occur during translocation of scrub-jays and routine land management activities such as prescribed burning. Scrub-jay translocation events will be conducted by appropriately permitted persons, so take of individual birds will be accounted for under the analysis of the issuance of 10(a)(1)(A) permits. Weather conditions necessary for prescribed burns in scrub typically occur during the growing season, which can coincide with the scrub-jay nesting season. Adult and juvenile scrub-jays can avoid flames and smoke. Prescribed burns and associated human activity may temporarily disrupt the birds' daily behavior patterns and ability to forage for a short period, and existing nests may be lost in prescribed fires. The use of prescribed fire or mechanical vegetation reduction has the potential for reducing the height of entire scrub-jay territories to an unsuitable height, and can also destroy the available acorn crop until the scrub oaks again grow large enough to bear fruit.

Indirect Effects

Indirect effects may also occur as a result of development. These may include: degraded, overgrown, or unmanaged habitat; increased habitat fragmentation; increased 'edge effect'; introduction of exotic flora and predatory fauna; introduction of non-native food items; reduction of native food sources; reduction of breeding, feeding, and sheltering habitats; collisions with motor vehicles; and becoming more exposed to natural predators due to habitat conversion and fragmentation. Additionally, should scrub-jays disperse from areas of take, dispersal will be more difficult due to the above indirect effects associated with urban and suburban habitats. Overall, Fitzpatrick *et al.* (1991) noted individual encounters between humans and scrub-jays are likely to result in increased mortality rates of both juvenile and adult birds for many of the same reasons listed above.

Interrelated and Interdependent Effects

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No additional interrelated or interdependent effects were identified for the proposed Project.

Species' response to a proposed action

Permanent alteration of occupied habitat is likely to have adverse effects to resident scrub-jays as development continues in the Project area. The reduction in feeding, breeding, and sheltering habitat will likely reduce adult survivorship; reproductive success; juvenile survival; and possibly lead to abandonment of territories. As losses of habitat continue, dispersal opportunities for scrub-jays will become increasingly limited. Scrub-jays are not strong flyers and cannot sustain long-distance flights. Instead they typically stop periodically in patches of scrub or similar habitats while seeking new territories or exploring adjacent habitat.

While habitat management activities can temporarily disturb breeding, feeding, and sheltering behavior, this species typically re-nests rapidly after fire. With proper habitat restoration and adequate resources, scrub-jays can increase in numbers (Thaxton and Hingtgen 1996). The rate of recovery depends on the size of the habitat preserved and availability of new recruits naturally migrating from surrounding territories or being translocated. Acquisition, restoration, and maintenance of scrub habitat over time will help stabilize scrub-jay populations in the action area.

Eastern indigo snake

Beneficial Effects

The Applicant will conserve and maintain in perpetuity 4,496 acres of eastern indigo snake habitat. Current conservation lands account for 3,160 acres of this total, and the Applicant anticipates adding another 1,336 acres of sheltering, foraging, and potential nesting habitat for this species through implementation of the HCP. The majority of the 1,336 acres will be acquired in the central part of the County (M7). Although opportunities that arise to acquire additional lands in M6 and the southern portion of M5 will not be ignored, the generally larger-sized parcels in M7 offer a better chance to obtain the large continuous tracts of land that would be more beneficial to this species. The Applicant has designed a fee payment schedule, based on property size, to be paid by all owners of vacant land located partially or wholly in the buffer areas around confirmed scrub-jay observations when these properties are developed. These fees will be dedicated to acquisition and restoration of an additional 1,336 acres of scrub habitat, and management in perpetuity of current and future public lands for the benefit of this species.

Direct Effects

Direct effects to the species' ability to breed, feed or shelter will occur by the permanent alteration of occupied habitat during otherwise lawful activities associated with residential, commercial, or County development projects. Permanent alteration of eastern indigo snake habitat will include clearing of lots for development; installation of infrastructure and impervious surfaces; and construction of buildings and ancillary structures. It is estimated that up to 32 eastern indigo snakes will be directly affected by the development of 3,056 acres.

Additional direct effects may occur during routine land management activities such as prescribed burning, mechanical vegetation reduction, and fire break maintenance. Adult eastern indigo snakes can typically avoid fire or mechanical management activities by finding refuge underground; however, juveniles can be injured or killed because they often seek refuge in debris piles. The Service also estimates up to 48 eastern indigo snakes could also be affected by habitat management activities.

Indirect Effects

In addition to the direct take of occupied eastern indigo snake habitat, indirect effects may occur as a result of development. These may include: degraded, overgrown, or unmanaged habitat; increased habitat fragmentation; increased 'edge effect'; introduction of exotic predatory fauna; reduction of native food sources; reduction of breeding, feeding, and sheltering habitats; collisions with motor vehicles; direct mortality from humans; and becoming more exposed to natural predators due to habitat conversion and fragmentation. Additionally, should eastern indigo snakes disperse from areas of take, dispersal will be more difficult due to the above indirect effects associated with urban and suburban habitats.

Interrelated and Interdependent Effects

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No additional interrelated or interdependent effects were identified for the proposed Project.

Species' response to a proposed action

Permanent alteration of occupied habitat is likely to have adverse effects to resident eastern indigo snakes as development continues in the Project area. The reduction in feeding, breeding, and sheltering habitat will likely reduce adult survivorship; reproductive success; juvenile survival; and possibly lead to abandonment of territories. As losses of habitat continue, dispersal opportunities for eastern indigo snakes will become increasingly limited. Dispersing eastern indigo snakes will have to cross roadways containing ever increasing numbers of vehicles. However, with proper habitat restoration and adequate resources eastern indigo snakes could increase in numbers. The rate of recovery depends on the size of the habitat preserved and availability of new recruits naturally migrating from surrounding areas. Acquisition, restoration, and maintenance of scrub habitat over time will help stabilize eastern indigo snake populations in the action area.

Gopher tortoise

Beneficial Effects

The Applicant will conserve and maintain in perpetuity 4,496 acres of gopher tortoise habitat. Current conservation lands account for 3,160 acres of this total, and the Applicant anticipates adding another 1,336 acres of sheltering, foraging, and potential nesting habitat through implementation of the HCP. The majority of the 1,336 acres will be acquired in the central part of the County (M7). Although opportunities that arise to acquire additional lands in M6 and the southern portion of M5 will not be ignored, the generally larger-sized parcels in M7 offer a better chance to obtain the large continuous tracts of land that would be more beneficial to this species. The Applicant has designed a fee payment schedule, based on property size, to be paid by all owners of vacant land located partially or wholly in the buffer areas around confirmed scrub-jay observations when these properties are developed. These fees will be dedicated to acquisition and restoration of an additional 1,336 acres of scrub habitat, and management in perpetuity of current and future public lands for the benefit of this species.

Direct Effects

Direct effects to the species' ability to breed, feed or shelter will occur by the permanent alteration of occupied habitat during otherwise lawful activities associated with residential, commercial, or County development projects. Permanent alteration of gopher tortoise habitat will include clearing of lots for development; installation of infrastructure and impervious surfaces; and construction of buildings and ancillary structures.

Additional direct effects may occur during routine land management activities such as prescribed burning, mechanical vegetation reduction, and fire break maintenance. Having evolved in fire-maintained habitats like scrub, the Service anticipates many gopher tortoises can typically fire or mechanical management activities by finding refuge underground. However, some adults and juveniles may not successfully escape the fire; adults, juveniles and eggs could be crushed by mechanical equipment; and adults and juveniles could be entombed if mechanical equipment collapses their burrows. As the numbers and distribution of gopher tortoises in the action area is unknown, neither the Applicant nor the Service has an estimate of how many gopher tortoises may be directly affected by development or habitat management.

Indirect Effects

In addition to the direct take of occupied gopher tortoise habitat, indirect effects may occur as a result of development. These may include: degraded, overgrown, or unmanaged habitat; increased habitat fragmentation; increased 'edge effect'; introduction of exotic flora and predatory fauna; introduction of non-native food items; reduction of native food sources; reduction of breeding, feeding, and sheltering habitats; collisions with motor vehicles; and becoming more exposed to natural predators due to habitat conversion and fragmentation. Additionally, should gopher tortoises disperse from areas of take, dispersal will be more difficult due to the above indirect effects associated with urban and suburban habitats. As the numbers and distribution of gopher tortoises in the action area is unknown, neither the Applicant nor the Service has an estimate of how many gopher tortoises may be indirectly affected by development or habitat management.

Interrelated and Interdependent Effects

An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for its justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation. No additional interrelated or interdependent effects were identified for the proposed Project.

Species' response to a proposed action

Permanent alteration of occupied habitat is likely to have adverse effects to resident gopher tortoises as development continues in the Project area. The reduction in feeding, breeding, and sheltering habitat will likely reduce adult survivorship; reproductive success; juvenile survival; and possibly lead to abandonment of territories. As losses of habitat continue, dispersal opportunities for gopher tortoises will become increasingly limited. Dispersing tortoises will have to cross roadways containing ever increasing numbers of vehicles. However, with proper habitat restoration and adequate resources gopher tortoises could increase in numbers. The rate of recovery depends on the size of the habitat preserved and availability of new recruits naturally migrating from surrounding areas. Acquisition, restoration, and maintenance of scrub habitat over time are likely to help stabilize gopher tortoise populations in the action area.

