Status Survey of the
Eastern Indigo Snake (*Drymarchon couperi* Holbrook),
Black Pine Snake (*Pituophis melanoleucus lodingi* Blanchard), and
Southern Hognose Snake (*Heterodon simus* Linnaeus)
In Alabama

A Report Prepared for

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INTRODUCTION

The herpetofauna of the southeastern Coastal Plain has experienced exceptional pressures following European colonization. This region was the primary building site for past agriculture, urban development (Guyer and Bailey, 1993), certain forestry practices, and natural processes thwarted, namely fire suppression (Ward et al., 1993). These events have led to a highly fragmented and altered landscape, which is attributable to an ever growing list of biological species of conservation concern (e.g., Noss, 1988). Three reptiles that are closely associated with this region that have experienced demise due to anthropogenic factors are the eastern indigo snake (*Drymarchon couperi* Holbrook), black pine snake (*Pituophis melanoleucus lodingi* Blanchard), and southern hognose snake (*Heterodon simus* Linnaeus).

By the 1960s and 1970s, serious decline of eastern indigo snake numbers raised concern among zoologists and naturalists (Speake and Mount, 1973; Lawler, 1977). Awareness and interest over the plight of the eastern indigo snake eventually led to its listing as a threatened species by the federal government in 1978 (Federal Register Vol. 43 No. 52: 11082-11093). Reasons identified that contributed to the species' demise and eventual listing were over-collecting for the pet trade, habitat loss and fragmentation, highway mortalities, and the "gassing" of gopher tortoise burrows (often used as den and nest sites by indigo snakes) to drive out rattlesnakes (Speake, 1993). Based on the retraction of populations and overall rarity, conservation priorities have been given to the eastern indigo snake by the Heritage Network and The Nature Conservancy (TNC).

The Natural Heritage ranking system, developed by TNC sets conservation priorities for biological species and ecosystems that require special attention based on rarity, endangerment, or integrity (Adams et al., 2000). Conservation priorities are based on a numerical ranking system from 1 (critically imperiled, five or less occurrences) to 5 (demonstrably secure, occurrences far in excess of 100). *Drymarchon couperi* has a global rank (G) of G3, which implies that the eastern indigo snake is both very rare and local throughout its range or found locally in a restricted range (21 to 100 occurrences worldwide). In Alabama, the eastern indigo snake has a state rank (S) of S1, meaning that the taxon is critically imperiled within Alabama's borders.

The black pine snake is another species of the Coastal Plain that has received considerable concern over the past few decades. The species was petitioned and subsequently added to the candidate list (Category Two, C2) for federal protection in 1977 by the U.S. Fish and Wildlife Service (USFWS). Following the C2 designation, a review and survey was conducted (Jennings and Fritts, 1983) to determine if the species warranted federal listing under the Endangered Species Act of 1973. The results of all surveys and reviews thus far suggest that additional information is needed before a decision can be made for federal listing.

The Heritage ranking system has given a conservation priority rank to the black pine snake of G5T3, which implies that at the species level (i.e., *Pituophis melanoleucus*) the pine snake is apparently secure, globally with a G5 ranking. However, the rank of T3

implies that the subspecies, *P. m. lodingi*, is both very rare and local throughout its range or found locally in a restricted range (21 to 100 occurrences worldwide). The black pine snake has a state ranking of S2 suggesting that the taxon is imperiled in Alabama because of rarity (6 to 20 documented occurrences) or some factor(s) making it very vulnerable to extirpation.

In 1991, *Heterodon simus* was designated as a C2 species by the USFWS (USFWS, 1991) but was not granted federal protection under the Endangered Species Act due to insufficient information. TNC has recently assigned a conservation priority rank to the southern hognose snake of G2 (TNC, 1998), which suggests that the species is globally imperiled due to extreme rarity or highly vulnerable to extinction. The state ranking for *H. simus* is SH (state historical) indicating that the species has not been documented in Alabama in over 20 years.

With the exception of the recent study on the black pine snake (Duran, 1998 and Duran and Givens, 2001), very little work or information has been reported concerning the federal threatened eastern indigo snake and/or the southern hognose snake in Alabama. Despite an intensive reintroduction program during the 1970s and 1980s to re-establish the eastern indigo snake in Alabama, no one has revisited the original release sites to assess habitat conditions or *Drymarchon* presence since 1989. It is also unclear whether any one has attempted to examine historical localities for the indigo or southern hognose snakes. To begin the long-term task of assessing the status of these three rare snakes in Alabama, several objectives were established to begin formulating baseline information. This project is intended to help guide future survey and conservation efforts for three of Alabama's rare reptiles. Because of its federal protection, the eastern indigo snake was given priority throughout this study.

OBJECTIVES

The objectives of this study were to: 1) provide a natural history overview of each species to guide subsequent survey and conservation action; 2) map all available or known historical and recent occurrences; 3) specifically map and visit eastern indigo snake reintroduction sites; 4) examine and assess habitats through field visits and/or aerial photography; 5) visit and assess the validity of recent indigo snake sightings; 6) garner new information or updates from landowners and land managers since the 2000 status survey.

METHODS

Natural history information and occurrence records of eastern indigo, black pine, and southern hognose snakes were extracted from published literature, unpublished status reports, anecdotal accounts, and herpetological collections of universities and museums. Interviews were conducted with herpetologists, foresters, landowners, land managers, and Wildlife Management Area (WMA) managers to aid in the assessment and status of probable/confirmed snake occurrences, including the reintroduction and subsequent

relocation efforts of the eastern indigo snake. Records that were deemed mappable (i.e., occurrences with associated locality information enabling the mapper to plot records within a five-mile radius of the actual collection or observation) were plotted onto USGS 7.5 topographical maps and processed into an Element Occurrence Record for inclusion into TNC's Biological Conservation Database (TNC, 1996). Electronic maps were produced (Appendix 2) utilizing Geographical Information Systems software to illustrate mapped occurrences and the distribution of each species.

Visits were made to several localities that represent either historical or current occurrences. Habitats and general landscape conditions were examined and assessed. General statements on land management and/or current condition (e.g., habitat structure and quality) are provided. Aerial photographs of localities known to support one or more of the snakes were examined.

