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Strategic Environmental Research and Development Program

Species Profile: Eastern Indigo Snake *(Drymarchon corais couperi)* on Military Installations in the Southeastern United State

by Charlotte O. Hallam, Kimberly Wheaton, The Nature Conservancy
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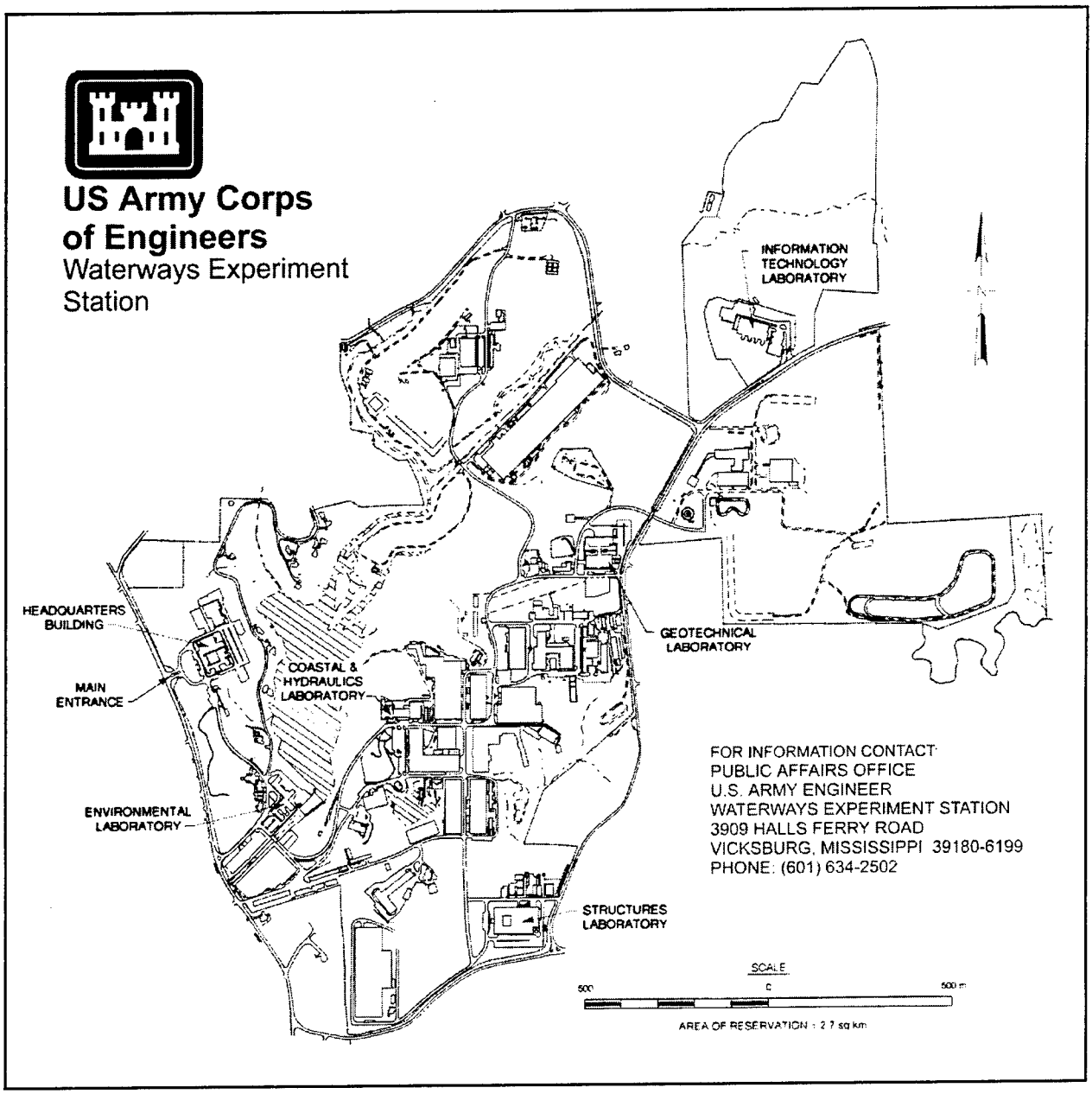

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Preface

The work described herein was authorized by the Strategic Environmental Research and Development Program (SERDP), Washington, DC. The work was performed under the SERDP study entitled "Regional Guidelines for Managing Threatened and Endangered Species Habitats." Mr. Brad Smith was Executive Director, SERDP.

