United States Department of the Interior

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

June 23, 2004

Memorandum

To: Gloria Bell, Chief of Endangered Species, Southeast Region
Attention: Victoria Davis

From: James J. Slack, Field Supervisor, South Florida Ecological Services Office

Subject: Biological Opinion addressing effects of issuing a recovery permit (TE088035-0) to Archbold Expeditions for fire management

This document transmits the Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed issuance of a section 10(a)(1)(A) recovery permit to Archbold Expeditions to carry out a prescribed burn program, in accordance with section 7 of the Endangered Species Act of 1973, as amended (ESA) (87 Stat. 884; 16 U.S.C. 1531 *et seq.*). All proposed activities covered by the research permit will be conducted in Highlands County, Florida, in the three divisions of Archbold Expeditions on three separate properties – Archbold Biological Station (Station), the Reserve, and the MacArthur Agro-Ecology Research Center (MAERC).

Injury or death from prescribed fire is possible for all federally listed animal species that occur on the three properties in the action area (Table 1). However, we believe that the proposed action is not likely to adversely affect the endangered Florida panther (*Puma* (=*Felis*) *concolor coryi*) or endangered wood stork (*Mycteria americana*) for the following reasons. The panther, which is a rare visitor and not a resident in the action area, can avoid fire. There are no known panther denning sites in the project area. Dr. Hilary Swain, Executive Director of Archbold Expeditions, agreed to always contact the Florida Fish and Wildlife Conservation Commission (FWC) before each prescribed burn is conducted to find out if there are any radio-collared panthers in the area, and to coordinate with the FWC and the Service to revise burn plans as necessary if panthers are known to be in the area. There are no wood stork rookeries in the action area, and any individuals that do occur there would be able to fly away from fire.

The American alligator (*Alligator mississippiensis*) is listed for similarity of appearance with the American crocodile (*Crocodylus acutus*), which does not occur in Highlands County. The alligator is a wetland species that is unlikely to be caught in prescribed burns and will not be discussed herein.

We believe the threatened Florida scrub-jay (*Aphelocoma coerulescens*), threatened Audubon's crested caracara (*Caracara cheriway* (=*Polyborus plancus audubonii*), three threatened reptiles –

eastern indigo snake (*Drymarchon corais couperi*), bluetail mole skink (*Eumeces egregius lividus*), and sand skink (*Neoseps reynoldsi*), – and the 13 threatened or endangered plants named in Table 1 are likely to be adversely affected by the proposed action. These species are addressed in the biological opinion.

This biological opinion is based on information provided in research reports, the complete permit application and subsequent correspondence, telephone conversations, field investigations, and other sources of information. A complete administrative record of this consultation is on file in this office.

CONSULTATION HISTORY

From March 29, 1999 to March 31, 2004, the Station was permitted to conduct prescribed burns for habitat management, restoration, and research under TE833439-0.

The Southeast Regional Office received a permit application from Archbold Expeditions dated May 7, 2004.

On May 18, 2004, we received the permit application and your May 13, 2004, request for formal consultation. Permit number TE088083-0 was assigned to this application. It was requested that we make a determination of effect for each species in Table 1 based on information provided.

We communicated with Dr. Swain by email and phone June 9-21, 2004. She provided the following information:

- Although wood storks do occur in the action area, no wood stork rookeries are there. Also, there are no eagle nests in the action area.

- There are no known panther denning sites in the project area. In the past 10 years, they observed one set of panther tracks at the Station in January 2002 and one set of panther tracks at the Reserve in the summer of 2002. Both sets of tracks were probably made by a young male, and probably the same individual made both sets. There was a young, uncollared male killed on the road 3 weeks after the summer, 2002, track siting, which was likely the same panther that made both sets of tracks.

- Dr. Swain agreed to coordinate with the FWC before Archbold Expeditions does any prescribed burning to find out if there are any radio-collared panthers in the area, and to coordinate with the FWC and the Service to revise burn plans as necessary if panthers are known to be in the area.

- The caracara is a rare visitor at the Station, and no caracara nests have been documented. There are no known caracara nests on the Reserve. At MAERC within the past 5 years, Dr. Swain thought there were approximately 10 caracara territories and approximately 8 nests when Dr. Joan Morrison last conducted her research there. About 19 individual

caracaras have been known to roost at MAERC at a given time. Dr. Swain said they do not establish where caracara nests are before burns. One-third of MAERC is burned each year, usually in January and February.

- Dr. Morrison recorded one caracara nest lost to fire during her studies at MAERC. In this case the adults renested late and successfully fledged young.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

Proposed Action

Fire management planning for the three Archbold Expeditions properties attempts to balance diverse goals and provide temporal and spatial heterogeneity across the landscape. The goals are enhancing biological diversity, enhancing habitat for the benefit of listed species, mimicking natural processes, providing a diversity of research and educational opportunities, interacting with other fire management agencies, reducing fire hazards, and conducting safe burns. A mosaic of units of various sizes, burned at various fire-return intervals, should satisfy these goals. The system is built around five fire-return intervals, each of which is a range of years within which individual burn units are planned to reburn. A key characteristic is the assignment of modal fire-return intervals to vegetation types (*e.g.*, most sandhill will burn every 2 to 5 years; most rosemary scrub will burn every 20 to 59 years). Using fire-return intervals, rather than a fixed number of years, increases heterogeneity, provides research opportunities, and creates a plan with flexibility, including the ability to absorb most lightning-ignited fires. Initial burns in fire-suppressed areas are staggered to be burned over a time period corresponding to the modal fire-return interval.

Heterogeneity is also encouraged by assigning units to intervals other than the modal one for the vegetation, and through variation in fire timing, patchiness, intensity, and size. Over time, the Station has increased the number of prescribed burns, shifted most burns to the natural ignition season, and used a range of fire sizes (< 1 to 73 hectares [ha]). A variety of fire-return intervals is also assigned to units containing critically-endangered species in order to provide research-based management information. The Station's 1997 fire management plan, included as part of the application, describes the mechanics of the plan, including how burn dates are selected for burn units, how prescribed fires are conducted, pre- and post-fire monitoring, fire mapping, burn unit surveys, and burn day preparations. Details concerning locations, timing, and frequency are also provided. Policies for dealing with all fires (including lightning-ignited and accidental fires) provide information about acceptable prescription parameters, necessary safety equipment, crew training, maintenance of fire breaks, and archival of fire data.

The most frequently-burned vegetation type at the Station is turkey-oak dominated sandhill vegetation. The modal fire-return interval for this vegetation is 2 to 5 years, and the majority of the area is slated to burn every 2 to 5 or 6 to 9 years. Cutthroat-dominated communities are

also frequently burned. Swales, which cover little of the Station, are generally burned every 2 to 5 years. Flatwoods, other than cutthroat-dominated flatwoods, have a modal fire-return interval of 6 to 9 years. Scrubby flatwoods will be managed using fires in the 6 to 19 year intervals. The fire-return interval most beneficial for hickory scrub is not known, though a 10 to 19 year modal fire-return interval will be used. The majority of rosemary scrub will be burned at 10 to 19 or 20 to 59 year intervals. Burn unit assignments for sand pine scrub will mostly be in the 60 to 100 year class with substantial amounts in the 20 to 59 and 10 to 19 year classes. Most bayheads will rarely, if ever, be deliberately burned because they are spatially limited at the Station and because burns near bayheads are logistically difficult.

Most area at the Station is designated for burning in the summer (May through August) because summer burns match the natural fire season. In general, winter burning (December through February) is used in areas that have been fire-suppressed, causing unusually high fuel loads and duff build-up. Units around buildings or other developments may also be burned in winter, since sudden wind shifts are less likely during this time of year. Some burning is also done during spring and fall (March through April and September through November). Scrub-jay nestling mortality is a concern for early spring burns. Scrub-jay researchers provide input into spring burns, and most burns are delayed until nestlings have fledged.

Archbold Expeditions uses many techniques to ignite prescribed burns, including back fires, flank fires, strip head fires, and point-source ignition fires, though the goal is to burn the majority of burn units with head fires to mimic presettlement fire intensities. To minimize the possibility of injury and death, methods of prescribed fire ignition will not involve ring burns or aerial burns. Each individual burn unit prescription is evaluated with respect to specific listed species.

At the Reserve, fire management of the extensive improved pastures, which occupy about two-thirds of the site, will initially meet the needs of agricultural operations (grazing) and wildlife, but will be shifted to goals for natural community as pastures are restored ecologically. As Archbold Expeditions just acquired this property in 2002, they are still in the early stages of planning. They are working towards designating burn units and fire return intervals; preparing internal firebreaks around units and fire lanes around the perimeter of the property; constructing new fencing along the perimeter of the property and repairing interior fencing to improve the ability to conduct safe burns; developing a 10-year burn plan; and starting to implement and monitor prescribed burns. Fire management planning for the Reserve will be modeled after the protocols established for the Station.

Staff will conduct listed species surveys prior to mowing or disking internal fire breaks, or for land clearing along the south and west perimeters of the Reserve. All locations of listed species will be noted and avoided in land clearing. Locations of exotic species will be noted and treated before fence lines and fire lines are established.

Fire is a key component of experimental design and agricultural operations at MAERC, a working cattle ranch, and citrus grove. Cattle ranchers have traditionally burned ranchland landscapes on a 1 to 3 year cycle for maintenance of forage production. At MAERC, burns are

conducted in pasture units at similar fire return intervals. These are low intensity grassland burns typically conducted in January and February. MAERC replicates the activities of many other central Florida ranchers by using prescribed burning to maintain forage production, vegetation composition, and structure. In some MAERC research plots, scientists test hypotheses about responses of pasture systems to different regimes (growing season and dormant season burns).

Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The Service has determined that the action area for this project is the three divisions of Archbold Expeditions – the Station, Reserve, and MAERC.

The Station occupies 2,000 ha and is located near the southern end of the Lake Wales Ridge, one of the most distinctive natural regions in the United States. The Ridge is a north-south oriented sandy upland at the center of the Florida peninsula. It is a series of relict dunes, reflecting its origins as a shoreline feature during pre-Pleistocene sea level rises, and at times it was an archipelago. The isolation contributed to the evolution of the numerous endemic plants and animals of the Ridge and has one of the highest concentrations of threatened and endangered species in the United States. The Station is dedicated to long-term ecological research and conservation, with its primary focus being on the organisms and environments of the unique Ridge region and adjacent central Florida.

The Reserve is a new division of the Archbold Expeditions that was acquired in 2002. It lies immediately west of the Station. The southern one-third of the site is approximately 255 ha of relatively intact, but fire suppressed, communities including globally imperiled Florida scrub habitat, mesic flatwoods, cutthroat seeps, and bayhead. The remaining two-thirds of the Reserve is largely Bahia pasture that is currently burned as part of ongoing agricultural operations.