RESULTS AND DISCUSSION

Eastern Indigo Snake

Natural History Overview

Considered to be one of the largest snakes naturally occurring in North America, the eastern indigo snake frequently attains lengths in excess of 2.1 m with a maximum recorded length of approximately 2.6 m (Speake, 1986; Conant and Collins, 1998). Coloration of this subspecies is a uniform, lustrous bluish-black except for the area about the chin, cheeks, and throat, which may be reddish or cream-colored. The scales are large and smooth and occur in 17 rows at mid-body (Mount, 1975). Some adult males from Florida and Georgia exhibit faint keels near the anterior edge of scales comprising the first to fifth mid-dorsal scale rows (Layne and Steiner, 1984; Speake, 1993). Hatchlings are typically 46 to 61 cm and are similar in color to the adults with the exception of some having light gray spots that disappear with age (Speake, 1986). Neill (1951) examined numerous juveniles from Florida and Georgia and described their general coloration as being similar to adults though some possessed extensive reddish shades anteriorly.

Reports from north Florida indicate that breeding occurs between November and April (Moler, 1992). For latitudes comparable to south Alabama, however, the breeding season is projected to range from late October to February with a peak in activity occurring in December (Speake, 1986). Oviposition has been documented to occur from March to July (Speake et al., 1987) but typically occurs during May or June with five to twelve eggs deposited (Kochman, 1978). Nests are often established in gopher tortoise burrows within dry, pineland habitats (Speake et al.,1978; Diemer and Speake, 1983), but stumps are chosen as oviposition sites in lowland flatwoods and cypress pond habitats (Smith, 1987; Speake, 1993). Hatching has been documented to occur from May through October (Speake et al., 1987) with peak emergence occurring between August and September (Smith, 1987).

The eastern indigo snake is active during the daytime and is considered to be a voracious predator feeding on practically any vertebrate it can subdue. The diet of an adult indigo snake may include fish, frogs, toads, lizards, turtles, turtle eggs, juvenile gopher tortoises, birds, small mammals, and snakes, including rattle snakes (Speake, 1986 and 1993). Adults have been observed cannibalizing juvenile indigos (Dan Speake, pers. comm.). Young indigo snakes prey upon invertebrates but are also known to consume other species of small snakes (Smith, 1987).

Eastern indigo snakes are known to use a wide range of habitats. In his description, Holbrook (1842) associates the snake as occurring in dry pine hills and among burrows created by the gopher tortoise (*Gopherus polyphemus*). More recent evidence suggests that habitats frequented by the eastern indigo vary latitudinally (USFWS, 1982; Speake, 1993) and they require a complex of habitats to complete their annual cycle. In the milder climates of south Florida, the indigo snake has been observed in pine flatwoods, tropical hardwood hammocks, freshwater marshes, coastal prairies, mangrove forests, agriculture fields, citrus groves, and along canal banks where they seek crab holes for refuge (Lawler, 1977; Kochman, 1978; Steiner et al., 1983).

In central and north Florida and southern Georgia, it has been discovered that indigo snakes have a strong seasonal preference for certain habitats. Speake et al. (1978), using radio-telemetry, determined that season and temperature were key factors prompting movement of snakes between and among differing habitats. During the winter months, adult snakes were found to inhabit xeric sandridge habitats almost exclusively. Indigos were most often observed during this period outside or in the entrances of gopher tortoise burrows, which provide winter refuge. Movements during this time were typically of snakes leaving one tortoise burrow for another or snakes moving from one sandridge site to an adjacent one. Snakes were typically found outside their winter dens when air temperatures reached 10.6° C or above. Movement patterns increased dramatically during spring months, which is attributed to snakes searching for moist, summer retreats. During the warmer periods, snakes were found moving long distances from one habitat type to another, particularly into and among lowland areas of agriculture fields and stream bottom thickets. The highest movement activity occurred in August. Movement activity continued through the fall, presumably of snakes searching for mates and winter habitats and den sites. In December, activity dropped sharply as snakes had sought their winter retreats. This study also discovered a strong homing tendency among some of the snakes. One individual that was displaced by researchers traveled 4 km to return to a favored location. Additional data from this study showed that one individual moved over 3.5 km in just 42 days and several others moved distances greater than 1.5 km in less than 55 days of tracking.

An added complexity to the life history of the eastern indigo snake is the segregation of habitats utilized by young snakes (both hatchlings and juveniles) as opposed to those used by adults. In areas supporting xeric conditions, studies suggest that adult females prefer high pineland areas where they lay their eggs in gopher tortoise burrows (as discussed above) and secondarily in stumps within flatwood and cypress pond habitats. Yearlings and hatchlings, on the other hand, are attracted to wetland areas supporting

dense vegetative cover along lake and pond edges or in pine flatwoods. It has also been found that young snakes have a lower preference for xeric habitats such as longleaf pine-turkey oak associations and avoid gopher tortoise burrows, though most hatching occurs in tortoise burrows (Smith, 1987; Speake et al., 1987; Speake, 1993).

Distribution and Status

Until recently, the indigo snake of the southeastern Coastal Plain was classified as one of eight described subspecies of *Drymarchon corais* that are primarily tropical in distribution. At the species level, *D. corais* has an overall range that extends from the Coastal Plain of the United States to northern Argentina with a core distribution of six subspecies occurring in South and Central America. The taxonomic treatment and classification of *D. corais* at the subspecies level has recently been challenged and revised by some herpetologists. Wüster et al. (2001) described a new species of *Drymarchon* from north-western Venezuela and also investigated the population systematics of the genus in South America. The authors conclude that based upon scalation and coloration differences the various South American "forms" should be treated as separate species rather than subspecies. They also argue that based upon labial scalation, the eastern indigo snake should be regarded as a separate species from other *Drymarchon*. Presented with these arguments coupled with the most recent classification as indicated in Collins and Taggart (2002), the treatment of the eastern indigo snake in this study is at the species level (i.e., *D. couperi*).

The distribution of the eastern indigo snake reportedly occurs along the Coastal Plain physiographic region from South Carolina to Florida and westward to southern Louisiana (Smith, 1941). The most recent range maps indicate the species occurring from southeastern Georgia, throughout Florida, westward to southern Mississippi just beyond the Mississippi-Alabama state line (Conant and Collins, 1998). In Alabama, the species was historically reported from only four localities, amounting to three county records (Löding, 1922; Haltom, 1931; Neill, 1954; Appendix 1, Table 1; Appendix 2, Figure 1). These published accounts represent observations from the first half of the 1900s with the last report from 1954. Surprisingly, early accounts from naturalists that visited this region in the late 1700s and 1800s never reported the species. In an early account of the black pine snake, Blanchard (1920) suggested that the eastern indigo snake was more commonly seen than the black pine snake. On emphasizing the black pine snake being overlooked by observers from the Mobile area, Blanchard stated, “Possibly, however, it [black pine snake] has been confused in the field with some of the 'more common' large black snakes, as *Drymarchon couperi* and *Coluber constrictor constrictor*.” Furthermore, Löding (1922) made no mentioning or reference to the indigo snake as being rare. It is possible that the indigo snake was more abundant in Alabama than former records indicate. Certainly, it is impossible to prove this and we are now left with only passing speculations.