CUMULATIVE EFFECTS

Cumulative effects include those of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

The action area is expected to continue to experience urban growth and many patches of scrub habitat that are not currently under public ownership will be lost or further degraded. At present, all development in buffer areas around confirmed scrub-jay observations requires Service review before building permits are approved by Charlotte County. If a proposed project is within 850 feet of a confirmed scrub-jay location in the northern portion of M6, either Sarasota County or the City of North Port, depending on which entity is issuing the building permit, provides notifications to landowners and the Service that the landowners should consult with the Service. Additionally, Sarasota County will provide the same notification if the project is 5 acres or larger and is located in scrub habitat, regardless of whether there is a scrub-jay observation within 850 feet. The Service has yet to develop such a working relationship with DeSoto County, which contains the northern portion of M7 and a small portion of M6, so this County notifies neither the Service nor landowners when development is proposed in areas that could, or do, contain federally-listed species.

There are numerous isolated patches of poor quality scrub habitat in the action area that are not occupied by scrub-jays, but are probably used occasionally as refugia by dispersing birds, and possibly by eastern indigo snakes and gopher tortoises. Because these isolated sites do not contain occupied scrub-jay territories, and the presence of eastern indigo snakes is difficult to determine, clearing and subsequent development would not be considered take of habitat and would not be subject to consultation under sections 7 or 10. Therefore, the Service anticipates unoccupied, overgrown scrub that may occasionally be used by scrub-jays, eastern indigo snakes, or gopher tortoises will be lost to urban uses in the future. The extent and timing of these losses cannot be determined because of variation in urban growth patterns over time.

Commitments by the State of Florida to continue land acquisition and management may provide opportunities to protect additional xeric scrub in southwestern Florida, and the action area in particular. One of the goals of Florida's land acquisition program (Florida Forever) is to acquire additional scrub uplands; however, the amount of lands reasonably certain to be acquired cannot be determined as funding for this program is not guaranteed from year to year.

CONCLUSION

The proposed action including commercial, residential, and infrastructure construction will permanently alter an estimated 3,056 acres of occupied scrub-jay, eastern indigo snake, and gopher tortoise habitat in Charlotte County. This loss of habitat is expected to result in adverse effects to these species. However, effects of these losses will be minimized through timing of construction activities to avoid scrub-jay nesting season, implementation of the Service's *Standard Protection Measures for the Eastern Indigo Snake (Drymarchon corais couperi)* (Service 2004; and subsequent iterations as they become available), and implementation of the most recent guidelines established by the FWC and the Service, as they become available,

concerning all activities affecting gopher tortoises. Mitigation in the form of acquisition, restoration, and management in perpetuity of conservation lands is expected to provide permanent, appropriately managed habitat for scrub-jays, eastern indigo snakes, and gopher tortoises. Although population viability analysis indicates long-term viability of scrub-jays can only be achieved in the central part of Charlotte County, we anticipate benefits to the security and viability of the other affected species on public lands throughout Charlotte County as a result of implementation of the minimization and mitigation measures in the Permit.

Listed species/Critical habitat

The Service has reviewed the current status of the scrub-jay and eastern indigo snake, the environmental baseline for the action area, and the direct, indirect, and cumulative effects of the proposed action within the action area and, it is our biological opinion that issuance of this Permit is not likely to jeopardize the continued existence of the scrub-jay, the eastern indigo snake, or the gopher tortoise. No critical habitat has been designated for these species; therefore, none will be affected.

Candidate species

The Service has reviewed the current status of the gopher tortoise, the environmental baseline for the action area, and the direct, indirect, and cumulative effects of the proposed action within the action area and, it is our conference opinion that issuance of this Permit is not likely to jeopardize the continued existence of the candidate gopher tortoise.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without a special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns, which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided such taking is in compliance with the terms and conditions of this incidental take statement.

The Applicant's HCP and its associated documents clearly identify expected impacts to affected species likely to result from the action and the measures that are necessary and proper to minimize those impacts. Such measures are nondiscretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the Act to apply. If the Applicant

fails to implement the measures outlined in the HCP and its accompanying section 10(a)(1)(B) permit, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The amount or extent of incidental take expected under the Applicant's HCP, associated reporting requirements, and provisions for disposition of dead or injured animals are as described in the HCP and its accompanying section 10(a)(1)(B) permit.

AMOUNT OR EXTENT OF TAKE

The Service anticipates 3,056 acres of habitat occupied by scrub-jays, eastern indigo snakes, and gopher tortoises will be permanently altered due to development of vacant land in the Project area, and an additional 4,496 acres of habitat will be periodically impacted as a result of restoration and management activities. The Service expects incidental take of scrub-jays, eastern indigo snakes, and gopher tortoises will be difficult to detect for the following reasons: (1) we do not know they are present in the entire 7,552 acres, (2) we do not know the current reproductive rate of the affected individuals, and (3) monitoring for any affected individuals will not be conducted after each construction, restoration, or management activity in the Project area. However, the level of take of eastern indigo snakes can be estimated using the total Project area (7,552 acres) that could contain up to 80 individuals. Incidental take of individual scrub-jays may also be difficult to detect, but the level of take can be estimated by the permanent alteration of 3,056 acres of undeveloped parcels that are currently being used by 136 scrub-jay families, and the restoration and management of 4,496 acres of scrub habitat that is occupied by 10 known scrub-jay families and an additional number of unknown families. While the exact amount of incidental take of gopher tortoises may be difficult to predict, this number is expected to be minimal.

Depending on availability of unoccupied habitat in the vicinity of each construction site over the life of the Permit, the affected species may:

1. Alter their territories to include adjacent, suitable habitat to compensate for the loss,
2. Persist in their reduced territories, or
3. Abandon their territories.

In all three events, scrub-jays, eastern indigo snakes, and gopher tortoises will be affected by the loss of habitat and the reduction in the amount and/or quality of habitat that remains. This portion of the Project is expected to cause significant habitat modification resulting in take in the form of direct mortality, harassment, or harm through significant impairment to feeding, breeding, or sheltering behavior of the resident species.

Depending on availability of unoccupied habitat in the vicinity of each restoration or management site over the life of the Permit, the affected species may:

1. Alter their territories to include adjacent, suitable habitat to compensate for the temporary loss, or
2. Persist in their reduced territories until the restored or managed portion becomes suitable again.

Scrub-jays, eastern indigo snakes, and gopher tortoises will be temporarily affected by habitat restoration and management activities. This portion of the Project is expected to cause temporary habitat modification resulting in take in the form of harassment.

The level of incidental take will be monitored by the acres and frequency of habitat undergoing prescribed burn activities and exotic vegetation removal. Take in the form of harassment, harm or direct mortality is possible during any part of the Project, but the likelihood is reduced with the implementation of the minimization measures.

EFFECT OF TAKE

In the accompanying Biological Opinion, the Service determined the level of anticipated take is not likely to result in jeopardy to the scrub-jay or eastern indigo snake, or destruction or adverse modification of critical habitat.

The prohibitions against taking the species found in section 9 of the Act do not apply to the gopher tortoise until the gopher tortoise is listed in Florida. However, we advise the Service to consider requiring the Applicant to implement the following reasonable and prudent measures. If this Conference Opinion is adopted as a Biological Opinion following a listing or designation, these measures, with their implementing terms and conditions, will be nondiscretionary.

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 Applicant's HCP prescribes methods to mitigate for habitat loss, minimize habitat disturbances, and address unforeseen future circumstances. These methods represent actions to minimize and mitigate adverse effects to the scrub-jay and eastern indigo snake to the maximum extent practicable. In addition, the Applicant has agreed to implement measures to reduce the risk of take of the gopher tortoise. The Service will ensure the Applicant implements the HCP.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline the required reporting / monitoring requirements. These terms and conditions are non-discretionary:

1. The Service must issue a Permit with the conservation measures as identified in the HCP and any standard special conditions necessary. The proposed Project and conditions of the section 10(a)(1)(B) permit are designed to minimize the effects of incidental take that might otherwise result from the proposed action. The Service believes that no more than 3,056 acres of habitat in the Charlotte county; currently occupied by 136 scrub-jay

families, up to 32 eastern indigo snakes, and an unknown number of gopher tortoises; will be permanently altered. In addition, 4,496 acres of habitat; currently occupied by 10 or more families of scrub-jays, up to 48 eastern indigo snakes, and an unknown number of gopher tortoises; will be periodically disturbed during vegetation management activities. If, during the course of this action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the project design and special conditions of the incidental take permit. The Service must immediately provide an explanation of the causes of the taking and review the need for possible modification of the project.

2. The Service will require the Applicant to provide an annual report of mitigation and monitoring activities including number of acres acquired, vegetation management, vegetation monitoring, and success criteria, for the 30 year duration of the permit, and every 5 years after the Permit has expired. The report will also include observations of listed species and any effects to listed species resulting from the mitigation and monitoring activities. These reports will be submitted to: U.S. Fish and Wildlife Service, South Florida Ecological Services Office, 1339 20th Street, Vero Beach, Florida 32960-3559 by October 1 of each reporting year.