This report was prepared by Mses. Charlotte O. Hallam and Kimberly Wheaton, The Nature Conservancy (TNC), Chapel Hill, NC; and Dr. Richard A. Fischer, Natural Resources Division (NRD), Environmental Laboratory (EL), U.S. Army Engineer Waterways Experiment Station (WES), Vicksburg, MS. Portions of this report include information from TNC's Element Stewardship Abstract (ESA) titled "Species Stewardship Summary; *Drymarchon corais couperi*" prepared by Ms. Hallam for TNC. A revised ESA titled "Species Stewardship Summary; *Drymarchon corais couperi*" was prepared by Ms. Wheaton under contract with the U.S. Army Construction Engineering Research Laboratories (CERL), Natural Resources Division, Champaign, IL, for a document titled "Integrated endangered species management recommendations for Army installations in the southeastern United States: Assessment of Army-wide guidelines for the red-cockaded woodpecker on associated endangered, threatened, and candidate species."

Mr. Chester O. Martin, EL, WES, and Ms. Ann-Marie Trame, Land Management Laboratory, CERL, were Principal Investigators for the regional guidelines work unit. Dr. Fischer managed and coordinated preparation of species profiles for this study. Report review was provided by Dr. C. Kenneth Dodd, National Biological Service, Gainesville, FL; Dr. Paul E. Moler, Florida Game and Fresh Water Fish Commission; and Mr. Dirk Stevenson, Fish and Wildlife Branch, Fort Stewart, GA. WES internal review was provided by Mr. Martin, Ms. Dena Dickerson, and Dr. Wilma Mitchell, EL.

This report was prepared under the general supervision of Dr. Michael F. Passmore, Chief, Stewardship Branch, NRD; Dr. Dave Tazik, Chief, NRD; and Dr. John Harrison, Director, EL.

At the time of publication of this report, Dr. Robert W. Whalin was Director of WES. COL Robin R. Cababa, EN, was Commander.

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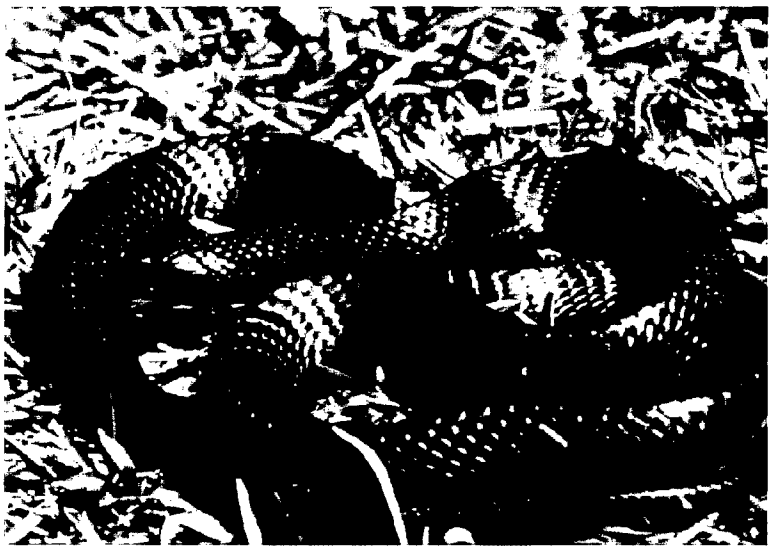
Species Profile: Eastern Indigo Snake
(Drymarchon corais couperi)



Eastern Indigo Snake; photo courtesy of the Florida Agricultural Information Retrieval System

Taxonomy

Class	Reptilia
Order	Squamata
Family	Colubridae
Genus/species	*Drymarchon corais couperi*
Other Common Names	Blue gopher snake, gopher snake, blue indigo snake, blue bull snake

Description

The eastern indigo snake is a large, nonpoisonous snake that attains a maximum length of 2.6 m ($\bar{x}$ = 1.8 m) (8.5 ft; $\bar{x}$ = 5.9 ft). Color is a uniform lustrous blue-black, except for some reddish or cream-colored areas around the chin, throat, and cheeks. Scales are large, shiny, and in 17 rows at midbody (Conant 1975, Mount 1975). The anal plate is undivided. Most large males may have weakly keeled scales on as many as five middorsal scale rows, starting at about the second quarter of the body (Layne and Steinert 1984). Juvenile indigo snakes (43 to 61 cm (17 to 24 in.) long at hatching) are similar to adults but may have much more reddish areas on the head and forward part of the belly (Conant and Collins 1991).