By the mid-1970s, herpetologists were concerned whether the species still existed in Alabama (Mount, 1975). Similar concern was expressed by herpetologists in other states where retraction of the species' range was apparent (Federal Register Vol. 43 No. 52:

11082-11093). To help offset further demise and disappearance of the species, a prodigious captive propagation and reintroduction program began across the Southeast.

Experimental Reintroductions

In 1976, Dr. Dan W. Speake of Auburn University and the Alabama Cooperative Fish and Wildlife Research Unit began an intensive captive breeding and experimental reintroduction program of eastern indigo snakes. Various age classes of snakes were released into protected areas in Alabama, Georgia, Florida, Mississippi, and South Carolina. The reintroduction program (i.e., rearing and releasing snakes and relocation attempts) continued until approximately 1990.

Several criteria were used to identify and nominate reintroduction sites. These criteria were developed primarily from a study that examined indigo snake habitat preferences and movement patterns (Speake et al., 1978) and included: 1) habitats supporting gopher tortoise burrows; 2) a mosaic of habitats supporting pine-scrub oak ridges and intervening low, wetlands and riparian thickets; 3) large, continuously undeveloped landscapes, typically comprised of 3,000 to 4,000 ha; 4) landowner consent and agreement to protect released snakes. In Alabama, nine release sites were chosen (Appendix 1, Table 2).

Since 2000, most of the 1977 to 1986 Alabama introduction sites were visited and landowner contacts made. A primary objective for each visit was to renew interest and develop trust among both landowners and land managers associated with the former release sites. Interviews were conducted among those familiar with and knowledgeable of the releases and subsequent relocation attempts. The following are accounts of snake introductions at each site, recent site visits to the release areas, and examination of supporting material such as aerial photographs and soil maps. Management recommendations are included where appropriate. One reintroduction site was not visited nor could the precise locality where snakes were released be determined.

Autauga County Community Hunting Area

Fifteen eastern indigo hatchlings (sex unknown) were released in the Autauga County Community Hunting Area during fall 1986 (Appendix 1, Table 2). This experimental introduction is approximately 180 km north of the nearest historical occurrence in Alabama. Despite this distance, the community hunting area was chosen as an introduction site because of the managed area's size (ca. 2840 ha), natural community and habitats, and potential for long-term protection.

Historically, the uplands of this area of Autauga County most likely supported an extensive expanse of open, longleaf pine-scrub oak community. Harper (1943) refers to this region as "the central longleaf pine hills" and within portions of the hunting area, remnant pockets of an upland, longleaf pine-turkey oak association still persist. The higher elevations of the area support deep, well-drained white, sandy soils, which have characteristics of many areas across the Lower Coastal Plain. Much of this natural community, though, has either been completely removed or severely altered through intensive silviculture practices and fire suppression. Currently, a large portion of the area

is owned and managed by International Paper (IP), but prior to their ownership, Union Camp Corporation was the major landowner. In addition to timberlands, several small plots within the hunting area are owned by private landowners.

Aerial photographs taken in 1992 reveal a mosaic of coverage types across the landscape in the vicinity of the release site. Extensive agriculture fields comprise much of the private lands sector (i.e., non-corporate lands) that border both east and west sides of County Road (CR) 57. CR 57 bisects the hunting area north to south and several residences occur along the road. The portion of the hunting area in IP ownership is primarily planted loblolly pine plantations but isolated areas or pockets exist that support a relatively open overstory of longleaf pine. Streams dissect the uplands of the hunting area and these low-lying habitats typically support heavily forested, mixed pine-hardwoods.

Following the 1986 introduction, all relocation attempts beginning after the release date through September 1989 failed to find any indigo snakes (Appendix 1, Table 2). Additionally, no anecdotal accounts from locals or land managers have reported seeing any snakes that fit the description of the species.

It is premature to write this experimental introduction off as a failure. Despite the management regime of the property and the proximity of homes and secondary roads, the complexity of habitat over the area (i.e., the well drained, deep sandy hills, pockets of open longleaf pine-scrub oak, and intervening bottoms supporting streams and seepages) may provide conditions suitable for supporting a small population of indigo snakes. It is recommended that this area be revisited over the next several years to further assess the success of the initial releases. However, given the small number of snakes released coupled with its northern latitude, this introduction site should receive lower priority for future relocation attempts than the southern-most sites.

Baldwin County, Perdido River Hunting Club

Indigo snake reintroductions in this portion of Baldwin County (Appendix 1, Table 2) took place on two separate occasions. In August 1978, 12 snakes (two juveniles, a male and female 1-year of age; 10 hatchlings, sex unknown) were released along a pipeline/powerline right-of-way near the crest of a gently sloping hillside. In September of the following year, 15 hatchlings (seven males and eight females) were introduced at the same locality as the previous year's release. All subsequent relocation attempts following the initial releases have failed to document any captures or sightings of indigo snakes. Interviews with the area's land manager and forester revealed no indigo sightings.

The site where snakes were released is currently owned and managed by IP. Speake (1990) estimated the area of IP ownership at 4,000 ha. The majority of this area is managed strictly for timber. Pine plantations of both loblolly and longleaf are planted in designated stands and typically removed on a 20 to 30-year rotation. Thus, a patchwork of stand-age and condition exists across the landscape. The pine stand encompassing the 1978-1979 reintroduction site was cleared around 1992 and was estimated at 28 years of

age (Bernard Zemlich, pers. comm.) at the time of harvest. The site was subsequently replanted in loblolly pine with tree spacing of approximately two to three meters apart. This separation is allowing sunlight and ground vegetation to grow, which has resulted in some gopher tortoise use. Several tortoise burrows (< 10 burrows) were observed in portions of this young stand during recent surveys. However, hardwood encroachment into this stand is occurring, which is inhibiting tortoise use and reducing the amount of basking sites for snakes.

Despite current management activities, the site of the releases was strategically chosen to maximize the various habitats used by indigo snakes over the course of a year. The upland areas surrounding the release site consist of deep, white sands with linear openings that are created by powerline and pipeline right-of-ways. These open edges support the highest gopher tortoise density on the property and would also provide optimal "staging" habitat for courting and reproduction among indigo snakes. Additionally, the right-of-ways lead to intervening lowland depressions that maintain wet, boggy conditions throughout much of the year. These lowland areas coupled with the bottomlands along the Perdido River that border the site to the east provide optimal habitat for the eastern indigo snake during the hotter seasons.