3. The Service will require reinitiation of consultation and review of the Project designs and special conditions of the incidental take permit if, during the course of this action, the above-stated levels of incidental take are exceeded, a new species is listed, or critical habitat becomes designated. The Service must immediately provide an explanation of the causes of the taking and review the need for possible modification of the Project.

4. The Service will meet with the Applicant in years 2, 4, 6, and every 5 years thereafter to evaluate whether land acquisition, development, and fee collection are on track to meet the goal of acquiring 1,336 acres for conservation by the end of the Permit term.

5. The Service will require that if the Applicant locates a dead, injured, or sick specimen of Florida scrub-jay, an eastern indigo snake, FBB, or gopher tortoise, the Applicant will first notify the nearest Service Law Enforcement Office (Fish and Wildlife Service; 9549 Koger Boulevard, Suite 111; St. Petersburg, Florida 33702; 727-570-5398). The Service will also require the Applicant to make secondary notification to the FWC, South Region; 3900 Drane Field Road; Lakeland, Florida 33811-1299; 800-282-8002. The Service will instruct the Applicant to take care in handling sick or injured specimens to ensure effective treatment and care, or in the handling of dead specimens to preserve biological material in the best possible state for later analysis as to the cause of death. In conjunction with the care of sick or injured specimens or preservation of biological materials from a dead animal, the Service will make sure the Applicant understands the finder has the responsibility to carry out instructions provided by Law Enforcement to ensure that evidence intrinsic to the specimen is not unnecessarily disturbed.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to further 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. Make available an informational brochure to the public that explains the basic habitat requirements of the scrub-jay, the threats to its continued existence, the adverse effects of human-related disturbances such as free-roaming cats and invasive exotic vegetation, and encourages the retention and use of native scrub vegetation in landscaping to provide suitable habitat for scrub-jays where practicable.

REINITIATION NOTICE

This concludes formal consultation on the proposed issuance of the Permit by the Service. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Service involvement or control over the action has been retained (or is authorized by law) and if:

1. The amount or extent of incidental take is exceeded;
2. New information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion;
3. The Service's action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or
4. A new species is listed or critical habitat designated that may be affected by the action.

In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

The Service may confirm the Conference Opinion as a Biological Opinion issued through formal consultation if the gopher tortoise is listed in Florida. If the Service reviews the proposed action and finds there have been no significant changes in the action as planned or in the information used during the conference, the Service will confirm the Conference Opinion as the Biological Opinion on the project and no further section 7 consultation will be necessary.

After listing of the gopher tortoise as endangered/threatened and any subsequent adoption of this Conference Opinion, the South Florida Ecological Services Office shall request reinitiation of consultation if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect the species or critical habitat in a manner or to an extent not considered in this Conference Opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the species or critical habitat that was not considered in this Conference Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

The incidental take statement provided in this Conference Opinion does not become effective until the gopher tortoise is listed in Florida and the Conference Opinion is adopted as the Biological Opinion issued through formal consultation. At that time, the project will be reviewed to determine whether any take of the species has occurred. Modifications of the Opinion and incidental take statement may be appropriate to reflect that take. No take of the species may occur between the listing of the gopher tortoise and the adoption of the Conference Opinion through formal consultation, or the completion of a subsequent formal consultation.

If you have any questions, please contact Elizabeth Landrum at 772-469-4304.

cc: electronic only
Service, Atlanta, Georgia (David Dell)
Service, Jackson, Mississippi (Linda LaClaire, Matt Hinderliter)
Service, St. Petersburg, Florida (Todd Mecklenborg)
Service, Tallahassee, Florida (Jerry Ziewitz)
Service, Vero Beach, Florida (Marilyn Knight, Brian Powell)

LITERATURE CITED

General

Intergovernmental Panel on Climate Change Fourth Assessment Report. 2007. Climate Change 2007: Synthesis Report. Summary for Policy Makers. Draft.

Pearlstine, L.G. 2008. Ecological consequences of climate change for the Florida Everglades: An initial summary. Technical memorandum, South Florida Natural Resources Center, Everglades National Park; Homestead, Florida.

U.S. Fish and Wildlife Service. 1999. South Florida multi-species recovery plan [Internet]. Atlanta, Georgia [cited December 14, 2006]. Available from: http://verobeach.fws.gov/Programs/Recovery/vbms5.html.

U.S. Fish and Wildlife Service. 2006. Strategic Habitat Conservation. Final Report of the National Ecological Assessment Team to the U.S. Fish and Wildlife Service and U.S. Geologic Survey.

U.S. Fish and Wildlife Service. 2007. Draft communications plan on the U.S. Fish and Wildlife Service's Role in Climate Change.

Florida scrub-jay

Abrahamson, W.G. 1984. Post-fire recovery of Florida Lake Wales Ridge vegetation. American Journal of Botany 71(1):9-21.

Abrahamson, W.G., A.F. Johnson, J.N. Layne, and P.A. Peroni. 1984. Vegetation of the Archbold Biological Station, Florida: an example of the southern Lake Wales Ridge. Florida Scientist. 47(4):209-250.

American Ornithologists' Union. 1957. Check-list of North American Birds. Fifth edition. Allen Press; Lawrence, Kansas.

American Ornithologists' Union. 1983. Checklist of North American Birds. Sixth edition. Allen Press; Lawrence, Kansas.

American Ornithologists' Union. 1995. Fortieth supplement to the North American Ornithologists' Union Checklist of North American Birds. Auk 112(3):819-830.

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.

Bendire, C.E. 1895. Life histories of North American birds. U.S. National Museum Special Bulletin No. 3. U.S. Government Printing Office; Washington, D.C.

Boughton, R.K. and R. Bowman. 2011. State wide assessment of Florida scrub-jays on managed areas: A comparison of current populations to the results of the 1992-93 survey. Archbold Biological Station; Venus, Florida.

Boughton, R.K., J.W. Atwell, and S.J. Schoech. 2006. An introduced generalist parasite, the sticktight flea (*Echidnophaga gallinacea*), and its pathology in the threatened Florida scrub-jay (*Aphelocoma coerulescens*). Journal of Parasitology 92(5):941–948.

Bowman, R. 1998. Population dynamics, demography, and contributions to metapopulation dynamics by suburban populations of the Florida scrub-jay, *Aphelocoma coerulescens*. Final report on Project No. NG94-032 to Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Bowman, R. and L. Averill. 1993. Demography of a suburban population of Florida scrub-jays. Annual progress report for Agreement No. 14-16-0004-91-950 with U.S. Fish and Wildlife Service; Jacksonville, Florida.

Bowman, R., G.E. Woolfenden, A.L. Fleischer, Jr., and L.M. Walton. 1996. Nest site selection by Florida scrub-jays in natural and modified habitats [abstract]. Page 2 *in* Symposium on Current Research at Archbold Biological Station. Lake Placid, Florida.

Breininger, D.R. 1999. Florida scrub-jay demography and dispersal in a fragmented landscape. The Auk 116(2):520-527.

Breininger, D.R. and P.A. Schmalzer. 1990. Effects of fire and disturbance on plants and birds in a Florida oak/palmetto scrub community. American Midland Naturalist 123(1):64-74.

Breininger, D.R., M.J. Provancha, and R.B. Smith. 1991. Mapping Florida scrub-jay habitat for purposes of land-use management. Photogrammetric Engineering and Remote Sensing 57(11):1467-1474.

Breininger, D.R., V.L. Larson, B.W. Duncan, R.B. Smith, D.M. Oddy, and M.F. Goodchild. 1995. Landscape patterns of Florida scrub-jay habitat use and demographic success. Conservation Biology 9(6):1442-1453.

Breininger, D.R., V.L. Larson, B.W. Duncan, and R.B. Smith. 1998. Linking habitat suitability to demographic success in Florida scrub-jays. Wildlife Society Bulletin 26(1):118-128.

Breininger, D.R., M.A. Burgman, and B.M. Stith. 1999. Influence of habitat quality, catastrophes, and population size on extinction risk of the Florida scrub-jay. Wildlife Society Bulletin 27(3):810-822.

Breininger, D.R., B. Toland, D. Oddy, M. Legare, J. Elseroad, and G. Carter. 2001. Biological criteria for the recovery of Florida scrub-jay populations on public lands in Brevard County and Indian River County. Annual Progress Report, U.S. Fish and Wildlife Service; Jacksonville, Florida.

Breininger, D.R., B.W. Duncan, and N.J. Dominy. 2002. Relationships between fire frequency and vegetation type in pine flatwoods of east-central Florida, USA. Natural Areas Journal 22(3):186-193.

Breininger, D.R, B. Toland, D. Oddy, M. Legare, J. Elseroad, and G. Carter. 2003. Biological criteria for the recovery of Florida scrub-jay populations on public lands in Brevard County and Indian River County. Final Report, U.S. Fish and Wildlife Service; Jacksonville, Florida.

Byrd, H. 1928. Notes from correspondents: Florida jay. Florida Naturalist 1(4):87.