MAERC is a working cattle ranch and citrus grove managed at commercial production levels for research purposes. It covers 4,170 ha and provides staff and visiting scientists an opportunity to measure and monitor ecological effects of agricultural practices at real world scales of space and numbers. Its primary mission is to conduct long-term research on the relationships among cattle ranching and the native ecosystems of central and southern Florida. No federally listed plants are known to occur at MAERC.

STATUS OF THE SPECIES AND CRITICAL HABITAT RANGEWIDE

The status of the scrub-jay, caracara, Eastern indigo snake, bluetail mole skink, sand skink, and the 13 threatened or endangered plants named in Table 1 are discussed below. None of the species have critical habitat designated. Most of the species are associated with Florida's Lake Wales Ridge, a geologic feature that comprises a large, sandy, relatively elevated expanse in the

center of Florida. The area was isolated by higher ocean levels in pre-historic times, and remains ecologically segregated by soils, topography, and hydrology from the surrounding terrain. Consequently, many plant and a few animal species are endemic to the region.

Much of the following discussion is summarized from the *South Florida Multi-Species Recovery Plan* (MSRP) (Service 1999). Other sources are referenced. The MSRP is incorporated by reference and should be used to obtain specific information about these species.

Florida scrub-jay

Species/Critical Habitat Description

The Florida scrub-jay is approximately 25 to 30 centimeters (cm) in length. It has a pale blue head without a crest, pale blue wings and tail. The throat is gray to whitish bordered by a streaked blue-gray breast band. The back and underside are pale gray in color. Scrub-jay eggs are green in color and are flecked with brown. The scrub-jay is the only bird whose entire geographic range is restricted to Florida.

Life History

The scrub-jay is endemic to the xeric oak (*Quercus* spp.) scrub, rosemary (*Ceratiola ericoides*) scrub, open sand pine (*Pinus clausa*) scrub, and open scrubby flatwoods on well-drained sandy soils in peninsular Florida (Fitzpatrick et al. 1991). Scrub-jays depend on recurring fire to keep their habitat in suitable condition for raising their families. Without regular burning, low oaks shrubs grow into trees, leaving the birds exposed to hawks and other predators. At least 10 to 15 percent of the habitat must be bare sand in which to store acorns (Fitzpatrick et al. 1991). A healthy scrub ecosystem burns approximately every 8 to 15 years. Scrub-jays are extremely habitat-specific, sedentary, and territorial. These birds form family groups and fledglings remain with their monogamous parents in their natal territories as helpers. Although scrub-jays may live for more than 10 years (McDonald et al. 1996), most never travel more than a few miles from their birthplace. They do not migrate, but stay close to home, defending a year-round average territory size of approximately 10 ha per breeding pair against predators and other birds. The Florida scrub-jay was listed as a threatened species in 1987 because of loss, fragmentation, and degradation of scrub habitats throughout Florida.

Population Dynamics

A statewide scrub-jay census was last conducted in 1992-1993, at which time there were an estimated 4,000 groups of scrub-jays left in Florida (Fitzpatrick et al. 1994a). The scrub-jay was considered extirpated in 10 counties (Alachua, Broward, Clay, Dade, Duval, Gilchrist, Hernando, Hendry, Pinellas, and St. Johns) and functionally extinct in 5 more counties (Flagler, Hardee, Levy, Orange, and Putman), where 10 or fewer pairs remained (Fitzpatrick et al. 1994b). The species may have declined by as much as 25 to 50 percent during the 1980s (Fitzpatrick et al. 1994a).

Countywide surveys of Brevard County and Charlotte County have also revealed population declines. The 1992-1993 statewide survey estimated that on Federal lands within Brevard County there were 860 pairs of scrub-jays. Surveys from outside Federal lands estimate 276 breeding pairs were present (Fitzpatrick et al. 1994a). The scrub-jay population estimate on non-Federal lands dropped to 185 pairs in 1999 (Toland 1999). A countywide survey in Charlotte County showed similar numbers of scrub-jays overall, from 134 families in 1992-1993 to 135 families in 2001 (Miller and Stith 2002). The appearance of stability in the Charlotte County survey may be due to a more intensive survey effort on private property during the recent survey. Some metapopulations, such as the one known as Tippecanoe, have shown a decline of 33 families with 75 individuals in 1992-1993 to 10 families with 35 individuals in 2001. During the 1992-1993 survey, the coastal western metapopulation was estimated at 51 families with 117 individuals. These number dropped to 35 families with 89 individuals in 2001 (Miller and Stith 2002).

Results from Stith's (1999) metapopulation viability model included estimates of extinction, quasi-extinction (the probability of a scrub-jay metapopulation falling below 10 pairs), and an estimate of percent population decline. Twenty-one statewide metapopulations were ranked by the relative risk of extinction and quasi-extinction which provides a measure of susceptibility of each of these metapopulations (Stith 1999). The model predicted that five metapopulations have low risk of quasi-extinction (*e.g.,* low probabilities of extinction and quasi-extinction), two of the five, however, later experienced significant population declines. Eleven of the remaining 21 metapopulations were predicted to be highly vulnerable to quasi-extinction if no additional habitat were acquired, and five were moderately susceptible. Three of the metapopulations evaluated (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.

Status and Distribution

The status of scrub-jays rangewide varies depending primarily on the amount of habitat protected and managed (Stith 1999). Decreasing the vulnerability of susceptible metapopulations can be achieved in some cases by acquiring and managing additional habitat within the metapopulation. Thus, in some areas of Florida, conservation measures for scrub-jays will involve protection and long-term management of additional suitable scrub habitat (Stith et al. 1996, Service 1999).

Scrub-jays have declined in abundance and distribution due to habitat loss and fragmentation as a result of increasing urban and agricultural development. It is noteworthy that xeric uplands have declined by an estimated 70 to 85 percent since European settlement (Fernald 1989; Fitzpatrick et al. 1994b). Habitat loss, fragmentation, and degradation due to fire exclusion affect the demography of scrub-jays. These influences are expected to increase the likelihood of localized extirpations in many areas throughout Florida, including the action area.

Research on scrub-jays in urban areas has provided information on the demographic reactions of scrub-jays to urban pressures (Bowman and Averill 1993, Thaxton and Hintgen 1996, Bowman

1998, Bowman and Fleischer 1998, Breininger 1999). Thaxton and Hintgen (1996) demonstrated that scrub-jay dispersal behavior was substantially different in urban settings than in natural scrub habitat. When compared with scrub-jays in natural conditions, both male and female urban scrub-jays exhibited dispersal characteristics different from birds in natural conditions. Males tended to disperse further because the likelihood of inheriting high quality habitat within urban areas was low. Females dispersed greater distances, at an earlier age in urban settings due to the lack of adjacent unoccupied habitat and single males. Single males typically established territories by breeder replacement. With increasing dispersal distance at a younger age, females are susceptible to increased mortality. Female scrub-jays dispersing from urban areas have a higher mortality rate than those dispersing from natural scrub areas (Thaxton and Hintgen 1996). Overarching these findings, it is also suggested that habitat in suburban areas, if abandoned or unoccupied due to death of the mated pair, had a higher probability of remaining vacant, leading to the conclusion that populations of scrub-jays in suburban areas were likely to decrease and eventually be extirpated.

Bowman and Averill (1993) evaluated demographic patterns of scrub-jays along a gradient from nearly complete residential development to undisturbed scrub and compared these patterns to those of jays occupying undisturbed, unfragmented scrub. At the highest residential development density, scrub-jay territories and family group size was significantly smaller than in low density residential areas or natural scrub. They also found that scrub-jays in densely developed areas had significantly poorer nesting success than scrub-jays occupying less-densely developed areas or natural scrub. Bowman (1998) found that scrub-jays living in areas of dense residential development produced fewer fledglings than in other areas.

Overall, fledgling survival in residential areas (at any development density) has been found to be significantly lower than survival of fledglings in undisturbed, unfragmented scrub. Adult survival in densely developed areas is also thought to be lower than that of scrub-jays living in less dense residential areas or native habitats. Like Thaxton and Hintgen (1996), Bowman and Averill (1993) also concluded that habitat fragmentation associated with residential development and other urban uses increases mortality during dispersal.

Adverse effects of residential and other urban development on the demography of scrub-jays are likely, due to a combination of factors (Breininger 1999). Bowman and Averill (1993) alluded to the presence of "dangerous" habitats within suburban settings, including roads which increase the likelihood of collisions with motor vehicles. Exotic turf grasses and ornamental shrubs and trees may increase a scrub-jay's vulnerability to predators and competitors and provide suboptimal nesting substrates. Overgrown scrub may also attract predators and competitors. Predictable food sources, such as birdfeeders, also tend to congregate scrub-jays and make them more susceptible to domestic predators. Malicious shooting of scrub-jays with pellet guns has also been documented in some residential areas.

In addition to the outright loss of xeric uplands within the action area, increasing fragmentation has resulted in fire exclusion and the subsequent degradation of many of the remaining parcels of xeric habitat. These xeric communities require periodic fire to maintain their ecological and

biological functions and values. Urban and agricultural uses now interspersed between xeric upland habitats do not allow the natural periodicity or magnitude of fires that once spread across this xeric landscape. In most instances, fire suppression is practiced to protect human life and property. Lacking fire, xeric uplands tend towards more mesic conditions, which include denser vegetative canopies and more heterogeneous vegetative structure. Under these conditions, many of the species that evolved in presence of periodic fires and low structural diversity diminish in abundance and eventually are extirpated.

The distribution of scrub-jays provides a good indicator of xeric upland quality, particularly oak dominated scrub. In a synopsis of data collected during a statewide survey for scrub-jays, Bowman and Fleisher (1994) compared site-specific numbers of scrub-jays observed from 1992 to 1993 with scrub-jay surveys conducted from 1980 to1981 (Cox 1987). In most cases the numbers of scrub-jays observed in 1992 and 1993 declined from those observed in the 1980 to 1981 study and in many cases the decline was attributable to habitat degradation due to vegetative overgrowth. In a few instances, Bowman and Fleisher (1994) reported substantial increases in the number of scrub-jays observed, which typically corresponded to areas that had been burned since the previous survey. Subsequent studies in Charlotte (Miller and Stith 2002) and Brevard Counties (Toland 1999) have shown similar results.

Audubon's crested caracara

Species/Critical Habitat Description

The crested caracara is a large raptor with a crest, naked face, heavy bill, elongated neck, and unusually long legs. It is about 50 to 64 cm long and has a wingspan of 120 cm. Caracaras are blackish-brown overall, with white throat and neck, bare yellow-orange facial skin, and pale bluish bill. Sexes are similar in appearance in adult birds. Full adult plumage is obtained sometime after 2 years of age, and the sexes are similar in appearance (J. Morrison, University of Florida, personal communication 1996). Although its feet are clearly those of a raptor, it has flatter talons that allow it to run and walk more easily than other raptors and indicate its terrestrial habits (Morrison 1996). It is a strong flier and may reach speeds of 64 kilometers (km).