Though all relocation attempts to assess the success of this reintroduction have failed, it is felt that habitat and conditions are present to support the species. It is recommended that: 1) stands supporting optimal spacing (at least 3 to 5 m) of planted pines receive fire management to maintain an open mid-story; 2) windrows following a harvest should remain on the landscape to provide habitat for indigo snakes; 3) keeping the size of a cleared stand to a minimum at any one given harvest will ensure greater complexity over the landscape and will help eliminate broad-scale impacts; 4) further field work in this area continue to help assess whether the success of the initial reintroductions were successful.

Baldwin County, Gulf State Park Preservation Area

Introduction efforts of eastern indigo snakes in this area began in September and October 1978 with the release of 10 snakes (two juveniles, a male and female; eight hatchlings, sex unknown). In October of the following year, 27 hatchlings (13 males and 14 females) were additionally released.

The introduction site is located in an area of Gulf State Park referred to as the "preservation area". This portion of the park has been gated and visitor use is not encouraged. Of all the areas in the park, the preserve receives the greatest amount of protection and hence, became the focal point for releasing indigo snakes. The area where snakes were released was estimated by Speake (1990) to encompass approximately 1600 ha. The habitat associated with the release site is characterized as gulf coastal scrub sandhills with intervening swales and bogs. The deep sandy ridges or dunes provide superior basking conditions in cool weather and the associated swales remain wet during most dry periods, thus providing thermal refuge during the hotter months. Gopher tortoise burrows are occasionally seen in sandy openings and were found to be moderately abundant in some local areas (2 to 3 burrows per ha in optimal habitat; visual

estimate only – not systematically measured).

Along with the inherent difficulty of colonizing an area with no population base, released indigo snakes faced daunting challenges in this area of Alabama. A year following the initial releases in 1978, Hurricane Fredrick hit this portion of the Gulf Coast on 19 September 1979. Photos housed at the Nature Center at Gulf State Park reveal the devastation of that particular storm. Much of the park was completely inundated by several feet of storm surge, but it is not known if the higher dune areas of the State Park's preserve were spared. Nevertheless, it is questionable whether the young snakes that were released prior to the hurricane survived the storm. Approximately three weeks after Fredrick, the last group of hatchlings (12 individuals) were released in the preserve. All relocation attempts following the releases have been unsuccessful with the exception of one possible but unconfirmed sighting by a field technician in 1981.

Another obstacle that the released snakes faced was confinement. Following the releases, lands bordering the park preserve to the north and east were either developed or plans were underway for development. Less than 1.0 mile to the south is Hwy 182, a heavily traveled road that is bordered by the Gulf of Mexico.

Even in the face of these adverse conditions, it is possible that the early releases were successful. Habitats found in this area of Baldwin County appear favorable for supporting the eastern indigo snake. Indigo snake introductions into similar coastal habitats elsewhere were successful for population establishment (Dan Speake, pers. comm.). Though the release site at Gulf State Park seems small for such a wide ranging species, Speake (1993) points out that indigo snakes have been found to thrive in some areas less than 1,000 ha where superior habitat persists. On these grounds, it is recommended that this area receive attention in future surveys to fully ascertain the success of the releases.

<u>Bullock County, Swift Plantation, Private Hunting Preserve</u>
Eastern indigo snake introductions onto the Swift Plantation were carried out during the fall season of 1980, 1981, and 1982. In all, 38 snakes were released; one adult and 37 hatchlings (proportional mix of males and females).

Speake (1990) estimated the hunting preserve to encompass 2800 ha. A visit was made to the release site to examine habitat structure and characteristics in addition to search for snakes. The general area where snakes were released is an extensive open field supporting deep sandy loam soils. Soil type coupled with an open landscape has created suitable habitat and conditions for supporting a moderate abundance of pocket gophers, *Geomys pinetis*, a potential food source for indigo snakes. An ocular estimate of 5 to 10 pocket gopher mounds per ha was observed in the general area of the reintroductions and in the surrounding open pine woodlands. Gopher tortoises are present as well and at least five active burrows were observed near the release site. Overall, though, tortoise density is rather low and burrows tend to occur sporadically.

Aerial photographs taken in 1992 reveal a mosaic of coverage types over the hunting

preserve. Open fields of varying sizes (typically 8 to 56 ha) are dotted across the landscape with extensive forested uplands forming connected corridors around the openings. A mixture of open, short-leaf pine stands with occasional interspersed pockets of longleaf pine was noted during a recent survey. Several patches in the preserve support shortleaf and longleaf pine trees >30 cm dbh with an open, park-like understory and thick herbaceous ground cover. Hardwoods mixed with occasional shortleaf pine characterize the lowland and riparian areas.

Based exclusively on the habitats that are supported, this area appears suitable for sustaining a population of indigo snakes. However, nearly all relocation attempts to find indigos following their initial release have failed. The only exception was a single individual that was found shortly after its release. All subsequent surveys have been negative.

Covington County, Blue Springs WMA – Conecuh National Forest

Eastern indigo snakes were released at two separate localities (Appendix 1, Table 2) within the Blue Springs WMA - Conecuh National Forest. Fifty hatchlings were released (29 males and 21 females) in the fall of 1981. Both release sites are situated in xeric uplands along the interface of gently sloping hillsides and prominent ridgetops. The site in Section 16 (T2N, R15E) is a wildlife food plot that is encompassed by a stand of longleaf pine and encroaching hardwoods, the latter creating a dense mid-story. At the crest of this ridge (northern half of Section 16), longleaf pines (approximately 6 to 10 m in height) are widely spaced with a scrub-oak dominated mid-story (e.g., *Quercus leavis*, *Q. margaretta*, *Q. incana*, *Q. falcata*, and *Q. geminata*). Overall, the ridge is a well-defined sandhill supporting deep sandy soils. Gopher tortoise burrows are quite common (visually estimated at 3 to 5 burrows per ha) and are dispersed over a broad area of the ridgetop in Section 16. This sandy ridge is bordered to the east and west by heavily forested lowland flats that retain moisture during much of the year.

The second release site is located on Red Wash Hill in Section 24 (T2N, R15E). The topographical relief of this site is steeper and more abrupt than the Section 16 area and is best characterized as a prominent north – south oriented ridgeline. Several small wildlife food plots (< 1 ha) are interspersed along the crest of the ridgeline, the edges of which are often colonized by gopher tortoises. One local area on this ridgeline supports a prominent sandstone outcropping that extends over a 1 to 2 ha area. The outcropping is accentuated by a moderately steep rocky bluff 5 to 7 m in height; an uncommon landscape feature of the Lower Coastal Plain. The vegetative composition and structure associated with the outcropping is primarily comprised of longleaf pine (dbh visually estimated at 20 to 25 cm) with a 30% canopy cover (visually estimated). Scars on the boles and trunks of pine trees indicate that fire has been an important factor at this site.