Similar Species

Smaller individuals often resemble the black racer *(Coluber constrictor)*, but the racer is generally more slender and faster, has less glossy coloration, white or brown chin, a divided anal plate (U.S. Fish and Wildlife Service 1982), and is almost always <1.2 m (3.9 ft) long. Neonate and juvenile racers are blotched and do not resemble indigo snakes. Populations of the eastern indigo snake are isolated from the Texas indigo snake (*D. c. erebennus*) by approximately 1,000 km (620 miles) (Moler 1992).

Status

Legal designation

Federal. The eastern indigo snake was listed as threatened in 1979 by the U.S. Fish and Wildlife Service (USFWS). The formal recovery plan for the species was developed in 1982 (USFWS 1982).

State. The eastern indigo snake is considered a protected nongame wildlife species in Alabama and has been granted full protection as threatened in both Florida and Georgia and endangered in South Carolina and Mississippi (King and Schrock 1985).

Distribution and numbers

Historically, the range of the eastern indigo snake extended from South Carolina through Georgia and Florida to the Keys, and west to southern Alabama and Mississippi (Moler 1985). In 1982, the snake was known from 50 counties in Georgia, where it appeared to be maintaining viable populations in protected areas of good habitat (USFWS 1982). However, in recent years there has been much concern over the decline of the eastern indigo snake across most of its original range. Indigo snakes currently occur almost exclusively in Florida and the Coastal Plain of Southern Georgia; they are now extremely rare or extirpated in Alabama, Mississippi, and South Carolina (Figure 1). However, recent reintroductions have been made; as of 1990, the Alabama Cooperative Wildlife Research Unit had released captive-reared individuals in Florida, Alabama, Georgia, and Mississippi. Populations are common to locally abundant in parts of peninsular Florida, but few known populations occur in the panhandle. Overall, indigo snake populations are declining in abundance and distribution.

Military installations

Table 1 represents the known status of indigo snakes on military installations in the southeastern United States.

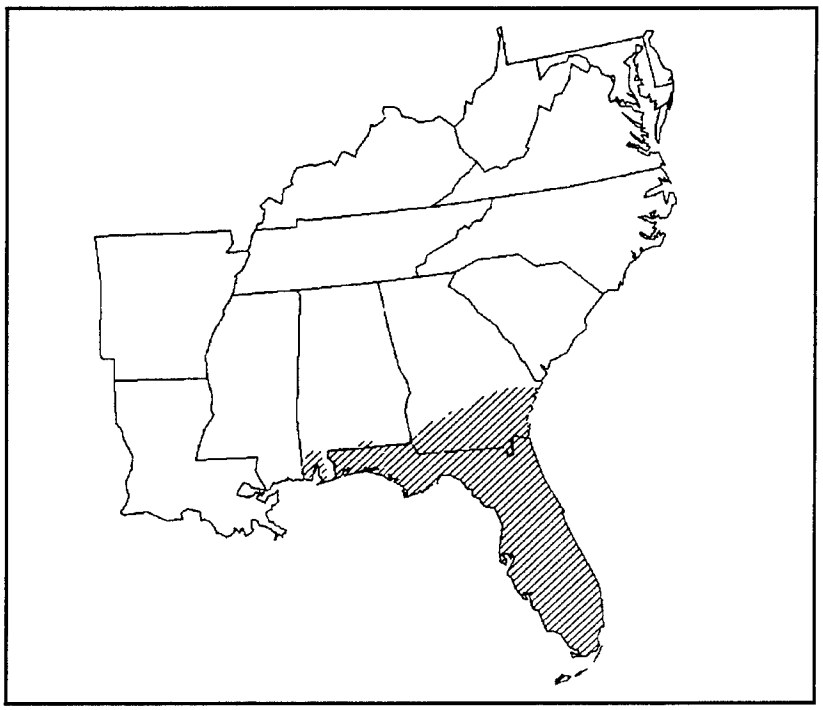


Figure 1. Approximate distribution of the eastern indigo snake (from Diemer and Speake 1983, Moler 1985)

Table 1
Known Status of Eastern Indigo Snake on Military Installations in the Southeastern United States