Life History

Caracaras are relatively long-lived raptors. Breeding pairs are apparently monogamous and remain together on the territory throughout the year, although they are not easily observed outside the breeding season (Morrison 1997). The pair bond is relatively strong, lasting until one mate dies (Service 1989).

Although caracaras historically nested in native prairie habitat adjacent to marshes, they are now found regularly in improved pastures, dominated by exotic forage grasses and low, maintained, vegetative structure (Morrison 2001). Nesting habitat for caracaras in south-central Florida

generally consists of large expanses of pastures, grasslands, or prairies dotted with shallow ponds and sloughs and single or small clumps of live oak (*Quercus virginiana*), cabbage palm (*Sabal palmetto*), and cypress (*Taxodium distichum*) (Morrison 1996).

Caracaras construct new, well-concealed nests each nesting season, often in the same tree as the previous year. They prefer to nest in cabbage palms, surrounded by open habitats with low ground cover and low density of tall or shrubby vegetation, although nests have also been found in live oak, cypress (Morrison et al. 1997), Australian pine (*Casuarina equisetifolia*), saw palmetto (*Serenoa repens*), and black gum (*Nyssa sylvatica*). The nests are usually constructed 4 to 18 meters (m) above the ground and consist primarily of haphazardly woven vines trampled to form a depression (Bent 1938, Sprunt 1954, Humphrey and Morrison 1996). Both males and females participate in nest building. Nest building activity ranges from 2 to 4 weeks with up to a 2 month time period between nest completion and egg-laying (Humphrey and Morrison 1997). Caracaras do not vigorously defend the nest site although they are aggressive toward other adult caracaras intruding near the nest itself (J. Morrison, University of Florida, personal communication 1996).

Humphrey and Morrison (1997) suggest that most reproductive activity occurs during the winter dry season, although nesting attempts may occur throughout the year. Caracaras are one of the first raptors in Florida to begin nesting. Egg-laying is estimated to begin as early as late September based upon evidence of chicks fledging in December (Humphrey and Morrison 1997). Peak egg-laying occurs from late December through early February (Morrison 2001). Nests with eggs have also been found as late as April (Nicholson 1929). Factors affecting nesting success may include weather, predation, and accidents, with most nest failures occurring near hatching (Morrison 1996).

There are usually two eggs in a clutch, though sometimes three. Incubation lasts for about 28 days and is shared by both sexes. If the eggs are taken, a second or even third set may be laid (Bent 1961). The young fledge at about 8 weeks of age (Layne 1978). Usually only one brood is raised in a season, though successful double broods have been recorded in the Florida population, particularly for pairs that initiate nesting early in the season (Humphrey and Morrison 1997). Double broods may be facilitated by favorable weather conditions, abundant food, and the fact that juvenile birds can disperse as soon as 8 weeks after fledging from the nest. Mean clutch size declines from the first to second brood, but pairs that successfully double-brood fledge significantly more young (Humphrey and Morrison 2000).

Caracaras exhibit strong fidelity to a nest site and year-round home range (Humphrey and Morrison 1997). Observations in south-central Florida indicate that pairs generally attempt breeding annually when the nesting site and surrounding feeding habitat are not substantially altered (Morrison 1997). Nests and nest supports (trees and bushes) are often reused from year to year (Morrison 1996).

Although nests in Florida were found to be as close as 1.5 km and adjacent home ranges indicated up to a 10 percent overlap, adult caracaras show little social behavior and are highly

intolerant of adult conspecifics within their territory (Morrison 1996). Juvenile caracaras exhibit a long fledgling dependency period and remain with their parents for at least 2 months after fledging from the nest (Humphrey and Morrison 1997). Juvenile and immature birds primarily use improved pasture, grassland habitats, and associated wetlands for foraging until permanently departing from the adult natal territory (Morrison 2001). After leaving the adult territory, young birds are nomadic and often join aggregations (Layne 1996). These gathering areas are used by many individual birds for varying lengths of time and will attract individuals from the periphery of the population's range (Morrison 2001). Caracara hunt on the wing, from perches, and on the ground (Service 1989) and forage within a variety of habitats, including improved pastures, adjacent to dwellings and farm buildings, newly plowed or burned fields, and agricultural lands including sod and cane fields, citrus groves, and dairies (Morrison 1996).

The caracara is a diet generalist and highly opportunistic in its feeding behavior, eating carrion and capturing live prey (Layne 1996). Its wide range in diet preferences extends from a variety of invertebrate prey such as crayfish, beetles, grasshoppers, worms and insects in pastures associated with carrion and dung, and vertebrate prey including rats, mice, skunks, rabbits, squirrels, snakes, frogs, lizards, nestling birds and bird eggs, turtles, and fish (Morrison 2001). Caracara patrol roads and highways in search of carrion (Palmer 1988) and may be seen feeding with vultures. However, caracaras are dominant over vultures and may occasionally chase the larger raptor from the road kill (Howell 1932). Road-killed animals, primarily raccoon (*Procyon lotor*), opossum (*Didelphis virginiana*), and armadillo (*Dasypus novemcinctus*) represent an important source of carrion for caracaras (Layne 1996).

Population Dynamics

The size of the caracara population in Florida remains in question. Obtaining accurate counts of caracara is difficult because of limited access to areas of suitable habitat and because the bird is difficult to detect (Humphrey and Morrison 1997). Heinzman (1970) published the results of a 4-year survey (1967 to 1970) which indicated that fewer than 100 caracara remained at 58 localities in Florida. Stevenson (1976) concurred with this estimate in 1974. Layne (1995), however, monitored caracara from 1972 to 1991 and estimated that the population was stable with a minimum of about 300 adults in 150 territories. The immature population was estimated to be between 100 and 200 individuals, bringing the total statewide population to between 400 and 500 birds.

Caracaras commonly occur in dry or wet prairie areas with scattered cabbage palms. It can also be found in lightly wooded areas where scattered saw palmetto, scrub oaks (*Quercus geminata, Q. minima, Q. pumila*), and cypress are present. Widespread land alterations may have forced the caracara to use improved or semi-improved pasture (Layne 1996). The presence of seasonal wetlands may be an important factor in the attractiveness of pastures to caracaras (K. Dryden, FWC, personal communication 1996). Humphrey and Morrison (1996) found that pasture constitutes the highest percentage of habitat cover type found within the home ranges of breeding caracaras, and Humphrey and Morrison (1997) found that there was a strong association of caracara home ranges with improved pasture. In addition, occupancy rate, breeding rates, and

nesting success were consistently higher on private lands during the 3-year study. One of the variables that may contribute to the difference in success is vegetation height. This may be related to lower predation rates in areas with less cover, or it may simply be easier for caracaras to walk around and forage in shorter vegetation. Other factors contributing to nest success may be nest tree height and distance to major roads or human activity.

Adults may be found in their home range year-round. Home ranges may encompass an area of up to 2,389 ha with an average of 1,552 ha. There is no significant difference between female and male home ranges which range from 3.8 to 24.9 km^2 and 3.9 to 22.5 km^2 respectively (Humphrey and Morrison 1996). Occasionally large groups of individuals are encountered (Layne 1978).

Status and Distribution

The overall range of the crested caracara extends from Florida, southern Texas, southwestern Arizona, and northern Baja California, south through Mexico and Central America to Panama, including Cuba and the Isle of Pines. It is accidental in Jamaica. The caracara was listed as threatened in 1987 because its dry prairie habitat had been destroyed or modified for agriculture and residential development. It was also listed because existing regulatory mechanisms did not adequately prevent the destruction or modification of the caracara's habitat, which is mainly located on private land.

Historically, Audubon's crested caracara was commonly found from northern Brevard County, south to Fort Pierce, Lake Okeechobee, and Hendry County. It had been reported as far north as Nassau County, and as far south as Collier County and the lower Florida Keys in Monroe County, although the latter sighting most likely were caracaras that escaped or were released from captivity. Available evidence indicates that the caracara's range has experienced a long-term continuing contraction, with birds now rarely found as far north as Orlando in Orange County or on the east side of the St. Johns River.

The caracara has declined throughout its range since the early 1900s. It was once plentiful in Texas and was more numerous in Arizona than it is at this time. It was considered uncommon in New Mexico and extremely rare in Oklahoma (Ellis et al. 1988). The current distribution is similar to the historic distribution; however, numbers of individuals are lower. The status in most areas where the crested caracara is found is largely unknown; however, it is thought to be severely declining in Mexico.

The caracara is currently found in Charlotte, Collier, DeSoto, Glades, Hardee, Hendry, Highlands, Indian River, Martin, Monroe, Okeechobee, Osceola, Palm Beach, Polk, and St. Lucie Counties. However, there is little evidence of breeding in Indian River, Martin, Monroe, or Palm Beach Counties (Layne 1978, Stevenson 1976, Sprunt 1954, Service 1989). Caracara are most abundant in a five-county area northwest of Lake Okeechobee, *i.e.* Desoto, Glades, Highlands, Okeechobee, and Osceola Counties.

Loss and degradation of nesting habitat likely represent significant threats to Florida's caracara population, particularly the conversion of pasture to citrus crops. In addition to suspected population declines related to habitat loss, direct human-related mortality might also be a factor in the slow recovery of the species. The increase in paved roads and high-speed traffic has been implicated in an increase in numbers of caracaras either injured or killed by vehicles (Layne 1996). Humphrey and Morrison (1997) have identified highway mortalities as a major cause of juvenile moralities, with young birds especially vulnerable within the first 6 months of fledging. Shooting and trapping are still a concern in some areas (Humphrey and Morrison 1997).

Eastern indigo snake

Species/Critical Habitat Description

The eastern indigo snake is the largest non-venomous snake in North America, obtaining lengths of up to 2.6 m. 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. Several researchers have informally suggested that lower Keys eastern indigo snakes may differ from mainland snakes in ways other than color.

Life History

Eastern indigo snakes breed between November and April, with females depositing 4 to 12 eggs during May or June (Moler 1992). Young hatch in approximately 3 months. There is no evidence of parental care. The snakes take 3 to 4 years to reach sexual maturity. Female eastern indigo snakes can store sperm and delay fertilization of eggs. There is a single record of a captive snake laying five eggs (at least one of which was fertile) after being isolated for more than 4 years. There is no information on the eastern indigo snake lifespan in the wild, although one captive individual lived 25 years, 11 months (Shaw 1959).

The eastern indigo snake is a generalized predator and will eat any vertebrate small enough to be overpowered. 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).