Based on a rich mosaic of habitats (e.g., nearby streams and riparian areas, wet depressions, rocky exposures, and thermal refuge such as gopher tortoise burrows), this site appears to support ideal conditions for indigo snakes. Surprisingly, all relocation attempts have failed to successfully document colonization. A local resident (name unknown) was questioned whether any sightings of indigo snakes had been made in the

area. The resident did share a description of a snake that he recalled seeing during the early 1990s (exact date unknown), and based on the snake's characteristics, strongly suggested that an adult eastern indigo snake was observed. No confirmation of this sighting was ever made, however.

In 2001, a private company was permitted to drill for oil on the crest of the sandhill in Section 16. Since drilling has ensued, impacts to this site are apparent. The movement of heavy equipment into the area coupled with the primary effects of drilling (e.g., sludge or oil residue, establishment of wells and platforms, etc.) has created obvious impacts to this sandhill community. Until evidence is provided that unequivocally documents the presence and establishment of the eastern indigo snake in the area, it will be impossible to assess the potential impacts that oil/gas drilling is exerting on this threatened species. Though individuals have not been confirmed, habitats and conditions appear ideal to support the eastern indigo snake. It is strongly recommended that the general area of the Blue Springs WMA receive high priority for conducting future surveys.

Escambia County, Solon Dixon Forestry Education Center

Multiple releases of eastern indigo snakes occurred at the Solon Dixon Forestry center from 1979 to 1986. A combined total of 45 individuals were released during this period with 33 of these representing adults, 10 juveniles, and two hatchlings.

The release site is a xeric hilltop or mound that has several interesting features. The elevation gain from the top of the hill to its base is approximately 7 to 10 m. The hill is rimmed with an outcropping of sandstone that appears to have a substantial intrusion of an iron ore-like layer. The most prominent concentration of the rocky substrate has a south-facing aspect, which receives a considerable amount of insolation. During the winter months, direct sun exposure coupled with the radiation of heat through the rock outcrop appears to create ideal conditions for basking. The vegetation and community coverage of this area is primarily a longleaf pine – scrub oak association (observed oaks were mostly *Quercus leavis*, *Q. hemisphaerica*, and *Q. incana*). Aside from the surficial exposure of sandstone, the substrate of the area is comprised of well-drained sandy soils. Gopher tortoise burrows occur throughout the area.

Overall, the landscape of the Dixon Center (ca. 2120 ha) is highly varied and diverse consisting of mature bottomland hardwoods along the Conecuh River, mixed pine-hardwood hillsides and ravines, several springs and upland sinks. Historically, the sandy uplands were primarily composed of open longleaf pine woodlands with the more prominent hilltops supporting a longleaf pine-turkey oak association.

During the period following the releases, several recaptures as well as regular sightings of indigo snakes were frequently made. From 1986 to 1989, the recapture rate was deemed to equal that of areas where wild populations were rated to have high population numbers (Speake, 1990). Many of the individuals released on the Dixon Center were fitted with transmitters and a rather intensive radio-telemetry study ensued. Results of this study revealed that some individuals (particularly adult males) moved distances greater than 2 km from the initial point of release. Indigo sightings were made over the entire area of

the center. Several individuals were found either basking or using the crevices of the "iron rock" outcropping at the release site for thermoregulation. However, the last confirmed sighting that center personnel recall making was approximately 10 years ago (Rhett Johnson, pers. comm.). This raises considerable concern over the status of this, apparently one time thriving, introduced population. It is highly recommended that intensive survey attempts in and around the release site be continued to determine or further assess the status of the species at this site.

The Solon Dixon Forestry Center, owned and operated under the direction of Auburn University, functions as an educational tool and opportunity for students and researchers alike. The area comprising the center is heavily visited during most seasons of the year with much of the grounds being covered through forestry as well as wildlife study. A central management directive for the center is forestry silvicultural practices. The principal pine species currently managed on the property is longleaf and many stands receive periodic fire to maintain an open mid-story and a high level of herbaceous ground cover. With this type of management regime, habitat is maintained for numerous coastal plain inhabitants including the eastern indigo snake.

Escambia County, T. R. Miller Hunting Area

Indigo snake releases took place in the fall of 1983. In all, 42 individuals were released; 3 juveniles and 39 hatchlings (sex ratio of the releases unknown). All relocation attempts in the 1980s failed to document population establishment in this area of Escambia County.

The precise locality where the releases took place on the Miller property is unknown at this time. According to conversations with Dan Speake, the introductions took place northeast of Brewton but an exact locality could not be determined. Speake (1990) estimated the area of ownership to include 4,000 ha.

Access onto the property was not allowed during this survey, but landowner consent is currently being pursued. Anecdotal information concerning habitat condition of the property is highly favorable for supporting several species associated with Coastal Plain habitats, including the eastern indigo snake. It is strongly recommended that this area receive high priority for future relocation and assessment attempts.

Mobile County, Altmayer Property

Reintroduction efforts in this area began in 1982 when 50 hatchlings were released on the west side of the Escatawpa River. Releases in this area held promise based on the size of the property (estimated at approximately 4,000 ha; Speake, 1990) and the assurance of continued protection. These private lands are among the largest holdings by a single corporation or individual in the northwest portion of Mobile County.

The releases took place within the lowland flats of the Escatawpa River. At the time of the initial releases, the habitat was devoid of standing trees as a result of Hurricane Frederick in 1979. Additionally, the site of the reintroductions supported a large concentration of gopher tortoise burrows (Perry Malone, pers. comm.). Since that time,

vegetative recovery has ensued with longleaf pine dominating portions of the area and loblolly pine as a secondary component. Intervening pockets of open, grassy areas and scrub oak patches occur within a longleaf pine matrix. Of the mid-story components, *Quercus leavis, Q. stellata, Q. nigra, Vaccinium* sp., and *Ilex* sp. are dominants.

The landscape beyond the introduction site is gently sloping to undulating (2 to 17 percent slopes) with well-drained, deep sandy soils, particularly along hillsides and ridgetops (Hickman and Owens, 1980). Beyond the lowlands and flats associated with the Escatawpa River, intermittent and perennial streams, including wet depressions and seasonally wet swamps, dissect the undulating landscape.