Coulon, A., J.W. Fitzpatrick, R. Bowman, B.M. Stith, C.A. Makarewich, L.M. Stenzler, and I.J. Lovette. 2008. Congruent population structure inferred from dispersal behavior and intensive genetic surveys of the threatened Florida scrub-jay (Aphelocoma coerulescens). Molecular Ecology 17:1685-1701.

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

Davis, J.H., Jr. 1943. The natural features of southern Florida: especially the vegetation and the Everglades. Florida Department of Conservation, Florida Geological Survey Bulletin 25:1-311.

Davis, J.H., Jr. 1967. General map of natural vegetation of Florida. Agricultural Experiment Station, Institute of Food and Agricultural Sciences, University of Florida; Gainesville, Florida.

DeGange, A.R., J.W. Fitzpatrick, J.N. Layne, and G.E. Woolfenden. 1989. Acorn harvesting by Florida scrub-jays. Ecology 70(2):348-356.

Dreschel, T.W., R.B. Smith, and D.R. Breininger. 1990. Florida scrub-jay mortality on roadsides. Florida Field Naturalist 18(4):82-83.

Duncan, B.W. and D.R. Breininger. 1998. Quantifying habitat change: modeling historic and current Florida scrub-jay habitat suitability. Proceedings of GIS/LIS 1998 Annual Conference; Fort Worth, Texas.

Duncan, B.A., S. Boyle, D.R. Breininger, and P.A. Schmalzer. 1999. Coupling past management practice and historic landscape change on John F. Kennedy Space Center, Florida. Landscape Ecology 14:291-309.

Fernald, R.T. 1989. Coastal xeric scrub communities of the Treasure Coast Region, Florida: A summary of their distribution and ecology, with guidelines for their preservation and management. Nongame Wildlife Program Technical Report Number 6. Florida Game and Fresh Water Fish Commission; 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, editors, 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*). Nongame Wildlife Program Technical Report No. 8. Florida Game and Fresh Water Fish Commission; Tallahassee, Florida.

Fitzpatrick, J.W., B. Pranty, and B. Stith. 1994. Florida scrub-jay statewide map, 1992-1993. Archbold Biological Station. Lake Placid, Florida.

Fleischer, A.L., Jr. 1996. Pre-breeding time budgets of female Florida scrub-jays in natural and suburban habitats [abstract]. Page 5 *in* Symposium on Current Research at Archbold Biological Station; Lake Placid, Florida.

Franzreb, K.E. and J. Puschock. 2004. Year 3 (FY 2003): Status, population dynamics, and habitat use of the Florida scrub-jay on the Ocala National Forest, Florida. Draft annual report 2003. Southern Region, U.S. Forest Service; Asheville, North Carolina.

Hanski, I., and M. Gilpin. 1991. Metapopulation dynamics: brief history and conceptual domain. Biological Journal of the Linnaean Society 42:3-16.

Harper, R.M. 1927. Natural resources of southern Florida. Florida State Geological Survey Annual Report 18:27-206.

Hastie, K. and E. Eckl. 1999. North Florida team rallies around scrub-jay. Page 28 *in* M. Durhan, editor. Fish and Wildlife News. July/August 1999. U.S. Fish and Wildlife Service; Washington, D.C.

Hofstetter, R.H. 1984. The effect of fire on the pineland and sawgrass communities of southern Florida. Pages 465-476 *in* P.J. Gleason, editor. Environments of south Florida: present and past II. Miami Geological Society; Coral Gables, Florida.

Kinsella, J.M. 1974. Helminth fauna of the Florida scrub-jay: host and ecological relationships. Proceedings of the Helminthological Society of Washington 41(2):127-130.

Laessle, A.M. 1958. The origin and successional relationship of sandhill vegetation and sand-pine scrub. Ecological Monographs 28(4):361-387.

Laessle, A.M. 1968. Relationships of sand pine scrub to former shore lines. Quarterly Journal of the Florida Academy of Science 30(4):269-286.

McGowan, K.J. and G.E. Woolfenden. 1989. A sentinel system in the Florida scrub-jay. Animal Behavior 37(6):1000-1006.

McGowan, K.J. and G.E. Woolfenden. 1990. Contributions to fledgling feeding in the Florida scrub-jay. Journal of Animal Ecology 59(2):691-707.

Menges, E.S. and C.V. Hawkes. 1998. Interactive effects of fire and microhabitat on plants of Florida scrub. Ecological Applications 8(4):935-946.

Menges, E.S. and N. Kohfeldt. 1995. Life history strategies of Florida scrub plants in relation to fire. Bulletin of the Torrey Botanical Club 122(4):282-297.

Miller, J.B. 2003. Personal communication. Biologist. Email to Billy Brooks dated May 13, 2003. Florida Park Service; St. Augustine, Florida.

Miller, K.E. 2004. Personal communication. Biologist. Email to U.S. Fish and Wildlife Service dated December, 14, 2004. Florida Fish and Wildlife Conservation Commission; Gainesville, Florida.

Miller, K.E. 2006. Assessing impacts of Hurricane Charley on Florida scrub-jays in Charlotte County. Progress Report to U.S. Fish and Wildlife Service; Vero Beach, Florida.

Miller, K.E., and B.M. Stith. 2002. Florida scrub-jay distribution and habitat in Charlotte County. Final Report to Charlotte County; Port Charlotte, Florida.

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

Mumme, R.L., S.J. Schoech, G.E. Woolfenden, and J.W. Fitzpatrick. 2000. Life and death in the fast lane: demographic consequences of road mortality in the Florida scrub-jay. Conservation Biology 14(2):501-512.

Myers, R.L. 1990. Scrub and high pine. Pages 150-193 *in* R.L. Myers and J.J. Ewel, eds. Ecosystems of Florida. University of Central Florida Press; Orlando, Florida.

Nash, G.V. 1895. Notes on some Florida plants. Bulletin of the Torrey Botanical Club 22(4):141-161.

Percival, H.F., D.B. McDonald, and M.J. Mazurek. 1995. Status and distribution of the Florida scrub-jay (*Aphelocoma c. coerulescens*) on Cape Canaveral, Florida. Technical Report No. 51. Florida Fish and Wildlife Research Unit; Gainesville, Florida.

Root, K.V. 1998. Evaluating the effects of habitat quality, connectivity, and catastrophes on a threatened species. Ecological Applications 8(3):854-865.

Schaub, R., R.L. Mumme, and G.E. Woolfenden. 1992. Predation on the eggs and nestlings of Florida scrub-jays. The Auk 109(3):585-593.

Schmalzer, P.A. and S.R. Boyle. 1998. Restoring long-unburned oak-saw palmetto scrub requires mechanical cutting and prescribed burning. Restoration and Management Notes 16(1):96-97.

Schmalzer, P.A. and C.R. Hinkle. 1992a. Recovery of oak-saw palmetto scrub after fire. Castanea 57(3):158-173.

Schmalzer, P.A., and C.R. Hinkle. 1992b. Species composition and structure of oak-saw palmetto scrub vegetation. Castanea 57(4):220-251.

Snodgrass, J.W., T. Townsend, and P. Brabitz. 1993. The status of scrub and scrub jays in Brevard County, Florida. Florida Field Naturalist 21(3):69-74.

Stallcup, J.A. and G.E. Woolfenden. 1978. Family status and contributions to breeding by Florida scrub-jays. Animal Behavior 26(4):1144-1156.

Stark, L.M. and D. Kazanis. 2001. Arbovirus surveillance: annual summary report, 2001. Florida Department of Health [Internet]. Tampa, Florida [cited December 14, 2006]. Available from: http://www.myfloridaeh.com/community/arboviral/pdfs/2001/2001_arboannual.pdf

Stevens, T. and J. Hardesty. 1999. Status and distribution of the Florida scrub-jay (*Aphelocoma coerulescens*) at Cape Canaveral Air Station, Florida, Annual Report: 1998-1999. Report to U.S. Air Force; Patrick Air Force Base, Florida.

Stith, B.M. 1999. Metapopulation viability analysis of the Florida scrub-jay (*Aphelocoma coerulescens*): a statewide assessment. Final Report to Fish and Wildlife Service; Jacksonville, Florida.

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* D.R. McCullough, editor. Metapopulations and wildlife conservation. Island Press; Washington, D.C.

Swain, H.M., R. Bowman, D. Breininger, P. Schmalzer, K. Root, S. Boyle, S. Bergen, and S. MacCaffree. 1995. Out of the pyrogenic frying pan and into the political fire: developing reserve designs for the Florida scrub jay [abstract]. Page 79 *in* Society of Conservation Biology annual meeting; Fort Collins, Colorado.

Thaxton, J.E. 1998. Personal Communication. Upland, Incorporated, Osprey, Florida.

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

Thaxton, J.E. and T.M. Hingtgen. 1996. Effects of suburbanization and habitat fragmentation on Florida scrub-jay dispersal. Florida Field Naturalist 24(2):25-60.

The Nature Conservancy. 2001. Saving the Florida scrub-jay: recommendations for preserving Florida's scrub habitat. The Nature Conservancy and Audubon of Florida; Altamonte Springs, Florida.