Population Dynamics

Eastern indigo snakes require a mosaic of habitats. Interspersion of tortoise-inhabited sandhills and wetlands improves habitat quality for the snake. Eastern indigo snakes require sheltered retreats from winter cold and desiccating conditions, and often use burrows of the gopher tortoise (*Gopherus polyphemus*) when available. In habitats lacking gopher tortoises, snakes may take shelter in hollowed root channels, hollow logs, or the burrows of rodents, armadillos,

or crabs. Over most of its range in Florida, the eastern indigo snake frequents diverse habitats such as pine flatwoods, scrubby flatwoods, floodplain edges, sand ridges, dry glades, tropical hammocks, edges of freshwater marshes, muckland fields, coastal dunes, and xeric sandhill communities. Eastern indigos also use agricultural lands and various types of wetlands, with higher population concentrations occurring in the sandhill and pineland regions of northern and central Florida. In extreme south Florida (*e.g.*, the Everglades and Florida Keys), eastern indigos are found in tropical hardwood hammocks, pine rocklands, freshwater marshes, abandoned agricultural land, coastal prairie, mangrove swamps, and human-altered habitats (Steiner et al. 1983). It is thought that 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).

In Georgia, the average range of the eastern indigo is 4.8 ha during the winter (December to April), 42.9 ha during late spring/early summer (May to July), and 97.4 ha during late summer and fall (August to November) (Speake et al. 1978). Adult male snakes have larger home ranges than adult females and juveniles; their ranges average 224 ha, reducing to 158 ha in the summer (Moler 1985a). In contrast, a gravid female may use from 1.4 to 42.9 ha (Smith 1987). In Florida, home ranges for females and males range from 1.9 to 150 ha and 1.6 to 326.6 ha, respectively (B. Smith, Dynamac, personal communication 2003). At the Station, average home range size for female indigos was determined to be 19 ha and overlapping male home ranges to be 75 ha (Layne and Steiner 1996).

Status and Distribution

The eastern indigo snake was listed as threatened in 1978 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.

Law enforcement has reduced pressure from the pet trade. However, because of its relatively large home range, this snake is especially vulnerable to habitat loss, degradation, and fragmentation (Lawler 1977, Moler 1985b). Extensive tracts of undeveloped land are important for maintaining eastern indigo snakes.

Tasks identified in the recovery plan for this species include: habitat management through controlled burning, testing experimental miniature radio transmitters for tracking of juvenile eastern indigo snakes, maintenance of a captive breeding colony at Auburn University, recapture of formerly released snakes to confirm survival in the wild, educational lectures and field trips, and efforts to obtain landowner cooperation in conservation efforts (Service 1999).

The eastern indigo snake ranges from the southeastern United States to northern Argentina. 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. 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. The eastern indigo 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).

The primary threat to the eastern indigo snake is habitat loss due to development and fragmentation. In the wildland urban interface areas of the Reservations, residential housing is also a threat because it increases the likelihood of snakes being killed by property owners and domestic pets.

To protect and manage this species for recovery, large expanses of land must be protected. Management of these lands must 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 are encouraged to utilize fire as a tool to maintain biodiversity in fire dependent ecosystems.

Skinks

Species/Critical Habitat Description

The sand skink and the bluetail mole skink were listed as threatened in 1987 due to modification and destruction of xeric upland communities in central Florida.

The bluetail mole skink is a small, slender, shiny, brownish to pink, cylindrical, lizard. Juveniles usually have a blue tail which makes up slightly more than half of the 13 cm length (Christman 1992a). Coloration is brown with lighter paired dorsolateral stripes diverging posteriorly (Christman 1978a). Regenerated tails and the tails of older individuals are typically pinkish. During the breeding season, males develop a colorful orange pattern on their sides. The legs are somewhat reduced in size and are used only during surface locomotion, not when the animal "swims" through the sand (Christman 1992a). The bluetail mole skink requires open, sandy patches interspersed with sclerophyllous vegetation.

The sand skink is a small, fossorial lizard that occurs on the sandy ridges of interior central Florida. The sand skink reaches about 13 cm, about half of which is tail. It is slender, shiny and usually gray to grayish-white, although it may occasionally be light tan. Hatchlings have a wide black band extending from the tip of the tail to the snout along each side. This band is reduced in adults and may only occur from the eye to snout on some individuals (Telford 1959). The sand skink's legs are vestigial and practically nonfunctional. Other adaptations to a fossorial existence include greatly reduced eyes, lack of external ear openings, a wedge-shaped snout, and a countersunk lower jaw. The sand skink is highly adapted for life in the sand. It spends the majority of time below the surface "swimming" in loose sand in search of food, shelter, and mates.

Life History

The bluetail mole skink occupies habitat similar to that of the sand skink, however, these species do not compete because of resource partitioning. Sand skinks are primarily fossorial and take prey below the surface, whereas the bluetail mole skink hunts at the surface and consumes mostly terrestrial arthropods (Smith 1977, 1982).

The reproductive biology of the bluetail mole skink is poorly known. Reproduction is presumably very much like that of the Peninsula mole skink, *E. e. onocrepis* (Mount 1963), in which mating occurs in the winter. This species lays three to seven eggs in a shallow nest cavity less than 30 cm below the surface. The eggs incubate for 31 to 51 days, during which time the female tends the nest. Individuals probably become reproductively active at 1 year of age (Mount 1963, Christman 1978a). The bluetail mole skink forages primarily at the soil surface or at shallow depths just below, usually during the morning or evening. Roaches, crickets, and spiders make up the bulk of the diet of mole skinks, including the bluetail (Mount 1963).

Telford (1959) found sand skinks to be most active from early March through early May, whereas Sutton (1996) found skinks to be most active from mid-February to late April. These high-activity periods correspond to movements associated with breeding season activities. After high-activity periods, females are difficult to collect, apparently due to nesting activity. Approximately 55 days after mating, about two eggs are laid in the sand, under logs or debris, in early summer (Telford 1959). The eggs hatch from June through July. No information is available on the dispersal of this species or its territory size. Sand skinks reach sexual maturity at 1 to 2 years (Telford 1959, Sutton 1996) and may remain reproductively active for 2 to 3 years (Sutton 1996).

Sand skinks feed on a variety of hard and soft-bodied arthropods that occur below the ground surface. Diel patterns of activity suggest sand skinks are active during the day and probably feed primarily during the morning and late afternoon when their preferred body temperatures are achieved (Sutton 1996). Most of their diet consists of beetle larvae and termites (*Prorhinotermes* spp.). Spiders, larval ant lions, lepidopteran larvae, roaches and adult beetles are also eaten (Myers and Telford 1965, Smith 1977).

Population Dynamics

A variety of xeric upland communities provide habitat for bluetail mole skink, including rosemary and oak-dominated scrub, turkey oak barrens, high pine, and xeric hammocks. Areas with few plant roots, open canopies, scattered shrub vegetation, and patches of bare, loose sand provide optimal habitats (Christman 1988, 1992a). Bluetail mole skinks are typically found under leaves, logs, palmetto fronds, and other ground debris. Shaded areas presumably provide microhabitat conditions which are important for thermoregulation, egg incubation, and

availability of prey (Mount 1963). Bluetail mole skinks tend to be clumped in distribution with highly variable densities, sometimes approaching 62.5 adults per ha (Christman 1992a). This pattern appears to be linked to the distribution of surface litter and, thus, soil moisture and prey distribution.

The sand skink is widespread in xeric uplands with sandy substrates, but appears to be most abundant in ecotonal areas, typically between high pine and scrub (Telford 1996). It is also found in rosemary scrub, turkey oak barrens or sandy areas of the high pine community (Campbell and Christman 1982). Optimal skink habitat includes areas with open canopies, scattered shrubby vegetation, and patches of bare sand with few plant roots (Christman 1978b, 1992b). However, recent surveys have located sand skinks in areas with dense undergrowth and extensive canopy closure (H. Mushinsky, University of South Florida, personal communication 1996), indicating that extensive loose, root free soils may not be a requisite for this species. Suitable habitat must also provide soil moisture conditions that provide for thermoregulation and egg incubation, as well as create conditions favorable for the skink's prey (Telford 1959).

The density of the sand skink varies considerably, ranging from about 5 to 23 individuals per 0.025 ha (Sutton 1996). Differences in abundance are attributed to habitat suitability. The sand skink is typically found 5 to 10 cm below the surface, where it burrows or "swims" (Carr 1940) through the sand to obtain its prey. Seasonally, sand skinks are most active from mid-February through mid-May and again in late summer-early fall. Activity patterns suggest sand skinks are active during the morning and evening, patterns typically associated with thermoregulatory behaviors (Andrews 1994).

Soil type is important in determining suitable habitat for skinks as they prefer sandy well drained soils, though the distribution of soils does not necessarily depict currently available skink habitat. Due to their small size and semi-fossorial to fossorial habits, both species are difficult to detect, as evidenced by the paucity of locality records for these species. As of 2002, the Florida Natural Areas Inventory (FNAI) database indicated bluetail mole skinks were known from 38 locations while sand skinks were recorded at 129 sites. However, experienced herpetologists and researchers acknowledge that skinks are more widely distributed than the locality records indicate and that if searched sufficiently, most suitable habitat would yield additional records for these species.

Historical surveys for sand skinks were conducted primarily in native xeric habitats. However, more recent surveys of lands converted to other land uses, *i.e.*, citrus groves and residential developments, noted the presence of sand skinks in these areas. Surveys of citrus grove noted sand skink tracks in the open sandy patches beneath the trees and in the open sandy areas between the tree rows. Surveys of residential properties noted the presence of sand skinks in remnant tracts of xeric habitats in these communities.

Status and Distribution

The bluetail mole skink occurs in suitable habitat on the Lake Wales Ridge in Highlands, Polk, and Osceola Counties in central Florida. It is apparently rare throughout its range, even in the most favorable habitats (Christman 1992a), and is not uniformly distributed within xeric upland communities.

The sand skink is endemic to the sandy ridges of central Florida, occurring in Highlands, Lake, Marion, Orange, Osceola, Polk, and Putnam Counties (Christman 1988). Principal populations occur on the Lake Wales and Winter Haven Ridges in Highlands, Lake, and Polk Counties (Christman 1992b; Mushinsky and McCoy 1995; P. Moler, FWC, personal communication 1998). The sand skink is uncommon on the Mount Dora Ridge, including sites within the Ocala National Forest (Christman 1970, 1992b). As of 1997, there were 114 locality records for the sand skink, most of which are found within the Lake Wales Ridge.

Both skinks only occur at elevations above 25 m (P. Moler, FWC, personal communication 2003).

Plants

Florida perforate cladonia (*Cladonia perforata*). This plant is a member of the family Cladoniaceae, commonly called the reindeer lichens. Unlike the more common and widely distributed species of the Cladoniaceae with which it occurs, *C. perforata* is restricted to the high, well-drained sands of rosemary scrub in Florida. It was listed as endangered in 1993 because of the significant loss of scrub habitat in Florida.