Status	Installation	Status on Installation
GA	Fort Stewart	Documented onsite; three populations, twelve individuals documented (The Nature Conservancy (TNC) 1995). Another individual was observed far removed from the three populations documented by TNC (Tim Beaty, Personal Communication, 1996).
	Fort Gordon	Poor potential (outside of known range).
	Fort Benning	Poor potential (outside of known range).
	Moody Air Force Base (AFB)	Documented onsite (Dirk Stevenson, Personal Communication, 1997).
	Marine Corps Logistics Base, Albany	Potential.
FL	Eglin AFB	Documented onsite (Department of the Air Force 1993).
	Homestead AFB	Documented onsite.
	Cape Canaveral Air Station	Documented onsite (Barbara Lenczewski, Personal Communication, 1997).
	Tyndall AFB	Potential (Stephen Shea, Personal Communication, 1996).
	Avon Park	Documented onsite.
	Naval Air Station (NAS) Jacksonville	Documented onsite (Sandra Maynard, Personal Communication, 1996).
	Cecil Field NAS	Potenital.
	Tyndall AFB	Potential.
	Key West NAS	Documented onsite (Barbara Lenczewski, Personal Communication, 1997).
	Camp Blanding	Documented onsite.
MS	Camp Shelby	Documented onsite.

Habitat Requirements

The eastern indigo snake is found in a variety of habitats including xeric uplands, pine flatwoods, wet prairies, and mangrove swamps (The Nature Conservancy (TNC) 1995). However, suitable habitat appears to vary depending on latitude. In more northern portions of its range, the indigo snake is typically found in xeric, sandhill habitats with well-drained sandy soils (i.e., those habitats favored by the gopher tortoise (*Gopherus polyphemus*)). Diemer and Speake (1983) described key habitat in Georgia as including long (>50 km (31 miles)) strands of contiguous, parabolic, or elliptical sand ridges associated with major coastal plain streams (Ohoopee, Canoochee, and Alapaha rivers) in the Georgia sandhills (vegetation is primarily scrub oak (*Quercus* spp.), longleaf pine (*Pinus palustris*), and turkey oak (*Q. laevis*), with occasional live oak (*Q. virginiana*)). The dry upland soils in the snake's range in Georgia occasionally support a "Florida Scrub" type habitat of myrtle oak (*Q. myrtifolia*) and Chapman's oak (*Q. chapmanii*). Indigo snakes occasionally also use slash pine (*P. elliottii*)-dwarf oak habitats, as well as clearcut areas with windrows (Diemer and Speake 1983). During winter, snakes have been observed almost exclusively in or near gopher tortoise burrows on sandhills (92 percent of sightings). In Georgia, indigo snakes may use creek bottom thickets, upland pine-hardwood forest, mixed hardwood forest, and agricultural fields during spring and fall (Speake et al. 1978). Maintaining corridors that link seasonal habitats may be important to allow snakes to safely travel among habitats.

Habitat preferences appear to be less restricted in the southern portions of its current range, as indigo snakes occupy a wider range of habitats possibly due to climate and winter behavior (USFWS 1982). For example, in southern Florida, indigo snakes can be found in riparian habitat, tropical hammocks, and dry glades (Carr and Goin 1955, Lawler 1977, Kochman 1978). They also were found along canal banks, using crab holes instead of gopher tortoise burrows.

Life History and Ecology

Home range and movements

Indigo snakes are exclusively diurnal. Temperature and season of year affect activity and seasonal home range sizes. Indigo snakes make extensive movements during warmer months (individual territories range from 50 to 100+ ha (124 to 248+ acres)); they remain active to a lesser degree throughout the winter (ranges typically less than 10 ha (25 acres) (Moler 1992)) leaving their dens when air temperatures exceed 10 °C (50 °F) (Ernst and Barbour 1989). In southwest Georgia, average seasonal home ranges were 4.8 ha (12 acres) during the winter (December through April), 42.9 ha (106 acres) during late spring and early summer (May through July), and 97.4 ha (241 acres) during late summer and fall (August through November) (Speake et al. 1978). In south Georgia, radio-marked indigo snakes made extensive movements during May and June from sandhill ridges to flatwoods or creek-bottom areas. Snake movements were also pronounced

during August to November (Speake et al. 1978). Wetlands are utilized to a large extent during spring and summer and are important foraging areas (TNC 1995). Snakes are typically inactive for a week or two prior to shedding (Moler 1992).