Toland, B.R. 1991. Nest site characteristics of a Florida scrub jay population in Indian River County [abstract]. Page 12 *in* Florida scrub jay workshop; Ormond Beach, Florida.

Toland, B.R. 1996. Personal communication. U.S. Fish and Wildlife Service, Vero Beach, Florida.

Toland, B.R. 1999. Current status and conservation recommendations for the Florida scrub-jay in Brevard County. Report to the Brevard County Board of County Commissioners. Brevard County Natural Resources Management Office; Viera, Florida.

Turner, W.R., D.S. Wilcove, and H.M. Swain. 2006. State of the scrub: conservation progress, management responsibilities, and land acquisition priorities for imperiled species of Florida's Lake Wales Ridge. Archbold Biological Station; [Internet] Lake Placid, Florida. [Cited December 13, 2006]. Available from: http://www.archbold-station.org/abs/publicationsPDF/Turner_etal-2006-StateotScrub.pdf

U.S. Fish and Wildlife Service. 1987. Endangered and Threatened Wildlife and Plants; Threatened Status for the Florida Scrub Jay. Federal Register 52:20715-20719.

U.S. Fish and Wildlife Service. 1990. Recovery plan for the Florida scrub-jay [Internet]. Atlanta, Georgia [Cited December 13, 2006]. Available from: http://ecos.fws.gov/docs/recovery_plans/1990/900509.pdf

Webber, H.J. 1935. The Florida scrub, a fire-fighting association. American Journal of Botany 22(3):344-361.

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

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

Woolfenden, G.E. 1978. Growth and survival of young Florida scrub-jays. Wilson Bulletin 90(1):1-18.

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

Woolfenden, G.E. and J.W. Fitzpatrick. 1978. The inheritance of territory in group-breeding birds. BioScience 28(2):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 history of the Florida scrub-jay. Pages 87-107 *in* D.I. Rubenstein and R.W. Wrangham, editors. 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, editors. Cooperative breeding in birds: long term studies of ecology and behavior. Cambridge University Press; Cambridge, United Kingdom.

Woolfenden, G.E. and J.W. Fitzpatrick. 1991. Florida scrub-jay ecology and conservation. Pages 542-565 *in*: Perrine, C.M., J.-D. Lebreton, and G.J.M. Hirons, editors. Bird population studies: relevance to conservation and management. Oxford University Press; Oxford, United Kingdom.

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, editors. Rare and Endangered Biota of Florida, Volume V. Birds. University Press of Florida; Gainesville, Florida.

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

Eastern indigo snake

Babis, W.A. 1949. Notes on the food of the indigo snake. Copeia (2):147.

Breininger, D.R., M.L. Legare, and R.B. Smith. 2004. Edge effects and population viability of eastern indigo snakes in Florida. Pages 299-311 *in* H.R. Akcakaya, M. Burgman, 0. Kindvall, P. Sjorgren-Gulve, J. Hatfield, and M. McCarthy, editors. Species Conservation and Management: Case Studies. Oxford University Press; New York, New York.

Carson, H.L. 1945. Delayed fertilization in a captive indigo snake with note of feeding and shedding. Copeia (4):222-224.

Conant, R. and J.T. Collins. 1998. A field guide to reptiles and amphibians of eastern and central North America. Third Edition, Expanded. Houghton Mifflin Company; New York, New York.

Cox, J.A. and R.S. Kautz. 2000. Habitat conservation needs of rare and imperiled wildlife in Florida. Florida Fish and Wildlife Conservation Commission; Tallahassee, Florida.

Diemer, J.E. and D.W. Speake. 1983. The distribution of the eastern indigo snake, *Drymarchon corais couperi*, in Georgia. Journal of Herpetology 17(3):256-264.

Keegan, H.L. 1944. Indigo snakes feeding upon poisonous snakes. Copeia (1):59.

Kochman, H.I. 1978. Eastern indigo snake, *Drymarchon corais couperi*. Pages 68-69 *in* R.W. McDiarmid, editor. Rare and endangered biota of Florida. University Presses of Florida; Gainesville, Florida.

Landers, J.L. and D.W. Speake. 1980. Management needs of sandhill reptiles in southern Georgia. Proceedings of the annual conference of the Southeastern Association of Fish and Wildlife Agencies 34:5 15-529.

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

Layne, J.N. and T.M. Steiner. 1996. Eastern indigo snake (*Drymarchon corais couperi*): summary of research conducted on Archbold Biological Station. Report prepared under Order 43910-6-0134 to the U.S. Fish and Wildlife Service; Jackson, Mississippi.

Lazell, Jr. J.D. 1989. Wildlife of the Florida Keys: a natural history. Island Press; Washington, D.C.

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

Moler, P.E. 1985b. Home range and seasonal activity of the eastern indigo snake, *Drymarchon corais couperi*, in northern Florida. Final Performance Report, Study E-l-06, III-A-5. Florida Game and Freshwater Fish Commission; Tallahassee, Florida.

Moler, Paul E. 1992. Rare and Endangered Biota of Florida. Volume III. Amphibians and Reptiles. University Press of Florida; Gainesville, Florida.

Moler, P.E. 1998. Personal communication. Biologist. Comments dated January 9, 2006, to the U.S. Fish and Wildlife Service on the technical/agency draft Multi-Species Recovery Plan for South Florida. Florida Fish and Wildlife Conservation Commission; Tallahassee, Florida.

Shaw, C.E. 1959. Longevity of snakes in the United States as of January 1, 1959. Copeia (4):336-337.

Smith, C.R. 1987. Ecology of juvenile and gravid eastern indigo snakes in north Florida. M.S. Thesis. Auburn University; Auburn, Alabama.

Smith, R. 2003. Personal communication. Biologist. Presentation to the U.S. Fish and Wildlife Service on February 24, 2003. Dynamac Corporation; Kennedy Space Center, Florida.

Speake, D.W., D. McGlincy, and C. Smith. 1987. Captive breeding and experimental reintroduction of the eastern indigo snake. Pages 84-90 *in* Proceedings of the 3rd Southeastern Nongame and Endangered Wildlife Symposium; Athens, Georgia.

Steiner, T.M., O.L. Bass, Jr., and J.A. Kushlan. 1983. Status of the eastern indigo snake in Southern Florida National Parks and vicinity. South Florida Research Center Report SFRC-83-Ol, Everglades National Park; Homestead, Florida.

U.S. Fish and Wildlife Service. 2004. Standard Protection Measures for the Eastern Indigo Snake (*Drymarchon corais couperi*). South Florida Ecological Services Office; Vero Beach, Florida.

U.S. Fish and Wildlife Service. 2008. Eastern indigo snake 5-year status review. Mississippi Field Office, Jackson, Mississippi.

Zeigler, M. 2006. Personal communication. Citrus grove operations manager. Meeting with the U.S. Fish and Wildlife Service on August 1, 2006. Agricultural Resource Management; Vero Beach, Florida.

Gopher tortoise

Arata, A.A. 1958. Notes of the eggs and young of *Gopherus polyphemus* (Daudin). Quarterly journal of the Florida Academy of Science 21:274-280.

Aresco, M.J. and C. Guyer. 1998. Efficacy of using scute annuli to determine growth histories and age of *Gopherus polyphemus* in southern Alabama. Copeia 1988(4):1094-1100.

Aresco, M.J. and C. Guyer. 1999. Growth of the tortoise *Gopherus polyphemus* in slash pine plantations of southcentral Alabama. Herpetologica 55:499–506.

Ashton R.E. and P.S. Ashton. 2008. The natural history and management of the gopher tortoise *Gopherus polyphemus* (Daudin). Krieger Publishing Company, Malabar, Florida.

Auffenberg, W. and R. Franz. 1982. The status and distribution of the Gopher Tortoise (*Gopherus polyphemus*). Pages 95–126 *in* R.B. Bury, editor. North American tortoises: Conservation and ecology. U.S. Fish and Wildlife Service, Wildlife Research Report 12.

Auffenberg, W. and J.B. Iverson. 1979. Demography of terrestrial turtles. Pages 541–569 *in* M. Harless and H. Morlock, editors. Turtles: Perspectives and Research. Wiley-International, New York.

Baskaran L.M., V.H. Dale, and R.A. Efroymson. 2006. Habitat modeling within a regional context: an example using gopher tortoise. American Midland Naturalist 155:335-351.

Birkhead, R.D. 2001. Ingestion of seeds by gopher tortoises (*Gopherus polyphemus*) in a southeastern pine savanna: species composition and effects on germination. Auburn University, Department of Biological Sciences 46pp.

Boglioli, M.D., C. Guyer, and W.K. Michener. 2003. Mating opportunities of female gopher tortoises, *Gopherus polyphemus*, in relation to spatial isolation of females and their burrows. Copeia 2003:846-850.

Boglioli, M.D., W.K. Michener, and C. Guyer. 2000. Habitat selection and modification by the gopher tortoise, *Gopherus polyphemus*, in Georgia longleaf pine forest. Chelonian Conservation and Biology 3:699-705.