Up to eight species of reindeer lichens commonly occur in Florida scrub. *C. perforata* is the most unique member of the scrub-lichen community, by virtue of its restricted and unusual disjunct distribution and overall global rarity. In 1991, the FNAI surveyed 111 sites throughout central and coastal Florida to determine the status of *C. perforata*. A total of only 12 sites were located, 6 of which were at the Station. Two additional sites were later located at the Station (R. Yahr, Station, personal communication 1995). With one Eglin Air Force Base site in Okaloosa County and several other more recently discovered south-central and coastal Florida locations, approximately 27 sites for *C. perforata* are currently known from 4 disjunct geographic regions. The farthest and most disjunct region, supporting the only remaining north Florida site, is defined by Santa Rosa Island in Okaloosa County. Central Florida's Lake Wales Ridge supports the bulk of the known sites for *C. perforata*.

Typical habitat for *C. perforata* is found on the high sand dune ridges of Florida's peninsula, including the Atlantic Coastal and the Lake Wales Ridges. In these areas *C. perforata* is restricted to the highest, xeric white sands in sand pine scrub, typically in the rosemary phase (Abrahamson et al. 1984). Such rosemary scrubs, frequently referred to as "rosemary balds," are particularly well-drained and structurally open. *C. perforata* typically occurs in open patches of sand between shrubs in areas with sparse or no herbaceous cover. It is a habitat-specialist,

usually restricted to openings in very xeric sites. It decreases in dominance in sites that have not been burned for more than 20 years (Menges and Kohfeldt 1995). This decrease in dominance on unburned sites may be a result of a combination of factors that influence microhabitat, such as decreased insulation or increased litter accumulation.

Pigeon-wing (*Clitoria fragrans*). Pigeon-wing is an erect perennial herb belonging to the pea family. The distribution of the species is limited mainly to the rapidly disappearing scrub habitat of the Lake Wales Ridge in Highlands and Polk Counties. Loss of habitat to agriculture and residential development resulted in the listing of this species as threatened in 1993. It is distributed along the Lake Wales Ridge primarily in Highlands, Orange, and Polk Counties (Fantz 1977, Wunderlin et al. 1980a, Christman 1988). It was also found at one site in central Osceola County in 1964 and near Leesburg, Lake County in 1910 (Fantz 1977), though it has not recently been reported from either historic locality.

Though the species may exist in a continuum of scrub to high pine habitat, it appears that it is most prevalent in an intermediate vegetative complex commonly referred to as the turkey oak barrens. In this habitat, wiregrass (*Aristida beyrichia*) may be locally patchy or scattered, longleaf pine (*Pinus palustris*) scattered, while bluejack (*Quercus cinerea*) and turkey oak (*Q. laevis*) are usually prominent. It has probably never been abundant since intermediate high pines/scrub habitat is not a major vegetative complex associated with central Florida ridges.

The total number of *C. fragrans* has been estimated to be less than 3,000 in Orange, Polk, and Highlands Counties (Muller et al. 1989). Most populations are found on the Lake Wales Ridge in Highlands and Polk Counties (Fantz 1977, Wunderlin et al. 1980a, Christman 1988), where they are protected at the Station, Lake Wales Ridge State Forest and State Park, Saddle Blanket Lakes, Lake Apthorpe, Tiger Creek, and at Bok Tower Gardens in the Ridge Pine Nature Preserve and in the surrounding natural buffer areas of the Gardens. *C. fragrans* can also be found at the Avon Park Air Force Bombing Range. The dependence of this species on fire is particularly evident when considering the quick and profuse blooming in response to a fire.

Scrub mint (*Dicerandra frutescens*). The scrub mint is a small, fragrant shrub that inhabits the scrub on central peninsular Florida. Loss of habitat due to residential and agricultural development (particularly for citrus groves), as well as fire suppression in tracts of remaining habitat, are the principle threats to this plant. It was listed as endangered in 1985 due to its extremely restricted range and the threat of commercial and residential development of its habitat.

The known range of the scrub mint is quite small. It occurs on the southern portion of the Lake Wales Ridge in Highlands County, and is found from just north of Lake June in winter, south to the Station (FNAI 1996a, Menges 1992). Because it inhabits the clearings created by fires and other disturbances, tracts of land that are protected from fire may be limited in their ability to support scrub mint. Colonies found in areas burned within the last 10 years exhibit the most vigorous growth (Menges 1992). However, though growth appears most vigorous during this period, it has not been demonstrated to be the optimum frequency of disturbance. In fact, the

species may not be sensitive to burning frequency, since it is found in areas that were last burned as recently as 3 and as late as 65 years ago (Menges 1992). Although colonies respond favorably to periodic fires, individuals die after being burned, defoliated, or cut at their bases (Menges 1992). Recruitment after a disturbance occurs via the seed bank (Menges 1992).

Scrub buckwheat (*Eriogonum longifolium* var. *gnaphifolium*). Scrub buckwheat was listed as a threatened in 1993 due to rapid loss of suitable habitat. It occurs in high pine and in turkey oak barrens habitats from Marion County to Highlands County (Christman 1988). Northern range limits are in Ocala National Forest and in areas of mixed scrub and high pine south of Ocala in Marion County. Suitable habitat and, possibly, the plant extend south into northern Sumter County. Scrub buckwheat historically occurred near Eustis in Lake County, where it was collected around the turn of the century, and it still occurs near Clermont in remnants of high pine with *Polygala lewtonii* and several other endangered plant species.

Snakeroot (*Eryngium cuneifolium*). Snakeroot has a very narrow geographic distribution in an area 39 km long in Highlands County. It occurs only on the southern Lake Wales Ridge, primarily near the town of Lake Placid. It is threatened by habitat loss and fire suppression, and was listed as endangered in 1987.

Snakeroot likes sunny sites and readily colonizes bare sand created by fire or other disturbance (Wunderlin et al. 1981, Abrahamson et al.1984). It occurs only on bare white sand in scrub, usually with rosemary, and is one of the few herbs able to survive the inhibitive effects on growth or reproduction by chemicals secreted into the environment by rosemary. Snakeroot also survives in a harsh physical environment, with droughty soil and low nutrient levels. The plant readily colonizes new patches of bare sand created by fire or disturbance by its stout, woody taproot. It does not tolerate shading or extensive competition from other plants, and is restricted to sand or fine sand soils with little clay or silt, rapid permeability, and low available water capacity. As fire return interval increases, open patches in rosemary scrub tend to close, and snakeroot undergoes rapid decline (Hawks and Menges 1996). It recovers from fire by resprouting and by seedling recruitment from the seed bank (Menges and Kimmich 1996).

Highland's Scrub hypericum (*Hypericum cumulicola*). This species is endemic to the lake Wales Ridge in central Florida and known only from Polk and Highlands Counties. The species is threatened by habitat loss, isolation of populations, and fire suppression. These factors led to its listing as endangered in 1987.

Highland's Scrub hypericum is limited to upland areas with well-drained, sterile, white sands (Judd 1980). It is almost exclusively found in the sunny openings in rosemary balds. Rosemary balds are unique vegetative communities that occur as patches within the more expansive scrub ecosystem. These habitat patches provide suitable habitat for a number of rare scrub endemics (Christman and Judd 1990). Rosemary balds have a low fire frequency from 40 to 100 years (Johnson 1982, Myers 1990), while the surrounding scrubs are burned more frequently. Where found, it is locally common and can occur even in large groups of several thousand individuals

(Judd 1980). Population increases of this species are associated with the occurrence of fires that may release local populations from competitive exclusion (Abrahamson 1984, Johnson and Abrahamson 1990, Quintana-Ascencio and Menges undated).

Suitable habitat for this species is often naturally patchy and occurs in a mosaic of other vegetation types. Extended periods without fire can result in the loss of some patches of suitable, occupied habitat. Increasing isolation may have an important detrimental effect on habitat colonization and the persistence of this species (Quintana-Ascencio and Menges undated).

Highland's Scrub hypericum has evolved in xeric vegetative communities that are fire maintained. It inhabits a specific vegetative community that has a relatively long burn return interval compared to most other upland xeric communities. When fire does occur within rosemary balds, the species responds favorably to the reduction in competing vegetation and is usually found in large numbers immediately following fire.

Scrub blazing star (*Liatris ohlingerae*). This species belongs to the aster family (Asteraceae) within a genus of perennial herbs that live in open, usually fire-maintained habitats. It was listed as an endangered species in 1989 due to habitat loss. It is endemic to the lake Wales Ridge in Highlands and Polk Counties. During comprehensive surveys in the mid-1980s, the scrub blazing star was found at 93 localities, 71 of them in Highlands County (Christman 1988). Its range extends from Lake Blue in Polk County (Service 1996), south along the Lake Wales Ridge to Archbold Biological Station at the south end of the Ridge in Highlands County.

The scrub blazing star is one of the endemic plants found in rosemary balds. It is also found along the ecotone between these balds and surrounding scrub habitats on white or (rarely) on yellow sands (Christman and Judd 1990). It can also be found scattered in surrounding scrub. Rosemary balds are a unique community type within the scrub ecosystem. They are represented by small "islands" separated from each other, often by considerable distances. These "islands" provide suitable habitat for a number of scrub endemics (Christman and Judd 1990) that have evolved within the well-drained, droughty, low-nutrient soils. These limiting habitat conditions have resulted in a vegetative complex whose above ground biomass is sparse and does not support frequent fires. Rosemary balds typically burn every 40 to 100 years (Johnson 1982, Myers 1990), while the surrounding scrubs burn more frequently. Fire may either burn a section of rosemary scrub or it may sweep through the entire bald (Herndon 1996). The ecotone between rosemary balds and surrounding scrub is a dynamic vegetative complex dependent on the frequency and intensity of fire.

Herndon (1996) found that the scrub blazing star has important microhabitat requirements, particularly its preference for shade. Unlike most other scrub endemics, it appears to thrive in lightly shaded areas, and is not as productive in sunny, open gaps. It occupies areas that would be too overgrown for other scrub endemics. Generally, it is found in highest densities on the lower slopes of rosemary balds especially where low, thin-canopied scrub oaks (*Quercus chapmanii*, *Q. geminata*, and *Q. inopina*) or patches of palms (*Sabal etonia* and *Serenoa repens*) dominate the vegetation and where patches of open sand exist. These habitat conditions are also

frequently found under individual sand pine crowns, but never in dense groves of sand pines. Over time, however, shady microhabitats are not fixed within rosemary balds. Large-scale disturbance such as intense fire may change the mosaic pattern of scrub vegetation and thus decrease the amount of shade in scrub habitat.

Aside from the obvious adverse effects occurring from the direct loss of habitat, a multitude of other factors resulting from habitat fragmentation and fire exclusion may be acting individually or synergistically to reduce the viability of scrub endemics, including the scrub blazing star. Though its mortality appears to be low, recruitment and colonization rates are severely limited, as indicated by the number of seedlings in the vicinity of adult plants. The species occurs sparsely over the landscape and is highly clumped within rosemary balds. Connectivity between the islands of habitat is very important to this species due to its cross-pollination needs. Lack of connectivity or loss of pollinators may be responsible for its loss at some isolated sites.