Aerial photographs of the general area associated with the reintroduction site reveal a large contiguous tract of woodlands with occasional cleared fields. Much of this area is used and managed for timber. While isolated patches of pine plantations are present, much of the area can be classified as moderately open woodlands. Much of the harvesting practice in this area involves select cutting and thinning of stands rather than large-scale removal and replanting in "off-site" timber. Longleaf pine is the dominant overstory tree of the uplands as well as along portions of the flat bottomlands. Some portions of the lowlands resemble open pine savannas that were described to have covered much of the area prior to large-scale removal (Harper, 1943). Fire is a vital management tool that is implemented in a large proportion of the Altmayer property. However, some areas are fire suppressed and hardwood encroachment into longleaf dominated stands has occurred over portions of the property.

Of all the reintroduction localities visited during this study, this site has received the largest number of indigo sightings within the past five years. The land manager and forester for Altmayer Limited Partnership have seen adult indigo snakes on several occasions from 1995 to October 1999. Four sightings (Appendix 1, Table 3) of indigo snakes within a 6.5 km-radius of the release site were recalled (David Jellenc and Perry Malone, pers. comm.). However, no additional sightings have been reported since the 1999 observation, despite intensive land management operations and activities.

Washington County, Annie Jordan Trust Property

Speake (1990) released 14 juveniles onto this 6400-ha preserve in 1986. Relocation attempts following the releases from 1986 through September 1989 were successful in that a gravid female was located near the original site of the release (Appendix 1, Table 2 and Table 3). No additional recaptures or sightings were reported during subsequent relocation attempts. However, recent sightings by the caretakers of the property are extremely encouraging (Bonnie Onderdonk, pers. comm.).

Indigo snakes were released over an area of approximately 64 ha. The landscape associated with these releases is gently sloping to undulating and supports deep, well-drained sandy soils. The uplands are dissected by low, heavily shaded stream bottoms and associated forested wetlands. The habitat surrounding the release site is dominated by longleaf pine with some midstory hardwood encroachment. Gopher tortoise burrows are common along the edges of wildlife food plots as well as in open woodlands. The

landscape was once reported to support some of the last extensive stands of open, park-like longleaf woodlands left in Alabama (Dan Speake, pers. comm.). While open stands of longleaf pine still occur, much of the property is managed for timber with some smaller stands having been recently clearcut. Managers of the property are implementing burns, which is helping to minimize hardwood encroachment and loss of herbaceous ground cover.

Recent indigo sightings (Appendix 1, Table 3) by the property's caretakers strongly suggest that the 1986 restocking attempts may have been successful. It is recommended that an extensive field survey be implemented to fully ascertain the success of the earlier releases. An additional recommendation for maintaining indigo snake habitat is to leave windrows of tree laps and cuts following each harvest along with prescribed burning throughout the longleaf pine dominated uplands.

Recent Accounts
(Localities Other Than Release Sites)

Since 1999, there has been a resurgence in the number of indigo sightings and reports in Alabama. Two highly probable observations and one confirmed report have been received from areas other than the experimental reintroduction sites. The most notable observation has come from an unlikely area. In late May or early June 2000, a naturalist living south of Enterprise, AL photographed a subadult indigo snake. The snake was estimated at one meter total length and was discovered in a privet (*Ligustrum japonicum*) hedge (Bill Parker, pers. comm.; Appendix 1, Table 3). The hedge in which this individual was observed is part of a fencerow that borders open pasture to the north and south. This occurrence is within 400 m of the nearest stream thicket. In fact, the only forested areas associated with the sighting are either small stands of planted loblolly pine or riparian vegetation along streams, ponds, and/or seasonal wetlands. The remainder of the surrounding landscape is agricultural fields and pastureland. Based on aerial photographs of 1992, over 70% of the landscape in a 5-km radius of this occurrence consists of open fields and portions of the city of Enterprise.

The origins of this juvenile indigo snake remain a mystery. It is possible that the individual observed by Mr. Parker represents an escaped pet from a local reptile enthusiast. Conversely, this snake may be the product of a wild population that, until now, has gone undetected or unreported from the area. Approximately 8 km to the northeast is Fort Rucker Military Reservation, which reportedly supports a mosaic of habitat types including open, longleaf pine woodlands and other habitats believed to be suitable for supporting the eastern indigo snake (Mark Bailey, pers. comm.). Herpetological accounts from the area associated with Fort Rucker have not included indigo snake observations (Snyder, 1944). Intensive sampling of upland habitats on Fort Rucker was conducted during the 2002 field season by herpetologist/conservation biologist, Mark Bailey. Reptiles were routinely captured via trapping and pedestrian surveys and a total of 272 trap nights were accrued during the spring survey. No eastern indigo snakes were observed.

Other highly convincing observations have come from the southwest corner of the state. Two observations were reported from the Wilmer area of northwest Mobile County during the spring of 2000. The first observation occurred in mid-March when Mobile County forester, Steve Lyda reported seeing an adult indigo snake moving from the edge of a hillside toward a riparian thicket (Appendix 1, Table 3). The individual was initially spotted close to an inactive gopher tortoise burrow. Estimated length of the snake was seven feet. The terrain in the general area of this sighting is undulating or "hilly" with gentle to moderately steep slopes and well-drained soils of the Troup-Benndale series (Hickman and Owns, 1980). Longleaf pine-mixed hardwood association is the predominant community type of the xeric ridgetops and hillsides. Hydric thickets and/or hardwood-dominated riparian communities occur throughout many of the intervening draws and drainages. An active gopher tortoise colony persists throughout the uplands where structure of the natural community remains open.

Alabama Natural Heritage zoologist, Jim Godwin, recorded the second observation in mid-May 2000 (Appendix 1, Table 3). Godwin was less than 1 km south of the intersection of U.S. Highway 98 and Wilmer Road (CR 5) when an adult indigo snake was seen crossing CR 5 and sought shelter in a culvert. It is unknown whether this is the same individual that was observed in March, but the sightings are approximately 2.5 km apart. The general area of this sighting is heavily influenced by human habitation as several residences occur along CR 5, which are in turn bordered by pastures and agriculture lands to the east and west.

The fate of the indigo snake in the immediate vicinity of Wilmer is precarious. The area is receiving residential expansion and there is heavy road traffic into and beyond the town. There are also plans to reroute US 98 to the north of Wilmer, which will pass precisely over the area of the March 2000 sighting. Road construction will negatively impact and further fragment potential indigo snake habitat.

In addition to the above accounts, two unsubstantiated but plausible sightings of eastern indigo snakes have recently been reported, also from the southwestern portion of Alabama. One account is of an adult indigo snake seen crossing a Mobile County road near Citronelle in 2001 (time of year unknown). This observation was produced by a reptile enthusiast and naturalist and is very likely to be credible. The second account comes from a landowner near Deer Park in Washington County who reported seeing an adult indigo snake on his property in autumn 1998. Based on the description of the animal, this is a plausible sighting, although it is possible that the snake was actually a black pine snake and not an indigo snake.