Burrows

Indigo snakes most often seek refuge from winter cold and desiccating conditions in gopher tortoise (*Gopherus polyphemus*) burrows, but also use land crab and armadillo (*Dasypus novemcinctus*) burrows, stump holes, root channels and rodent burrows at the base of large live oaks, and limestone solution holes, as available (Moler 1986, 1992). In Georgia, indigo snakes are primarily dependent upon gopher tortoise burrows for refugia, but also use stump holes, particularly during winter (Speake et al. 1978, Diemer and Speake 1983, Moler 1992). Of the 108 burrow/retreat sites described by Speake et al. (1978), 77 percent were in gopher tortoise burrows, 18 percent in or under decayed stumps and logs, and 5 percent under plant debris (Speake et al. 1978). Snakes also used windrows remaining from site preparation during the 1960s in a slash pine plantation for foraging and denning (Speake et al. 1978). Williamson and Moulis (1979) reported that indigo snakes on Fort Stewart, GA, were often observed at abandoned gopher tortoise burrows. Although many of these burrows were collapsed, a new hole approximately the diameter of the resident indigo snake was observed at the original burrow entrance or through the top of the burrow proximal to the original tortoise entrance.

Reproduction

Little is known about reproductive behavior in natural indigo snake populations. However, they have bred successfully in captivity at Auburn University, Alabama. Indigo snakes appear to reach sexual maturity at 3 to 4 years of age. Copulation in captivity has occurred primarily between October and March, with a peak in mid-November through late December (Speake et al. 1978, Ernst and Barbour 1989), although Moulis (1976) reported mating during April in Georgia. Clutches of 5 to 12 eggs ($\bar{x}$ = 8 to 9 eggs) are laid from April through May with hatchlings emerging approximately 3 months later (from late July through October) (Behler and King 1979, Ernst and Barbour 1989). Females can lay fertile eggs after several years of isolation (Behler and King 1979, Moler 1992). Nest sites have not been described, although eggs may be laid in inactive gopher tortoise burrows (USFWS 1992). Detailed descriptions of courtship are given in Gillingham and Chambers (1980).

Food habits and foraging

The indigo snake is an active, diurnal predator. Prey are captured and killed with strong jaws; it does not kill by constriction or poisoning. Snakes often feed along the edge of wetlands (Moler 1992) on a variety of vertebrates including fish, frogs, toads, lizards, small turtles including young gopher tortoises, snakes (e.g., black racers and diamondback rattlesnakes (*Crotalus adamanteus*) (Conant 1975, Mount 1975)), birds, and small mammals (e.g., cotton rats (*Sigmodon hispidus*)). The gut contents of one 1.8-m (5.9 ft) indigo snake contained two dusky pygmy rattlesnakes (*Sistrurus miliarius barbouri*) (30.5 to 35.5 cm (12 to 14 in.) long), four turtle eggs, unidentified eggshell fragments,

gravel, and small stones (scattered throughout the length of the intestines) (Babis 1949). Ernst and Barbour (1989) reviewed published food habit studies and concluded that the indigo snake prefers reptilian prey.

Habitat Assessment Techniques

Insufficient information was available in the literature to adequately address habitat assessment techniques. However, one indicator of habitat quality within the range of the gopher tortoise might be the presence/absence of tortoises, since snakes essentially depend on their burrows for dens (Dirk Stevenson, Personal Communication, 1997).

Impacts and Cause of Decline

Habitat loss and degradation

Habitat loss, conversion, and degradation (e.g., farming, urbanization/construction, forestry practices, pasture) are the major factors contributing to the decline of the eastern indigo snake (Lawler 1977, Moler 1992). Remaining habitat continues to be degraded. Because of its dependence on gopher tortoise burrows for shelter, factors that degrade tortoise habitat, such as fire suppression, also negatively impact indigo snake populations. Fire suppression has allowed suitable habitat to undergo succession from longleaf pine/scrub-oak to communities dominated by larger oak species, such as laurel oak (*Q. laurifolia*). Many even-aged pine plantations potentially suitable for snakes are often either not burned at a frequency suitable for snakes, are stocked too densely, or lack adequate prey.

In contrast to other secretive species that can persist on small woodlots, indigo snakes require relatively large tracts of suitable habitat. Habitat fragmentation exacerbates this problem since the indigo snake is a wide-ranging species (Moler 1992). Land development, even at low densities (e.g., 8-ha (20-acres) lot size), can negatively impact indigo snake populations since the home range of a single snake may overlap numerous individual properties (Moler 1992).