Habitat requirements of scrub blazing star suggest that it prefers a burn frequency shorter than that of the rosemary bald but longer than the surrounding oak scrub. The species is not abundant in rosemary balds because early seral stages do not provide sufficient shade. Following devastating fires, rosemary bald endemics generally recover via the seed bank (Menges and Kohfeldt 1995). Several years are then required to replace shade-bearing vegetation. For example, limited shade may be afforded to the scrub blazing star by rosemary or sand pine. Mature individuals of these species may be killed by fire and must then recover from seedlings. The temporal lag of little or no shade is not suitable for the re-establishment of scrub blazing star. Vegetation occurring on the ecotone of rosemary balds and surrounding scrub reacts differently to fire events. These species typically respond to ground-clearing fires by re-sprouting (Menges and Kohfeldt 1995). Resprouting results in the re-establishment of shade-bearing vegetation within one to several years. The scrub blazing star may become re-established more rapidly under these conditions (Abrahamson 1984).

Britton's beargrass (*Nolina brittoniana*). This species is a long-lived and relatively widespread scrub species. It is found from the south end of the Lake Wales Ridge in Highlands County north to Orange County and northern Lake County. Herbarium records indicate that its historic range extended north into Marion County. The present range is concentrated in Polk and Highlands Counties with smaller numbers occurring in Lake, Osceola, and Orange Counties (Service 1996). It is threatened by habitat loss or modification due to land conversions for agriculture and development and was listed as endangered in 1993.

Britton's beargrass occurs in a wide range of habitat types, from relatively open scrub to hammocks with closed canopies. It has been reported in scrub, high pine and occasionally in hammocks (Christman 1988). The wide range of habitat types that it occupies are very different in appearance, physiognomy, species composition, fire dynamics, and land use history, but are closely linked ecologically and historically (Myers 1990). The habitats all have similar soil characteristics (droughty and infertile), are upland sites, and are fire-maintained and fire-dependent ecosystems that are presumably replaced by hardwoods in the absence of fire (Myers 1990; C. Weekly, Lake Wales Ridge State Forest, personal communication 1996).

Overgrown scrub can shade Britton's beargrass, resulting in a reduction in sexual reproduction (Wunderlin et al. 1980b). It can remain vigorous in fire-suppressed habitat, but the trends of populations under these conditions are unknown (Reese and Orzell 1995). Flowering peaks 1 year after burning and quickly declines during the second year post burn (Menges et al. 1996). The flowering peak is important in that it represents a pulse of reproduction and potentially, recruitment of new individuals to the population. Although Britton's beargrass can persist in an area that has experienced fire suppression for many years, it may only exist in a vegetative state under these conditions. Adequate fire management is needed at protected sites to maintain population diversity.

Papery whitlow-wort (*Paronychia chartacea*). Like many of the other Lake Wales Ridge endemic scrub plants, this species is vulnerable because of habitat loss to agricultural, commercial, residential, and recreational purposes. It was listed as a threatened species in 1987. *P. chartacea* ssp. *chartacea* is endemic to the scrub community on the Lake Wales Ridge (Kral 1983), in Highlands, Polk, Osceola, Orange, and Lake Counties (Anderson 1991). The subspecies *P. chartacea* ssp. *minima* occurs in the karst region of the Florida panhandle, Washington and Bay Counties.

The natural habitat for the papery whitlow-wort on the Lake Wales Ridge is rosemary scrub, which is also known as the rosemary phase of sand pine scrub (Abrahamson et al. 1984, Christman 1988, Menges and Kohfeldt 1995). It can become very abundant in rosemary scrub after a fire or on disturbed sites such as along fire lanes or trails (Johnson and Abrahamson 1990, Service 1996), and it appears in post burn plots of rosemary scrub when it was rare or absent prior to the burn (Johnson and Abrahamson 1990). Because the species thrives in fire lanes and along sand roads, it is the last of the small endemic plants of the Lake Wales Ridge to disappear from fire-protected areas and is the least likely of the rare scrub plants to go extinct.

Density of the species increases in relation to available open space (Hawkes and Menges 1996, Menges and Kohfeldt 1995). Open spaces are commonly found in rosemary scrub after fire and in fire lanes and trails. The rosemary scrub has developed with periodic disturbances and the available open space and frequencies of disturbances are likely to influence the species composition (Hawkes and Menges 1996). Density decreases with time after fire, and the species is displaced from rosemary scrub within 9 to 12 years post fire (Johnson and Abrahamson 1990, Hawkes and Menges 1996).

Wireweed (*Polygonella basiramia*). Wireweed is an herbaceous perennial endemic to the Lake Wales, Winter Haven, and Bombing Range Ridges in central peninsular Florida. It ranges from Lake Pierce in Polk County southward to Venus near the southern tip of the Lake Wales Ridge in Highlands County (Christman and Judd 1990). It is found primarily in the rosemary phase of sand pine scrub and requires periodic disturbance, such as fire, to maintain habitat suitable for its survival and persistence. Today, the primary threats to this plant are the destruction of scrub vegetation and the lack of large-scale disturbance events. It was listed as endangered in 1987.

Wireweed occupies open spaces or gaps between shrubs and can be found in abundance along sandy fire lanes, which provide similar habitat. Open space (bare sand) in rosemary scrub was found to be a good indicator of the species, with higher plant densities being associated with greater amounts of open space (Hawkes and Menges 1995). Within rosemary scrub sites at the Station, wireweed density ranged from 0.000 to 0.085 plants per m^2. Along fire lanes where open sand is abundant, densities were much higher, with a mean of 8.1 plants per m^2 (Hawkes and Menges 1995).

The persistence of appropriate habitat for wireweed is dependent on disturbance processes which periodically create gaps. Historically, fire has been a large-scale disturbance which maintained open patches of different ages across the landscape. Today, wildfires no longer sweep through central Florida. Although wireweed also appears to be able to take advantage of smaller scale disturbances which disrupt soil crust and create space (such as animal paths and burrow mounds), this has not been studied and such disturbances may only be suitable for colonization if created at the right place and time.

Using fire to manage the habitat is the preferred option for wireweed. In rosemary scrub, open space decreases from nearly 100 percent immediately after fire to approximately 30 percent 4 years after fire, when a great deal of habitat variation exists (Hawkes and Menges 1996). Gaps are affected by the fire cycle because they are originally created by fires. There is no relationship; however, between fire intervals and wireweed density, and small-scale gap dynamics may be more important than the fire regime for this plant (Hawkes and Menges 1995). Wireweed is an obligate seeder (Menges and Kohfeldt 1995) often not present in the first few years after fire, but whether it recovers through delayed post fire germination from a soil seed bank or disperses into sites remains unknown.

Wireweed does not mature for 10 to 15 years and is adapted for a 10 to 40 year fire interval (Johnson 1982). Unlike oak-dominated scrubs, rosemary scrubs recover slowly from burns (Johnson et al. 1986) and openings persist longer. A long fire-return interval may not negatively affect wireweed if openings persist, but it may be harmful to other species that share the habitat (Hawkes and Menges 1995).

In designing fire management for rosemary scrubs, responses of the particular species present must be taken into account when planning fire return intervals (Hawkes and Menges 1995). Menges and Kohfeldt (1995) suggest a 15 to 40 year burn interval with mosaic burns on large pieces of property.

Sandlace (*Polygonella myriophylla*). Sandlace was listed as endangered in 1993 due to loss of natural habitat. It is found in moderately disturbed scrub. It is found in three sites in western Orange County (Wunderlin 1984) and at one site in Osceola County near Interstate 4. In Polk County, it is found on the Lake Wales Ridge from the Davenport-Poinciana area. It is also found well west of the Lake Wales Ridge in a highly altered area just southeast of Bartow. In Highlands County, sandlace is found on the Lake Wales Ridge south to Archbold Biological Station.

Sandlace probably requires regular fires to persist, although its allelopathic tendencies (Richardson 1985) may allow it to limit competition with other plants by creating suitable conditions to maintain sufficient bare sand for its persistence. It persists in scrub habitats with substantial bare ground. These patchy habitats are commonly found after intense fires in sandpine scrub. This habitat condition is also common within rosemary scrub due to extreme xeric conditions and the allelopathic nature of several species that limits vegetative growth. Persistent, patchy, open sands are not prevalent in oak dominated scrubs, since fires are more frequent and less devastating.

Management for sandlace will probably require development of long-term burning regimes that mimic the 50 to 100 year natural fire cycles of sandpine/rosemary scrub and rosemary balds (Wunderlin et al. 1980c). If allelopathic effects are sufficient to maintain open sand patches in some areas, fire may not be necessary as a management tool. However, the effects of fire timing and intensity on other scrub endemics should be considered before excluding fire (Service 1999).

Scrub plum (*Prunus geniculata*). The scrub plum is a small shrub listed as endangered in 1987 because of habitat loss due to conversion to agriculture (primarily citrus) and residential development. Scrub plum is also collected by ornamentalists because of its small, fragrant flowers. Despite the destruction of suitable habitat, the scrub plum still occurs within most of its historic range. Historically, it was found in Lake, Polk, Highlands and Osceola Counties. Presently, it is found in these four counties and a small portion of Orange County as well (FNAI 1996b, Johnson 1981, Stout 1982). Although it still occurs in the same range, the distribution of scrub plum within this range has decreased.

The scrub plum prefers dry, sunny, nutrient-poor sites (Harper 1911) and is native to the high pine and oak scrub community types. The high pine community has a grassy understory and is subject to frequent fires (every 1 to 5 years) of low intensity. The oak scrub community has shrubby vegetation and is subject to infrequent fires of greater intensity. Fires are important for the maintenance of both habitats. In the absence of frequent fires, high pine vegetation is typically invaded by sand pines and evergreen oaks, eventually succeeding to upland hardwood forest if fires do not occur for long periods (Myers 1985). Similarly, scrub is likely to succeed toward upland hardwood forest if fire is absent from the habitat for long periods (Myers 1985). This succession of scrub to upland hardwood forest is likely to result in the shading out of scrub plum.

In addition to habitat loss, two other factors pose threats to scrub plum. One threat is fire suppression, which has degraded the quality of scrub and high pine habitats of the species. The other is the low number of seedlings that have been found in the wild (Service 1996), suggesting that scrub plum may not be sufficiently reproducing.