Boyer, W.D. 1990. Longleaf pine [Internet]. Accessed January 26, 2011. http://www.na.fs.fed.us/pubs/silvics_manual/Volume _1/pinus/palustris.htm.

Breininger, D.R., P.A. Schmalzer, and C.R. Hinkle. 1994. Gopher tortoise (*Gopherus polyphemus*) densities in coastal scrub and slash pine flatwoods in Florida. Journal of Herpetology 28:60-65.

Burke, R.L., M.A. Ewert, J.B. McLemore, and D.R. Jackson. 1996. Temperature-dependent sex determination and hatching success in the gopher tortoise (*Gopherus polyphemus*). Chelonian Conservation and Biology 2:86-88.

Butler, J.A. and T.W. Hull. 1996. Reproduction of the tortoise, *Gopherus* polyphemus, in northeastern Florida. Journal of Herpetology 30:14-18.

Butler, J.A., R.D. Bowman, T.W. Hull, and S. Sowell. 1995. Movements and home range of hatchling and yearling gopher tortoises, *Gopherus polyphemus*. Chelonian Conservation and Biology 1(3):173-180.

Causey, M.K., and C.A. Cude. 1978. Feral dog predation of the Gopher Tortoise, *Gopherus polyphemus*, in southeast Alabama. Herpetological Review 9:94–95.

Congdon, J.D., A.E. Dunham, and R.C. van Loben Sels. 1993. Demographics of common snapping turtles *(Chelydra serpentine)*: implications for conservation and management of long-lived organisms. American Zoologist 34:397-408.

Cox, J., D. Inkley, and R. Kautz. 1987. Ecology and habitat protection needs of Gopher Tortoise (*Gopherus polyphemus*) populations found on lands slated for large-scale development in Florida. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program Technical Report No. 4, Tallahassee, Florida. 75pp.

Craul, P.J., J.S. Kush, and W.D. Boyer. 2005. Longleaf pine site zones. General Technical Report, SRS-89, U.S. Department of Agriculture, Forest Service, Southern Research Station.

Demuth, J.P. 2001. The effects of constant and fluctuating incubation temperatures on sex determination, growth, and performance in the tortoise *Gopherus polyphemus*. Canadian Journal of Zoology 79:1609–1620.

Diemer, J.E. 1986. The ecology and management of the Gopher Tortoise in the southeastern United States. Herpetologica 42:125–133.

Diemer, J.E. 1992a. Demography of the tortoise *Gopherus polyphemus* in northern Florida. Journal of Herpetology 26:281-289.

Diemer, J.E. 1992b. Home range and movements of the tortoise *Gopherus polyphemus* in northern Florida. Journal of Herpetology 26:158–162.

Diemer, J.E. and C.T. Moore. 1994. Reproduction of Gopher Tortoises in north-central Florida. Pages 129-137 *in* R.B. Bury and D. Germano, editors. Biology of North American tortoises. U.S. Department of Interior, National Biological Survey, Fish and Wildlife Research 13.

Douglass, J.F. 1978. Refugia of juvenile gopher tortoises, *Gopherus polyphemus* (Reptilia, Testudines, Testudinidae). Journal of Herpetology 12:413-415.

Douglass, J.F. 1986. Patterns of mate-seeking and aggression in a southern Florida population of the gopher tortoise, *Gopherus polyphemus*. Proceedings of the Desert Tortoise Council 1986:155-199.

Epperson, M. 2003. Impacts of a non-native species, *Soleopsis invicta,* on a keystone vertebrate, *Gopherus polyphemus,* and its associated commensal fauna. Ph.D. Dissertation. Clemson University. Clemson, SC.

Epperson, D.M. and C.D. Heise. 2003. Nesting and hatchling ecology of Gopher Tortoises *Gopherus polyphemus*) in southern Mississippi. Journal of Herpetology 37:315–324.

Eubanks, J.O., W.K. Michener, and C. Guyer. 2003. Patterns of movement and burrow use in a population of gopher tortoises (*Gopherus polyphemus*). Herpetologica 59:311-321.

Eubanks, J.O., J.W. Hollister, C. Guyer, and W.K. Michener. 2002. Reserve area requirements for gopher tortoises. Chelonian Conservation and Biology 4(2):464-471.

Florida Fish and Wildlife Conservation Commission (FWC). 2011. Preliminary list of high priority gopher tortoise conservation and restocking sites. Unpublished data, Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Florida Fish and Wildlife Conservation Commission (FWC). 2012. Gopher Tortoise Management Plan. Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Florida Fish and Wildlife Conservation Commission (FWC). 2013. Gopher Tortoise Permitting Guidelines (*Gopherus Polyphemus*). Florida Fish and Wildlife Conservation Commission, Tallahassee, Florida.

Garner, J.H. and J.L. Landers. 1981. Foods and habitat of the Gopher Tortoise in southwestern Georgia. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 35:120–133.

Gibbons, J. W. 1987. Why do turtles live so long? BioScience. 37(4): 292-269.

Guyer, C. 2003. Effects of population density on patterns of movement and behavior of gopher tortoises (*Gopherus polyphemus*). Unpublished draft final report for the National Council for Air and Stream Improvement, International Paper Company, National Fish and Wildlife Foundation, and U.S. Fish and Wildlife Service, Jackson, Mississippi Field Office.

Heppell S.S. and L.B. Crowder. 1996. A fishery model for hawksbill turtles: can we harvest an endangered species. Conservation Biology 10:874–880.

Hermann, S.M., C. Guyer, J.H. Waddle, and M.G. Nelms. 2002. Sampling on private property to evaluate population status and effects of land use practices on the gopher tortoise, *Gopherus polyphemus*. Biological Conservation 108:289-298.

Kelly, J.F. and F.M. Sims. 1987. Forest resources of Mississippi. Southern Forest Experiment Station, New Orleans, Louisiana. Resource Bulletin SO-147. U.S.D.A., Forest Service.

Landers, J.L. 1980. Recent research on the Gopher Tortoise and its implications. Pages 8–14 *in* R. Franz and R.J. Bryant, editors. The Dilemma of the Gopher Tortoise--Is There a Solution? Proceedings of the 1st Annual Meeting, Gopher Tortoise Council.

Landers, J.L. and J.L. Buckner. 1981. The Gopher Tortoise: effects of forest management and critical aspects of its ecology. Southlands Experimental Forest Technical Note No. 56. 7pp.

Landers, J.L. and D.W. Speake. 1980. Management needs of sandhill reptiles in southern Georgia. Proceedings of the annual conference of the Southeastern Association of Fish and Wildlife Agencies 34:515-529.

Landers, J.L., J.A. Garner, and W.A. McRae. 1980. Reproduction of the Gopher Tortoise (*Gopherus polyphemus*). American Midland Naturalist 103:353–359.

Landers, J.L., J.A. Garner, and W.A. McRae. 1982. Growth and maturity of the gopher tortoise in southwestern Georgia. Bulletin of the Florida State Museum, Biological Sciences 27:81.

Lohoefener, R. and L. Lohmeier. 1984. The status of *Gopherus polyphemus* (Testudines, Testudinidae) west of the Tombigbee and Mobile Rivers. Unpublished Report Submitted to US Fish and Wildlife Service.

MacDonald, L.A. and H.R. Mushinsky. 1988. Foraging ecology of the Gopher Tortoise, *Gopherus polyphemus*, in a sandhill habitat. Herpetologica 44:345–353.

Mann, T.M. 1995. Tortoise densities and burrow occupancy rates for gopher tortoises on selected sites in Mississippi. Mississippi Museum of Natural Science, Museum Technical Report 24.

Marshall, J.E. 1987. The Effects of Nest Predation on Hatchling Gopher Tortoises (*Gopherus polyphemus*). Unpublished master's thesis, University of South Alabama, Mobile, Alabama.

McCoy, E.D. and H.R. Mushinsky. 1995. The demography of *Gopherus polyphemus* (Daudin) in relation to size of available habitat. Project Report. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program, Tallahassee, Florida. 71pp.

McCoy, E.D., H.R. Mushinsky, and D.S. Wilson. 1993. Pattern in the compass orientation of gopher tortoise burrows at different spatial scales. Global Ecology and Biogeographic Letters 3:33-40.

McDearman, W. 2005. Gopher Tortoise *(Gopherus polyphemus)* soil classification for the federally listed range. U.S. Fish &Wildlife Service, Jackson, Mississippi. Unpublished Draft Report. 14 pp.

McDearman, W. 2006. Gopher tortoise population viability assessments with VORTEX. US Fish and Wildlife Service, Jackson. Unpublished Draft Report.

McRae, W.A., J.L. Landers, and J.A. Garner. 1981. Movement patterns and home range of the Gopher Tortoise. American Midland Naturalist 106:165–179.

Miller, P.S. 2001. Preliminary population viability assessment for the Gopher Tortoise (*Gopherus polyphemus*) in Florida. Conservation Breeding Specialist Group, Apple Valley, Minnesota. 45pp.

Mushinsky. H.R. and E.D. McCoy. 1994. Comparison of Gopher Tortoise populations on islands and on the mainland in Florida. Pages 39–48, *in* R. B. Bury and D. J. Germano, editors. Biology of North American tortoises. U.S. Department of the Interior, National Biological Survey, Fish and Wildlife Research 13.