Other concerns

During summer, snakes disperse from their overwintering habitats in the sandhills into areas where human encounters are more likely (e.g., fields, yards, and areas near water), resulting in increased roadway mortality (Diemer and Speake 1983). The snake's large, docile, highly visible, and wide-ranging nature also make it an easy target for persons who wantonly kill snakes (Speake et al. 1978) or collect individuals for the pet trade (USFWS 1992). Overcollecting was directly blamed for the snake's decline in numbers in southern Florida (Blaney and Blaney 1974). Use of all-terrain vehicles in sandhill areas destroys native vegetation that is crucial for soil stability. In addition, forage for gopher tortoises may be eliminated, as well as the tortoises' ability to construct burrows,

increasing the rates of erosion and leading to the disruption of the entire community (Lawler 1977).

Another potential source of pressure is brought on by the indigo snake's association with the eastern diamondback rattlesnake, both of which winter in gopher tortoise burrows. During "rattlesnake roundups," gasoline poured into the burrows to force out the rattlesnakes may kill or injure indigo snakes and other species using these burrows. Studies have suggested that indigo snakes are often found dead near burrows within hours or days after roundups (Speake and Mount 1973, Lawler 1977). Although the actual extent of such mortality is unknown (USFWS 1992), this may be a limiting factor in portions of their range where roundups are still conducted.

Lawler (1977) reported specimens containing extremely high levels of chlordane metabolites. Because the indigo snake is apparently long-lived and an upper level predator, it may be susceptible to direct or secondary effects of pesticides, including bioaccumlation from prey (USFWS 1982).

Military training (adapted from Trame and Harper 1997)

Mechanized training. Mechanized military training can alter natural plant communities through impacts to soils and subsequently cause soil erosion. Intense use of tactical land vehicles (both tracked and wheeled) can cause extensive soil disturbance, which may destroy gopher tortoise burrows in which indigo snakes may nest or seek refuge.

Bivouacs. Military bivouacs, which involve a combination of vehicle and non-mechanized trampling, represent a serious source of soil compaction and related impacts to sandhill habitat. Sustained high levels of trampling can ultimately eliminate vegetation.

Fire. Military training can impact native communities and associated species by fragmenting the fuel sources needed to carry fire over large areas. Native ground cover, especially grasses, are essential fuel sources that allow large areas to burn. Bunch grasses are often eliminated in bivouac sites, assembly areas, and tank-maneuver areas through direct destruction or soil compaction. Areas that do not burn undergo a change in species composition and become increasingly shaded through time, resulting in the loss of the natural community.

The reintroduction of fire resulting from activities such as live arms firing and use of incendiary devices may be potentially beneficial to sandhill organisms. The frequency of ignition on military installations, especially in high hazard impact areas, often produces a fire regime over large areas at a frequency that resembles presettlement natural fire return intervals. This encourages a mosaic burn pattern and enhances conditions for the fire-adapted species in southern pine woodlands (Gulf Engineers and Consultants, Inc., and Geo-Marine 1994; Leblond et al. 1994).

Management and Protection

Management procedures

Management of existing intact stands of mature longleaf pine and turkey oak is necessary to restore or maintain the open, parklike understory conducive to both the indigo snake and the gopher tortoise. Periodic burning is essential to the maintenance of these habitats to ensure the open, grassy areas between widely spaced trees. Burning reduces litter accumulation and aids in the persistence of wire grass (*Aristida stricta*) and associates, which provide gopher tortoise browse. Large enough areas are required to support sizeable tortoise populations and in turn an adequate number of burrow refugia. Large areas would also minimize habitat fragmentation and roadkills during dispersal. Reduced human disturbance would help keep sandhill ridges intact and prevent loose blowing sand and erosion (Ashton and Ashton 1981).

Concern for the endangered red-cockaded woodpecker (*Picoides borealis*) has generated increased interest in the preservation and restoration of the longleaf pine forest ecosystem. Because of its large home range and its dependence on mature forest stands, the woodpecker integrates the needs of many other plants and animals dependent on this shrinking resource. Both indigo snakes and gopher tortoises are found in habitats subject to Army-wide management guidelines for the red-cockaded woodpecker (U.S. Army Construction Engineering Research Laboratories 1994). These guidelines call for frequent (3- to 5-year), growing-season prescribed fires to reduce hardwood midstory growth. Enhancement of red-cockaded woodpecker habitat will likely have a positive effect on both gopher tortoise and indigo snake habitat.