Although several convincing accounts have been received, no observations of eastern indigo snakes were produced by the principal investigator during this study, which included a search effort of over 300 person hours during two field seasons (i.e., 2000 and 2002). Pedestrian surveys coupled with gopher tortoise burrow examinations were conducted over a broad area including eight of the nine reintroduction sites and at four of the five sites where recent observations were reported. Several factors likely contributed to the negative results of these field investigations that may include one or more of the

following conditions: 1) surveys were conducted under inappropriate conditions and time of year; 2) species is so rare and occurs in such low numbers that detection is improbable; 3) individuals may have been onsite but in complex habitats during survey period (e.g., fossorial retreats, riparian thickets, etc.); 4) species was absent from the area under consideration.

Black Pine Snake

Natural History Overview

Pituophis melanoleucus lodingi is a large, rather stout snake typically attaining lengths of 122 to 142 cm with a record length of 193 cm (Conant and Collins, 1998). Coloration of mature individuals is often a uniform, glossy black to dark brown dorsally and slate-gray to black ventrally with some possessing a few white scales and/or trace of patterning (Blanchard, 1920; Stull, 1940; Conant, 1956; Mount, 1986). Dorsally, the body scales are strongly keeled with the exception of some lowermost scale rows possessing smooth scales. Juveniles are often patterned with dark blotches or saddles on a brown background (Mount, 1986). Because of its coloration, the black pine snake is sometimes mistaken for the eastern indigo snake or the black racer (*Coluber constrictor*). A definitive character that separates these snakes is the strongly keeled scales of the black pine snake as opposed to the shiny smooth scales of the indigo (partially and only faintly keeled on mature indigo males) and dull smooth scales of the black racer.

Very little published information is available concerning the natural history of this Coastal Plain endemic. Most of what has been published is information on captive individuals and journal notes describing the surroundings where observations occurred (e.g., Blanchard, 1920 and 1924; Conant, 1956; Wright and Wright, 1957; Cliburn, 1957, 1962, and 1976). Mobile naturalist, H. P. Löding, submitted the first few black pine snakes for scientific study (Appendix 1, Table 4). Löding's collections came from an area southwest of Mobile, which he described as "mostly Satsuma orange and pecan orchards, but was formerly fairly high and dry pine lands" (Blanchard, 1924; Stull, 1940; Wright and Wright, 1957). As more specimens were collected and surrounding landscapes described, it became evident that the species is closely associated with xeric uplands or sandhills supporting well-drained sandy soils and open longleaf pine-scrub oak association (Conant, 1956; Cliburn, 1962; Mount, 1986). It is thought that *lodingi* spends much of the time underground in gopher tortoise burrows or in the burrows of rodents (Mount, 1986).

The majority of what is known concerning pine snake (*Pituophis melanoleucus*) ecology and population status in general comes from intensive radio-telemetric studies. An extensive study was undertaken on a disjunct population of the nominate form (*P. m. melanoleucus*) in the New Jersey Pine Barrens. These findings revealed that pine snakes in the northern limits of its range selected habitats in the pitch pine-scrub oak uplands; avoided lowland wet and swampy areas; avoided areas of high human use such as towns and villages; selected nest sites within clearings of soft, moist sands and low tree cover (< 10% cover); and required heavy vegetation for shade or thermoregulation (Burger and Zappalorti, 1986, 1988, 1989, and 1991). Additional studies on this same population

have discovered that females dig long, underground burrows for oviposition sites, and hibernacula are constructed in areas that support a higher concentration of trees and ground cover as opposed to summer dens, which have less vegetative cover (Burger et al., 1988; Burger and Zappalorti, 1991).

Franz (1992) reported that radio-telemetry studies on the Florida pine snake (*P. m. mugitus*) in north Florida revealed that areas supporting well-drained, loosely packed sand in longleaf pine-turkey oak and old field habitats were preferred over forest types with heavy canopies. From these studies, two females fitted with transmitters were found to exhibit a home range of 11 and 12 ha while three males used larger areas (2 to 8 times that of the females). Radio-tracked snakes were found to be highly fossorial frequenting the tunnel systems of the pocket gopher (*Geomys pinetis*), and to a lesser extent, the gopher tortoise. Florida pine snakes were active from March through October with peak activity occurring from May through July and in October. Franz also reported that eggs are laid from June to August with hatching occurring in September and October. Like other members of the genus, the Florida pine snake feeds primarily on small mammals.

The *Pituophis* studies in the New Jersey Pine Barrens and in north Florida strongly suggest that open, xeric sandy habitats supporting some vegetative cover are required for pine snakes to carry out an annual cycle. Open areas with sparse tree densities are required for nesting sites, and vegetative cover is used for hibernacula and thermoregulation.

Recently, a radio-tracking study was conducted on the black pine snake in south Mississippi (Duran, 1998). The results of Duran's study differ from the generalizations that biologists have been making concerning the black pine snake. Of 12 *lodingi* fitted with radio-transmitters, tracked individuals were found underground approximately 65% of 685 observations. Snakes were often detected in the trunks and root channels of rotting pine stumps and rarely were black pine snakes found in gopher tortoise burrows, contrary to what was frequently suggested by many herpetologists. Duran also found little evidence that black pine snakes excavate their own burrows as was demonstrated in a disjunct population of the nominate form, *P. m. melanoleucus* in the New Jersey Pine Barrens (Burger and Zappalorti, 1991). Duran did, however, find similarities between *lodingi* and the New Jersey population. He found that *lodingi* chose open habitats with dense herbaceous ground layers and that snakes were often found on hilltops, ridges, and upper slopes that supported well-drained, sandy-loam soils. Similar to congeners in New Jersey and in north Florida, *lodingi* appears to avoid closed canopies, such as riparian areas and dense, hardwood forests. Additionally, Duran found that transmittered snakes had a mean home range of 47.5 ha with some evidence of territoriality being exhibited.

Duran’s work has provided much needed information to help elucidate many of the unknowns concerning this species. Still, much remains to be discovered about this secretive animal.

Observations and reports on captive black pine snakes suggest that courtship and mating take place in late April (or spring in general) and oviposition has been observed to take

place in late May and in mid-July (Cliburn, 1976; Reichling, 1982; Mount, 1986). However, few if any natural nests have been thoroughly studied. Nesting ecology, seasonal use patterns, summer and winter dens, and many other life history characteristics are poorly known and under-studied in this species. Gathering this information is paramount to fully understanding the habitat and landscape conditions this species requires for maintaining healthy, self-sustaining populations, a critical first step toward defining and establishing long-term conservation guidelines.