Fire, or equivalent artificial disturbance, appears to be necessary for perpetuation of scrub plum (Kral 1983, Myers 1985). This species readily resprouts after fires or mechanical disturbances (Service 1996). In addition, fires may benefit scrub plum by regulating the numbers or sizes of plants that shade or otherwise compete with it (Kral 1983). Though the optimum frequency of

disturbance is unknown, the fire frequencies typical of high pine (2 to 5 years) and scrub (15 to 20 years) are understood. Developing a prescribed burning program that mimics these typical frequencies and monitoring the response of scrub plum may be a prudent way to manage for this species (Service 1999).

Carter's mustard (*Warea carteri*). This species is a fire-dependent annual herb occurring in xeric, shrub-dominated habitats on the Lake Wales Ridge. The primary threats to Carter's mustard are habitat loss to citrus groves and residential developments, and long-term fire suppression, both of which cause local extirpations. It was listed as endangered in 1987.

The current known distribution for Carter's mustard includes Highlands, Polk, and Lake Counties on the Lake Wales Ridge, and it may also occur in coastal scrub in Brevard County on Florida's Atlantic coast. It occurred historically in south Florida slash pine forests of the Miami area in Miami-Dade County.

Carter's mustard typically occurs in dry oak sites where other scrub endemics are scarce (Service 1996) and at the ecotone between scrub and high pineland with scrub buckwheat and scrub plum (K. DeLaney, Environmental Research Consultants, Incorporated, personal communication 1995). The two largest populations of Carter's mustard on the Lake Wales Ridge occur at the Station and The Nature Conservancy's Tiger Creek Preserve. At the Station, the species occurs in scrubby flatwoods and in turkey oak- and hickory-dominated sandhills, and is often found in the ecotone between these two vegetation types. Several populations at the Station are adjacent to roads, firelanes, or in areas with historic human disturbance. At Tiger Creek Preserve, the species is found in degraded sandhill habitat where turkey oak is abundant, in scrubby flatwoods, and in xeric hammocks (E. Menges, Station, personal communication 1995).

Extreme fluctuations of population size are observed year to year at these two sites, and the data accumulated on population sizes indicate a strong relationship with fire. Carter's mustard seems to respond quickly, strongly, and positively to fire. Major population increases and the discovery of new populations consistently occur 1 year after fire, while major population crashes, including the appearance of no above ground individuals, occur 2 years after fire (Menges 1995).

The natural fire return interval in the various vegetation communities inhabited by Carter's mustard ranges from every 2 to 6 years for turkey oak-dominated sandhill, to every 6 to 10 years in scrubby flatwoods, to every 10 to 20 years in hickory-dominated sandhill (Myers 1990). Through demographic monitoring, it is becoming clear that fire is an essential management tool to maintain large populations of this species. Fire suppression is a threat to Carter's mustard because its demography and reproduction seem to be closely tied to fire.

In the absence of fire, populations of Carter's mustard have survived in smaller numbers in areas of prior human disturbance, such as the margins of roads or firelanes. Given that the species is a locally abundant annual that may remain dormant as seed for several years, a population may have a substantial number of growing, flowering plants only in the first year after a fire. Because this species is conspicuous only when in flower, monitoring and finding populations is difficult.

Fire management is a critical concern for this species. Long intervals between fires are likely to result in the real loss of viable seeds from the seed bank and declines in population sizes. The risk of extinction for this species is likely to be higher without proper fire management (E. Menges, Station, personal communication 1995).

ENVIRONMENTAL BASELINE

Status of the Species/Critical Habitat Within the Action Area

The Station has carried out a long-term study of the demography and behavior of the scrub-jay in which researchers conduct monthly censuses, find and monitor all nesting attempts, and capture and band all immigrants. There are approximately 60 families of scrub-jays at the Station, occupying about 5.2 km^2 of scrub habitat. These scrub-jays fledged 2.02 young per pair in 1999, and 1.67 young per pair in 2000. The long-term, 30-year average is 1.79 young fledged per pair.

The caracara is a rare visitor at the Station, and no caracara nests have been documented. There are no known caracara nests on the Reserve. There are approximately 10 caracara territories and approximately 8 nests maintained each year at MAERC. About 19 individual caracaras have been known to roost at MAERC at a given time.

The eastern indigo snake is most commonly observed in hardwood hammocks and pinelands where they can easily find sheltered retreat. However, indigo snakes also use dry prairie, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats. All three properties in the action area are occupied by the eastern indigo snake.

Both skinks are known to occur at the Station and the Reserve. They are not known to occur at MAERC.

None of the plants named in Table 1 occur at MAERC. All of them occur at the Station, and six occur at the Reserve. The scrub and cutthroat grass communities of the Reserve, and the species they support, are among the most critically endangered ecosystems in the United States. All natural communities on the Reserve are fire-dependent, except the bayheads, and depend on appropriate fire management for long-term viability. Aerial photography suggests that fire return intervals over the last two decades have been less frequent than desirable, allowing a significant fuel load to build up, and increased canopy cover.

Factors Affecting Species Habitat Within the Action Area

It has been estimated that Florida's scrub habitat has been reduced between 60 and 75 percent since settlement of the region. The most recent evaluations of scrub in central Florida indicate that only about 11,000 ha remain. Much of that scrub habitat is fragmented and has become overgrown due to fire suppression (Christman 1988, Christman and Judd 1990). In Highlands County, 64.2 percent of the xeric vegetation (sand pine scrub, scrubby flatwoods, and southern ridge sandhills) present before settlement was converted to other land uses by 1981. An

additional 10.3 percent of the xeric vegetation was moderately altered, primarily by building roads to create residential subdivisions (Peroni and Abrahamson 1985). The situation is similar in Polk and Lake Counties. Because rosemary balds are typically higher and potentially more attractive for human uses than the surrounding landscape, it is possible that these sites may have sustained greater loss than other central Florida ridge communities. Fire suppression has been in practice for many decades and is a threat to many scrub species because their demography and reproduction seem to be closely tied to fire.

Like most of south central Florida, the action area historically experienced large wildfires at regular intervals. As Europeans began to settle the area in the 1880s, fire suppression to protect property, and habitat conversions that reduced or eliminated combustible vegetation became the dominant regime. Like other managed lands at the time, the Station suppressed fires for a variety of reasons. This policy began to gradually change in the mid to late 1960s to accommodate controlled burns to restore habitat, manage fuel accumulation, and maintain native flora and fauna. Since 1988, the Station has actively prescribed fires in a variety of regimes across an array of habitat tracts.

Fire is critical for scrub habitats. Without it, shrub heights increase, pine canopy cover (tree density) increases, and the number of small open spaces or gaps decreases. These changes all result in the loss of many rare scrub species that are specifically adapted to low open scrub, with many gaps and limited tree cover. Different types of scrub have different return intervals.

As the entire Lake Wales Ridge becomes increasingly converted to human developments, the land managed by Archbold Expeditions becomes more ecologically significant for the listed species that occupy it. Land adjacent to the three divisions is dominated by agriculture, ranching, and residences. The proposed restoration and maintenance of native habitats will help ensure range-wide security for these species. In the absence of the proposed fire management plan, fuel loads will increase and existing habitats will progress in succession to more forested, closed-canopy ecosystems. Fires cannot be totally excluded, however, given the seasonally dry climate and high potential for lightning-strike ignition. Lack of fire management or reversion to fire suppression will only result in fewer, hotter, and more cataclysmic fires with greater adverse effects to the affected species than the more frequent, generally less intense, prescribed fires.

EFFECTS OF THE ACTION

All activities authorized by the Service under Section 10(a)(1)(A) must meet permit issuance criteria at 50 CFR 17.22, .32, or .52. All activities considered in this biological opinion must be justified in relation to enhancement of survival and recovery, effects to the wildlife species, peer review, and qualifications of permittees. By definition then, authorized activities should benefit species recovery with minimal adverse effect by qualified permittees.

The MSRP (Service 1999) is the official recovery plan for the species in Table 1. Prescribed fire is listed in the MSRP as a habitat-level recovery action for all of the species in Table 1 considered in this biological opinion except the eastern indigo snake. Fire is a necessary and

integral characteristic of the scrub community. A variable interval in fire return and in season is important to mimic the natural fire regime. In addition, spatial variation in fire intensity and unburned patches is necessary to construct a natural landscape. The scrub is naturally made up of islands of suitable and unsuitable habitat. To repeat this landscape pattern, sites should be burned as a mosaic when possible. Long periods without fire can change the species composition and the ability of the site to carry fire. Rehabilitation of a site can be a lengthy process, but with fewer and fewer sites remaining, these sites may become more valuable for future recovery.

The proposed activity will probably injure or kill listed wildlife individuals and will result in the destruction of listed plant individuals in the path of controlled burns. The extent of such take is not entirely quantifiable, as the applicant does not have quantitative population data for the affected species throughout the entire project area. Except in restricted study areas, the applicant is not likely to conduct pre- and post-burn population surveys to determine the direct fire-related injury or mortality of listed plant and wildlife species. A full inventory of all populations of listed species by burn unit would be an enormous effort in an area with the size and complexity of the Station alone, and pre-burn trapping or collection and removal of listed species would not be practical. Even with limitless resources, such a "rescue" strategy would probably fail to help most of the listed species in a given burn unit. The assumption is that by mimicking natural burn processes, habitat will be restored and improved, and the net effect will be enhancement for all listed species.

The proportion of habitat burned each year at the Station may provide an index to the relative numbers of listed plants and animals at risk. Only certain burn units at the Station are burned in any given year. The 1997 plan proposed that 826.1 ha would be burned during the first 5 years, at approximately 170.2 ha per year. In each of the first 5 years, then, 8.5 percent of the available habitat (2,000 ha) was subject to burning. These annual burn acreages are skewed toward the 2 to 5 and 6 to 9 year burn interval classes, 53.4 ha and 69.7 ha, respectively.

The response of the wildlife species to fires is well known only for the scrub-jay. This species depends on scrub habitats that are maintained by fire. Although it will decline on a burned site temporarily, it will become abundant once scrub vegetation returns, then gradually decline as trees encroach on the habitat. Scrub-jays can lose nests in wildfires and prescribed burns, but they typically renest rapidly after fire. Data collected on Station scrub-jays suggest that the loss of individual nests there as a result of fire has no detectable effect on the population.

Adult caracaras are highly mobile and capable of fleeing the project area during the burns. Displacement of adults could occur as a result of prescribed burning or smoke. Active nests can be destroyed during prescribed fire. One-third of MAERC, the only one of the three properties where caracaras are known to nest, is burned each year. Fuel loads in burned pastures will be kept low due to cattle grazing (up to 3,000 cow-calf pairs), frequent burning, and the fact that these burns are conducted in January and February, outside of the growing season. Therefore, fire intensity, based on fuels and topography is expected to be low. Caracaras are known to double brood and to lay up to three clutches if their eggs are lost.