Prescribed burning. Regular prescribed fire is highly desirable for the maintenance and improvement of indigo snake habitat because it acts to reduce the shrub and midstory woody vegetation and promotes a well-established herbaceous layer (which, in turn, favors the gopher tortoise). Growing-season burns typically are recommended for southern pine woodland communities (e.g., pine flatwoods, longleaf pine-turkey oak sandhills) based on response of many plant species and other threatened and endangered species potentially present in the community. Winter burns are sometimes recommended over growing-season burns for indigo snakes, since the species tends to be actively moving during the spring from winter habitats in the xeric sandhills to lower lying habitats. However, winter burns could result in increased predation on smaller indigo snakes that may rely on pine straw, logs, palmetto clumps, and other debris for shelter (Smith 1987). Paul Moler (Personal Communication, 1996) suggested that May and June burns could be conducted, as most snakes would have moved to low-lying areas by this time. Burn frequencies should be at least once every 5 to 10 years, but intervals of 2 to 4 years between burns have also been shown to be beneficial (USFWS 1982). Land managers should carefully consider the species that are present and their requirements before determining the timing of prescribed fire.

In pine plantations, commercial thinning is beneficial because it opens the canopy and increases understory development. Low-intensity site preparation through burning

should be used rather than more intensive methods such as root raking with heavy machinery (USFWS 1982). Also, reducing physical impediments to burning, including roads and habitat fragmentation, would help reduce the isolation of snake subpopulations.

Extractive land uses. Pine straw raking can destroy ground-layer vegetation and longleaf pine seedlings and cause or exacerbate erosion problems. In the long term, removal of pine straw fuels may also alter fire regimes (Harper et al. 1997). All of these potential effects would have negative impacts on indigo snakes. Timber harvest that shifts forest stands toward longer rotations and replaces offsite pines and hardwoods with longleaf pine may restore natural fire, hydrologic, and nutrient dynamics in plant communities. Forest management should minimize adverse impacts to wire grass and other herbaceous ground-layer species. Stump removal also can be damaging to indigo snake populations because it eliminates alternative underground refugia in areas lacking gopher tortoises (Paul Moler, Personal Communication, 1996).

Training restrictions. Restrictions on training activities within red-cockaded woodpecker habitat management units, to the extent that they minimize disturbance to vegetation and soils, should benefit both indigo snakes and gopher tortoises. Vehicular traffic on secondary and tertiary roadways should be monitored to reduce soil erosion, and off-road traffic in gopher tortoise/indigo snake habitat should be limited, as it is highly deleterious to ground cover, soil structure, and hydrologic patterns. Where off-road traffic is unavoidable, it should be prohibited near known gopher tortoise burrows.

Habitat preservation

Many of the last remaining large areas of longleaf pine-turkey oak sandhills and forests are found on U.S. Department of Agriculture Forest Service and Department of Defense lands. Many of the these areas are being managed for recovery of the red-cockaded woodpecker, and controlled burning programs have subsequently been initiated (2- to 3-year intervals) for hardwood midstory control and restoration of longleaf pine on suitable sites.

Active land management is required to restore degraded pine-oak forests to maintain existing eastern indigo snake populations and recover declining populations. Studies in Georgia and Florida indicated that indigo snakes occur in several habitat types, such that large areas should be protected. Habitat conservation must include the avoidance of habitat fragmentation that may put populations of this large, wide-ranging snake at greater risk. Diemer and Speake (1981) recommended protection of suitable large riverine-sandhill ecosystems in Georgia. Moler (1992) emphasized the need for protection of large tracts of suitable habitat (generally at least 1,000 ha). Land protection through acquisition, easement, and registry programs is the best means of ensuring that large tracts of suitable habitats for eastern indigo snake are preserved.

Management needs

Effective land protection for the eastern indigo snake in northern parts of its range depends upon the protection and restoration of longleaf pine-turkey oak sandhill habitats.