Mushinsky, H.R., T.A. Stilson, and E.D. McCoy. 2003. Diet and dietary preference of the juvenile gopher tortoise (*Gopherus polyphemus*). Herpetologica 59:475-483.

Mushinsky, H.R., D.S. Wilson, and E.D. McCoy. 1994. Growth and sexual dimorphism of *Gopherus polyphemus* in central Florida. Herpetologica 50:119–128.

Mushinsky, H.R., E.D. McCoy, J.E. Berish, R.E. Ashton, Jr., and D.S. Wilson. 2006. *Gopherus polyphemus* – gopher tortoise. *In* P.A. Meylan, editor. Biology and Conservation of Florida's Turtles. Chelonian Research Monographs No. 3, pp. 350-375.

Noel, K.M. and C.P. Qualls. 2004. The effects of incubation temperature, clay content of the soil, and the interaction of the two on hatching success of gopher tortoise (*Gopherus polyphemus*) eggs in south Mississippi. Mississippi Department of Wildlife, Fisheries and Parks, Museum of Natural Science, Jackson, Mississippi. Museum Technical Report Number 106.

Noss, R.F. 1988. The longleaf pine landscape: almost gone and almost forgotten. Endangered Species Update 5:1-8.

Ott, J. 1999. Patterns of movement, burrow use, and reproduction in a population of gopher tortoises (*Gopherus polyphemus*): implications for the conservation and management of a declining species. Auburn University, Department of Biological Sciences. 88pp.

Ott, J., M.T. Mendonca, C. Guyer and W.K. Michener. 2000. Seasonal changes in sex and adrenal steroid hormones of gopher tortoises (*Gopherus polyphemus*). General and Comparative Endocrinology 117:299-312.

Pike, D.A. 2006. Movement patterns, habitat use, and growth of hatchling tortoises, *Gopherus polyphemus*. Copeia 2006:68-76.

Rostal, D.C. and D.N.J. Jones. 2002. Population biology of the gopher tortoise *(Gopherus polyphemus)* in southeast Georgia. Chelonian Conservation and Biology 4(2):479-487.

Shaffer, M. L. 1981. Minimum population sizes for species conservation. BioScience 1:131- 134.

Seigel, R.A. and J. Hurley. 1993. Ecology and management of the gopher tortoise *(Gopherus polyphemus)* at Bens Creek Wildlife Management Area. U.S. Fish and Wildlife Service, Division of Federal Aid, Atlanta, GA. Report to U.S. Fish and Wildlife Service and Louisiana Department of Wildlife and Fisheries.

Seigel, R.A. and K.R. Smith. 1995. Demography and reproduction of gopher tortoises in Mississippi. Mississippi Museum of Natural Science, Department of Wildlife, Fisheries Parks, Jackson, MS. Museum Technical Report 32, Report to U.S. Fish and Wildlife Service, Mississippi Endangered Species Project E-1, Segment 9.

Smith, L.L. 1995. Nesting ecology, female home range and activity, and population size-class structure of the gopher tortoise,*Gopherus polyphemus*, on the Katherine Ordway Preserve, Putnam County, Florida. Bulletin, Florida Museum of Natural History 37:97-126.

Smith, R.B., D.R. Breininger, and V.L. Larson. 1997. Home range characteristics of radiotagged Gopher Tortoises on Kennedy Space Center, Florida. Chelonian Conservation and Biology 2:358–362.

Spotila, J.R., L.C. Zimmerman, C.A. Binckley, J.S. Grumbles, D.C. Rostal, List, A. Jr., E.C. Beyer, K.M. Phillips, and S.J. Kemp. 1994. Effects of incubation condition on sex determination, hatching success, and growth of hatchling Desert Tortoises, *Gopherus agassizii*. Herpetological Monographs 8:103–116.

Stewart, M.C., D.F. Austin, and G.R. Bourne. 1993. Habitat structure and the dispersion of gopher tortoises on a nature preserve. Florida Scientist, Biological Sciences 56:70-81.

Styrsky, J.N., C. Guyer, H. Balbach, and A. Turkmen. 2010. The relationship between burrow abundance and area as a predictor of gopher tortoise population size. Herpetologica. 66:401-410.

Taylor, R.W., Jr. 1982. Human predation on the gopher tortoise (*Gopherus polyphemus*) in north-central Florida. Bulletin of the Florida State Museum, Biological Sciences 28:79-102.

Tuberville, T.D., J.W. Gibbons, and H.E. Balbach. 2009. Estimating viability of gopher tortoise populations. Final report ERDC/CERL TR-09-2 U.S. Army Corps of Engineers, Washington, D.C.

Tuma, M.W. 1996. Life history and population structure of the gopher tortoise on Camp Shelby, Mississippi. Mississippi Natural Heritage Program, Mississippi Museum of Natural Science. 1995 Yearly Report.

U.S. Fish and Wildlife Service. 1987. Endangered and Threatened Wildlife and Plants; Determination of threatened status for the gopher tortoise *(Gopherus polyphemus).* Federal Register 52(129):25376-25380.

U.S. Fish and Wildlife Service. 1990. Gopher Tortoise Recovery Plan. US Fish and Wildlife Service, Jackson, Mississippi:28.

U.S. Fish and Wildlife Service. 2011. 12-month finding on a petition to list the gopher tortoise as threatened in the eastern portion of its range. Federal Register 76:45130-45162.

U.S. Forest Service. 1990. Gopher tortoise habitat management guidelines, DeSoto National Forest. U.S. Forest Supervisor Office, Jackson, Mississippi. Wildlife Habitat Management Handbook, Chapter 400.

Wester, E.E. 1995. Distribution and status of the threatened gopher tortoise, *Gopherus polyphemus*, on Camp Shelby, Mississippi. Mississippi Army National Guard, Hattiesburg, Mississippi.

Wester, E.E. 2004. Impact of natural gas pipeline operation and maintenance on longterm population viability of the threatened gopher tortoise (*Gopherus polyphemus*). Report to Florida Gas Transmission Company. Southern Ecosystems Research, Auburn, Alabama.

Wilson, D.S., H.R. Mushinsky, and E.R. McCoy. 1994. Home range, activity, and use of burrows of juvenile gopher tortoises in central Florida. Pp. 147-160 *In* R.B. Bury, and D.J. Germano (Eds.), Biology of North American tortoises. Washington, D.C.: National Biological Survey, Fish and Wildlife Research 13.

Wright, J.S. 1982. Distribution and population biology of the gopher tortoise, *Gopherus polyphemus*, in South Carolina. Master's Thesis, Clemson University, South Carolina.