Fire may adversely affect the eastern indigo snake by causing individuals to leave the area, abandon den sites, and possibly miss foraging and mating opportunities. Snakes may den in above-ground refugia, such as hollowed tree stumps. Above ground refugia may be lost during the prescribed burn events. Individual snakes fleeing the fire are more vulnerable to predation. Some snakes may seek underground refugia, if available. Eastern indigo snakes can remain in underground refugia throughout fire events, emerging within days of extinguishment (B. Smith, Dynamac, personal communication 2004).

While prescribed burning will result in short-term habitat degradation for the eastern indigo snake, it will not result in permanent detrimental impacts to habitat and may have beneficial effects on some habitat components. Florida's landscape has evolved with fire and many of the habitats within the action area depend on fire for long-term maintenance. It is expected that there will be a rapid regrowth of the mixed grasses vegetation, following timely prescribed burns (before the rainy season). Eastern indigo snakes are known to utilize disturbed areas, and have quickly recolonized habitats following burns (B. Smith, Dynamac, personal communication, 2004). Small prey species will move back into burned areas immediately following fire, and it is expected that eastern indigo snakes will quickly move back into burnt areas following their prey base.

Available studies indicate that both skink species associate with early successional scrub habitat. The two skinks are fossorial, and the indigo snake is fast-moving and can outrun fires or utilize gopher burrows to avoid heat. These scrub-dependent animals are adapted to fire, and, although there is a possibility of mortality of certain life history stages, they are dependent on fire in scrub communities for long-term survival and would be extirpated without it. It is expected that the proposed fire management will increase and maintain suitable habitat for the listed skinks and the eastern indigo snake.

The burn regime is planned to accommodate the plant species. Burning should benefit most of the affected plants, as they are adapted to various levels of fire frequency. Fire in this area has been suppressed, and the proposed action represents a restoration of more natural habitat conditions. Considering that fires, either wild or prescribed, are inevitable on the project area, and that most of the species named in Table 1 are fire dependent or prefer ecosystems maintained by regular burning, any direct losses are expected to be more than compensated by the restoration of regular fires to the project area. Recent experience on the project area indicates that almost all of the plant species respond positively to burning within 1 to 3 years. The one exception is *Cladonia perforata*. This lichen returns slowly to burn sites, yet it may decline on sites that have not burned in a long time. Archbold Expeditions proposes to manage for this plant with the longest fire return intervals (greater than 20 years).

The direct mortality that will occur will be mitigated by several factors so that adverse population effects to listed species are not expected to result in local extirpation. Primarily, the juxtaposition of burn units among unburned management units will provide refugia and sources of colonizing individuals. Secondly, fire intensity within a given burn unit should be patchy enough so that listed species will not likely be extirpated from any one burn unit. The seed bank

should survive most burns to provide for rapid repopulation. Lastly, scrub-jays are highly mobile, and the three reptile species are relatively mobile, so that the affected wildlife species may avoid direct effects of the fire.

These mitigating factors are enhanced by the fuel management provided by regular burns. As an ecosystem is regularly burned, fuel is regularly removed so that fire intensity is moderated. This increases the likelihood of a patchy burn, and decreases chances for intense, deep burns that could destroy the seed bank or kill reptiles attempting to burrow down from the heat.

The number of animals that will be injured or killed is difficult to determine. During a total of six prescribed burns in 2002 at the Station, three sand skink mortalities were observed after two of the burns and were attributed to heat from the fires. No other mortalities for scrub-jays, indigo snakes, or both skinks resulting from the 12 prescribed burns the Station conducted during 2002 and 2003 were reported.

The 13 plant species will be top-killed or completely burned during fires. Those that occur at the Station and the Reserve typically resprout or propagate from seed after fire. As with the animal species, although there may be immediate mortality of certain life history stages, these plants are dependent on fire for long-term survival and would be extirpated without it. Any individuals lost during the burn should be offset by opening up the habitat and promoting optimal conditions for propagation.

CUMULATIVE EFFECTS

Cumulative effects include the effects 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 that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

State, local, and private actions not associated with the proposed actions, such as development and agriculture, are likely to continue throughout the area covered by the proposed permit. These actions are likely to result in varying degrees of adverse effects to one or more of the species addressed in this biological opinion. Therefore, cumulative effects may occur. Considering the scientific and conservation goals of Archbold Expeditions, activities in the project area in the foreseeable future are not expected to be extensive enough to jeopardize their continued existence.

SUMMARY OF EFFECTS

Although short-term, minimal adverse effects may occur to the species named in Table 1, the overall effect of the proposed prescribed burn program is beneficial. Considering that fires, either wild or prescribed, are inevitable in the project area, and that most of the species named in Table 1 are fire dependent or prefer ecosystems maintained by regular burning, any direct losses are expected to be more than compensated by the restoration of regular fires to the project area.

CONCLUSION

After reviewing the status of the species named in Table 1, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is the Service's biological opinion that the issuance of Section 10(a)(1)(A) authorization, TE088035, as proposed, is not likely to jeopardize the continued existence of any species named in Table 1. No critical habitat has been designated for this species; therefore, none will be affected.

INCIDENTAL TAKE STATEMENT

Sections 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA 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 such as 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 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 ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are nondiscretionary, and must be undertaken by the Service so that they become binding conditions of any grant or permit issued to the applicant, as appropriate, for the exemption in action 7(o)(2) to apply. The Service has a continuing duty to regulate the activity covered by this incidental take statement. If the Service (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, the applicant must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement.

Section 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plants species. However, limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to possession of federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of State law or regulations or in the course of any violation of a State criminal trespass law. The State requires permission of private landowners for collecting of State-listed plants from their property. If this project is on private land and the landowner is not the project proponent, in addition to landowner permission, a Florida Department of Agriculture and Consumer Services permit for plants may be needed. To determine if such a permit is necessary or to apply for this permit, contact: Florida Department

of Agriculture and Consumer Services, Division of Plant Industry, Post Office Box 147100, Gainesville, Florida 32614-7100, 352-372-3505. http://www.doacs.state.fl.us/onestop/plt/plantinspinst.html.

AMOUNT OR EXTENT OF TAKE

The Service anticipates that the proposed action will incidentally take federally listed species, though the level of incidental take will be difficult to detect because finding a dead or impaired specimen is unlikely following a fire. It is possible that the scrub-jay, caracara, eastern indigo snake, both skink species, and the 13 plant species named in Table 1 could be temporarily extirpated from any given burn unit. The incidental take is expected to be in the form of harass, harm, wound, or kill. The Service expects, however, that listed species populations will rebound from temporary fire effects and be enhanced in the burn units. It is not expected that any of these species will be extirpated from the three divisions of Archbold Expeditions.

The Service will not refer the incidental take of any migratory bird or bald eagle (*Haliaeetus leucocephalus*) for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 7 03-712), or the Bald Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to any of the species named in Table 1. The Service also determined that no critical habitat would be affected.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of species named in Table 1.

- Adverse effects resulting from authorized activities can be minimized by following well-accepted methods for planning and conducting burns so that soils are not adversely affected and those fires do not get out of control. The fire management plans submitted for each of the three properties managed by Archbold Expeditions with the application provide for these concerns.

TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the ESA, the Service must comply, or ensure that the applicant complies, with the following terms and conditions, which implement the reasonable and prudent measures, described above and outline required reporting/monitoring requirements. These terms and conditions are nondiscretionary.

1. The reporting and monitoring requirements outlined in the section 10(a)(1)(A) permit will also satisfy the reporting/monitoring requirements required pursuant to section 7 of the ESA and its implementing regulations.

2. An annual report summarizing the authorized activities must be submitted to this office by December 31 of each year for which the permit is valid. A report must be submitted whether or not activities were conducted during the reporting period. Negative data should also be reported. Each report should include, at a minimum, the following information:

    - Location and dates of all prescribed burns conducted. Locations should be noted using figures and maps.
    - Results and discussion of prescribed burns in relation to habitat management goals and species recovery.
    - Copies of all published papers and reports that result from activities authorized under the permit.

3. If any injury or mortality should occur to the scrub-jay, caracara, eastern indigo snake, bluetail mole skink, or sand skink as a result of permitted activities, the permittee shall contact the Field Supervisor of this office by the next work day. The permitte shall also contact the Regional Permit Coordinator. Based upon discussions between these offices, a decision will be made as to whether or not the authorized activities will be allowed to continue. A decision will also be made regarding the disposition of any injured or killed species. Permitted activities that appear to be resulting in excessive injury or death will be immediately suspended until more protective measures or an alternative resolution can be initiated.

4. Upon locating a dead, injured, or sick scrub-jay, caracara, eastern indigo snake, bluetail mole skink, or sand skink under circumstances not addressed in the permit, or any other threatened or endangered species, initial notification must be made immediately to the nearest Service Law Enforcement Office (9549 Koger Boulevard, Suite 111, St. Petersburg, Florida 33702; 727-570-5398). Secondary notification should be made to the FWC, South Region, 3900 Drane Field Road, Lakeland, Florida 33811-1299; 1-800-282-8002. Care should be taken 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 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 ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA 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.

- The Service should continue to implement the MSRP (Service 1999).

For the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the proposed action. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency 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 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.

If you have any questions, please contact Melody Ray-Culp at 772-562-3909, extension 263.

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Table 1. Federally listed and candidate species that occur on three properties managed by Archbold Expeditions. E = endangered, T = threatened, S/A = similarity of appearance.

Common Name	Scientific Name	Listing	Station	Reserve	MAERC
Birds					
Florida scrub-jay	*Aphelocoma coerulescens*	T	√	√	
Audubon's crested caracara	*Caracara cheriway* (=*Polyborus plancus audubonii*)	T	√	√	√
Wood stork	*Mycteria americana*	E		√	√
Reptiles					
American alligator	*Alligator mississippiensis*	T(S/A)	√	√	√
Eastern indigo snake	*Drymarchon corais couperi*	T	√	√	√
Bluetail mole skink	*Eumeces egregius lividus*	T	√	√	
Sand skink	*Neoseps reynoldsi*	T	√	√	
Mammals					
Florida panther	*Puma* (=*Felis*) *concolor coryi*	E	√	√	
Plants					
Florida perforate cladonia	*Cladonia perforata*	E	√		
Pigeon wings	*Clitoria fragrans*	T	√		
Scrub mint	*Dicerandra frutescens*	E	√		
Scrub buckwheat	*Eriogonum longifolium* var. *gnaphifolium*	T	√		
Snakeroot	*Eryngium cuneifolium*	E	√		
Highland's Scrub hypericum	*Hypericum cumulicola*	E	√	√	
Scrub blazing star	*Liatris ohlingerae*	E	√	√	
Britton's beargrass	*Nolina brittoniana*	E	√		
Papery whitlow-wort	*Paronychia chartacea*	T	√	√	
Wireweed	*Polygonella basiramia*	E	√	√	
Sandlace	*Polygonella myriophylla*	E	√		
Scrub plum	*Prunus geniculata*	E	√	√	
Carter's mustard	*Warea carteri*	E	√	√	