The extensive seasonal movements of the indigo snake, particularly in Georgia, bear importantly on the reestablishment of the species (USFWS 1982). Land management should aim to protect large areas of longleaf pine, as well as associated habitats used seasonally by indigo snakes (e.g., bottomland hardwoods), in order to promote the mosaic of habitat types most beneficial to the snake. Diemer and Speake (1983) suggested that properly managed slash pine (i.e., seasonally burned), where slash pine has replaced longleaf pine in the Georgia sandhills, may support the gopher tortoise and, consequently, the indigo snake.

Inventory and Monitoring

Diemer and Speake (1983) described the use of questionnaires, follow-up surveys, searching for snakes, soil-survey data, and satellite imagery in the delineation of key areas of suitable habitat. They pointed out that use of satellite imagery allows the establishment of permanent tracking records and the location of noteworthy areas. On Fort Stewart, GA, surveys on foot were conducted during February through April. Searches were performed 12 to 15 days per year on sandhill sites >80 ha (200 acres) that supported dense gopher tortoise populations. Flashlights and mirrors were used to look for snakes just inside the burrows, and ground around tortoise burrows was searched for indigo snake shed skins and tracks. Additional searches were made during April through October in ecotones between sandhills and wetland communities (e.g., riverine swamps, pond borders, riparian thickets) to locate snakes basking or foraging near wetland edges.

Additional censuses are needed to determine the status of the species in the remaining longleaf pine-turkey oak habitats in the Southeast. Long-term monitoring programs that include a means of estimating population size and demographic trends would be helpful. Long-term monitoring would also aid tracking changes in habitat use and availability. These programs are also needed to assess the impacts of collecting, pesticide use, and human modification of those habitats on population size and demography.

Restoration and Recovery

The indigo snake has proven to breed successfully in captivity, and reintroduction into suitable habitats with low populations could be beneficial to maintaining viable populations (World Wildlife Fund 1990). Guidelines for selection of reintroduction sites include (a) areas of a minimum of 200 ha (500 acres) in size; (b) similarity in vegetation and soils to the closest known habitat presently or historically occupied; and (c) long-term security for the species that can be managed as needed (USFWS 1982).

Snakes collected for reintroduction purposes should come from areas where they are abundant or where suitable habitat is about to be destroyed. Released snakes should be taken from parent stock originating as near as possible to the release site (USFWS 1982). All reintroductions should be monitored to determine the success of establishment.

The objectives of the formal recovery plan for the indigo snake (USFWS 1982) are to "ensure that numerous indigo snake populations exist in the historical range of the species" so that the species can be delisted. Recovery of indigo snake populations depends on the preservation of large tracts of remaining forest, restoration of disturbed forest, and provision of habitat linkages to prevent fragmentation of home ranges. Indigo snake numbers are intimately related to the status of the remaining longleaf pine habitats and gopher tortoise populations upon which the species depends. However, current population levels of the eastern indigo snake are still not well-known.

Recovery of the species requires the maintenance of numerous stable and protected populations where suitable habitat remains within its historical range. Necessary research objectives include the following (USFWS 1982):

a. Develop appropriate population monitoring methods.

b. Determine juvenile habitat requirements (completed, Paul Moler, Personal Communication, 1996).

c. Explore captive breeding and restocking potential for the species (completed, Paul Moler, Personal Communication, 1996).

d. Describe the species reproductive behavior in the wild.

e. Investigate the extent and effects of pesticide exposure.

f. Determine optimum gopher tortoise burrow density required to maintain populations of indigo snakes in the northern portion of the snake's range.

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13. ABSTRACT *(Maximum 200 words)*

The eastern indigo snake (*Drymarchon corais couperi*) is an uncommon, large-bodied snake occurring in the southeastern United States, primarily in southern Alabama and Georgia and most of Florida. The U.S. Fish and Wildlife Service listed the species as Federally threatened in 1979. The species is most often found in xeric, sandhill habitats with well-drained sandy soils, but may occasionally be found in pine flatwoods, wet prairies, and mangrove. They often are found in the burrows of gopher tortoises (*Gopherus polyphemus*). Indigo snakes have been documented on several military installations in the Southeast. This document is one of a series of Species Profiles being developed for threatened, endangered, and sensitive species inhabiting southeastern United States plant communities. The work is being conducted as part of the Department of Defense (DoD) Strategic Environmental Research and Development Program (SERDP). The report is designed to supplement information provided in plant community management reports for major United States plant communities found on military installations. Information provided on the eastern indigo snake includes status, life history and ecology, habitat requirements, impacts and cause of decline, management and protection, and inventory and monitoring.

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