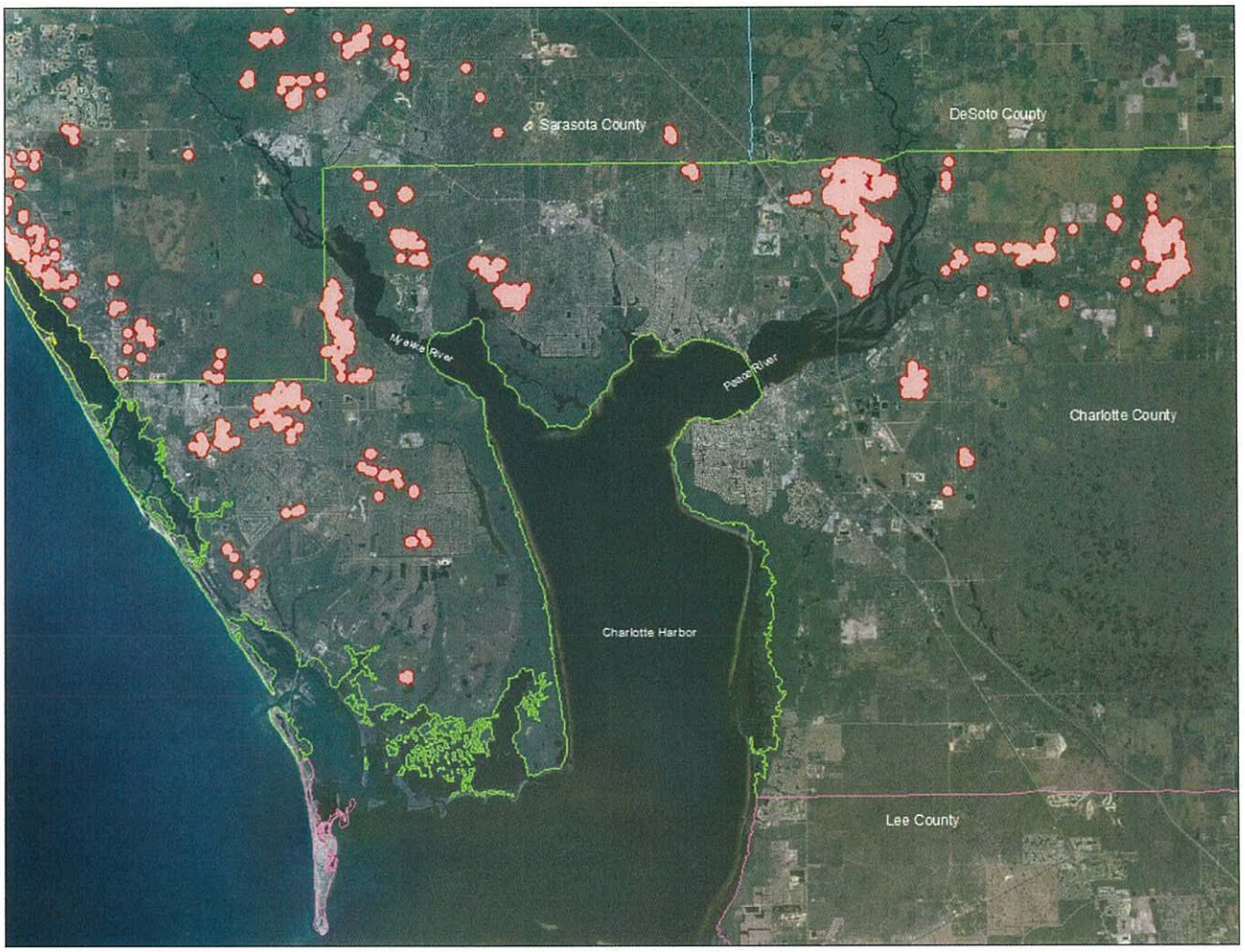

Figure 1. Buffers around scrub-jay observations in Charlotte County that contain 3,056 acres of undeveloped land.

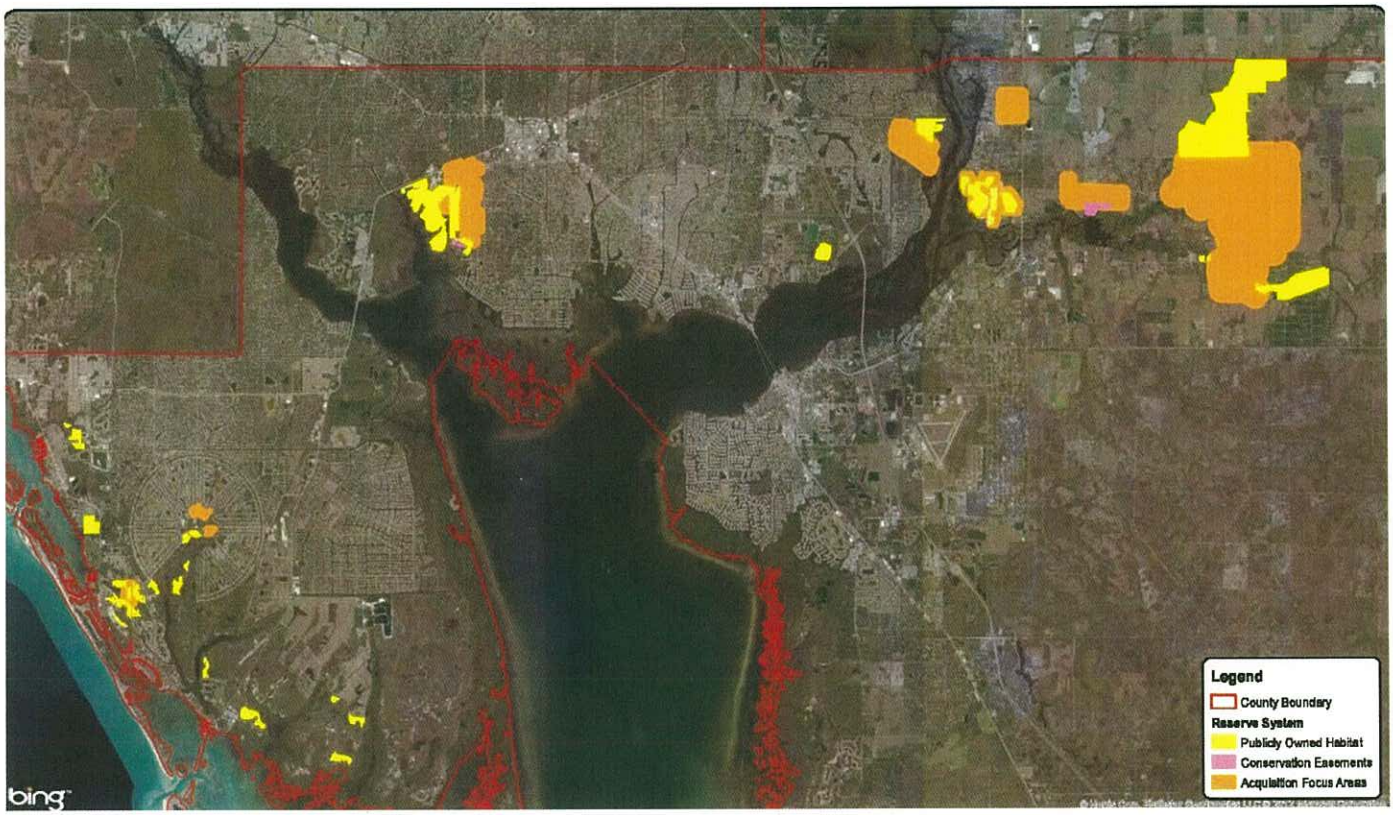

Figure 2. Locations of current scrub conservation lands and focus areas for future acquisition and management in Charlotte County.

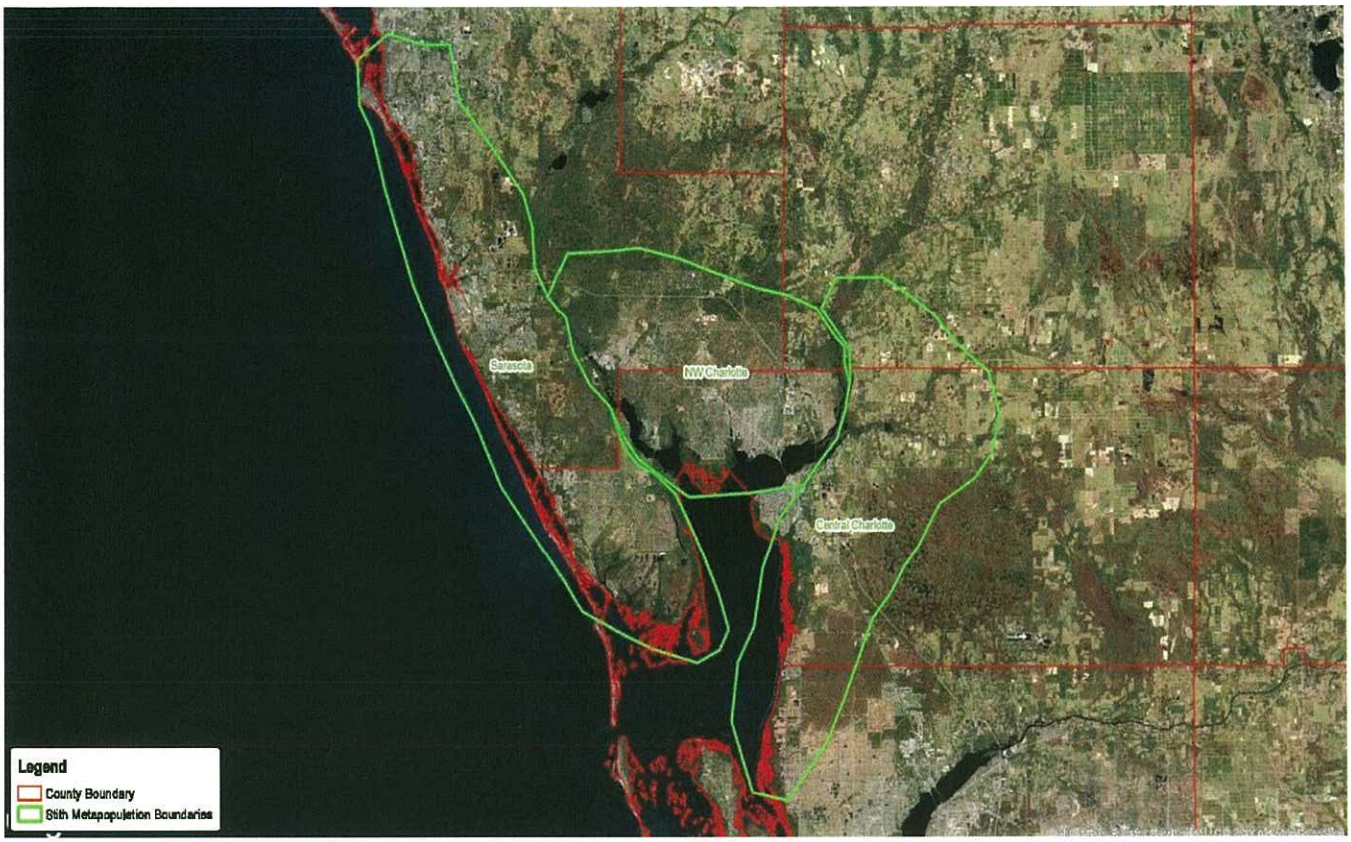

Figure 3. Scrub-jay metapopulations in Charlotte County as identified by Stith (1999).