Distribution and Status

Historically, the distribution of the black pine snake spanned the lower, longleaf pine belt from southwest Alabama and southern Mississippi, to extreme southeastern Louisiana (Mount, 1986; Conant and Collins, 1998). In Alabama, the black pine snake has been documented from three counties; Clarke, Mobile, and Washington (Appendix 1, Table 4; Appendix 2, Figure 2). In Mississippi, it is known from 13 counties, and in Louisiana, it has been recorded from a single county or parish. Furthermore, recent reports suggest that *lodingi* may now be extirpated from Louisiana (Duran, 1998).

Mount (1986) expressed concern over the black pine snake's status mentioning that it has "declined substantially in Alabama" since the 1960s. Several reasons for the species' decline have been speculated including the gassing of gopher tortoise burrows, deliberate killing, over-collecting for the pet trade, highway mortality, and detrimental forestry and agricultural practices. However, no threat is as fatalistic as the widespread urbanization and suburban sprawl that is occurring in portions of the species' historical range. Many of the early or historical sightings of black pine snakes have come from the Mobile area, former sites that now support high-density residential areas and industrial centers.

The species was first reported and documented from a narrow portion of south Mobile County along the xeric uplands from Mobile to Grand Bay (Löding, 1922; Blanchard, 1924; Stull, 1940). These historical accounts indicate that the black pine snake, though infrequently seen, occurred in areas that are now completely consumed by development and urban sprawl or intensive agricultural practices. In and around the Mobile area, several naturalists, landowners, and herpetological enthusiasts reported seeing black pine snakes on occasion up until approximately 20 years. Most recent sightings from Mobile County have come from areas that have remained relatively rural, especially along the western periphery of the county.

In other portions of the black pine snake's range in Alabama, reports are coming from rural areas in Clarke and Washington Counties. However, a major threat in all areas where the black pine snake is known to exist stems from the conversion of upland natural communities to extensive plantations of closely planted loblolly pine trees.

Much remains to be learned of the status of the black pine snake in Alabama. Though we may have an understanding of the species' detriment in the Mobile area, we know very little of its status or presence in areas that currently support large, continuous landscapes with little to no development. Such areas must be examined and surveyed for *P. m. lodingi* before an accurate statement of snake's status can be made.

Recent Accounts

A number of published and obscure historical records as well as recent accounts of black pine snakes have been garnered over the past several years (Appendix 1, Table 4). Duran (1998) and Duran and Givens (2001) have compiled the most recent and complete summary of black pine snake occurrences rangewide. The following discussion includes a synopsis of select county occurrences and habitat descriptions of those occurrences as well as records garnered during this survey that are not included in the aforementioned reports.

Mobile County

The first documented reports of the black pine snake came from the area between Mobile and Grand Bay (Blanchard, 1920; Löding, 1922; Blanchard, 1924; Wright and Wright, 1957). Even in the face of an expanding human population, black pine snake specimens continued to show up in museum records until the late 1970s when the effects of urbanization and city sprawl claimed former *Pituophis* habitat (Appendix 1, Table 4). Aerial photographs from 1992 reveal widespread urban and suburban sprawl extending over 15 km beyond the city center of Mobile. Sporadically embedded within this matrix of suburban complexes are a few forested areas that were left undeveloped. However, these areas are often heavily overgrown uplands or stream-swamp bottom thickets that have had an absence of fire for many years; and thus not associated as *lodingi* habitat (see Duran, 1998). Even if black pine snakes were to have survived such initial broad-scale impacts, there are no natural corridors that connect these "islands of trees" to more suitable pine snake habitats.

To this day, portions of the Grand Bay area remain marginally rural, but the landscape is a continuous patchwork of agriculture lands with very little natural forests left. Areas that are forested have been severely fire suppressed and now support closed canopy hardwoods. Some of the small towns across south Mobile County where black pine snakes historically occurred have received intensive agriculture or development pressures (e.g., Theodore, Irvington, Dawes, and Grand Bay). Despite rampant habitat alteration and fragmentation, black pine snake sightings continue to be made, albeit infrequently. In 1994, a road mortality of a black pine snake was reported in the Grand Bay area. Particularly intriguing is a remnant population of black pine snakes due west of Dawes. A landowner from this area reports seeing black pine snakes frequently since purchasing the property in 1974; five black pine snake sightings were reported during summer 2000 with the last observation occurring on 24 October 2000 (Appendix 1, Table 4, record 48). Unfortunately, none of these recent sightings are associated with what is considered prime pine snake habitat. The landscape associated with the Dawes area accounts is a patchwork of open agriculture fields and upland hardwood forests that typically support a closed canopy of *Quercus nigra* and *Q. hemisphaerica* as dominants. The future status of the species in this area appears bleak due to rapid residential expansion.

The recent sightings associated with the Tanner Williams-Big Creek Lake area (Appendix 1, Table 4, records 46, 47, and 49) are encouraging and warrant extensive surveys. The most recent observation, a May-June 2002 sighting, was reported from a landowner west of Big Creek Lake near Mobile Water and School Board property.

Unequivocal proof of this record was provided by the landowner as two photographs were taken of black pine snakes. One photograph reveals a copulating pair, both of which appear to be greater than 1.5 m total length, and the second photograph is of a single adult also appearing to be greater than 1.5 m total length. The area associated with these sightings reportedly is a patchwork of hardwood-invaded pine and old fields. Until recently, much of the property was mowed regularly. The property owner emphasized that the adjacent Water and School Board property had been burned at least twice over the past decade (Bill Finch, pers. comm.).

According to aerial photos taken in 1992, an extensive area associated with Big Creek (T4S R4W & R3W), due south of Big Creek Lake, has escaped development and intensive agricultural practices. The area supports a mosaic of cover and habitat types that include forested uplands and intervening lowland forested swamps and stream bottom thickets. A conservative estimate of undeveloped and non-agriculture land associated with the Big Creek lowland-upland complex is in excess of 2700 ha. The lowlands remain heavily forested but much of the uplands (which account for approximately 60% of the landscape) have an open to moderately open canopy, largely comprised of upland pines. Past silviculture activities are apparent from the photographs, but it is not known what management regimes or activities are currently taking place in the area. The soils of the uplands consist of a complex of soil types that are primarily well-drained sandy loam to loamy sand of 0 to 12% slopes (Hickman and Owens, 1980). Currently, the area is comprised of a complex of private landowners. Based on aerial photographs from 1992, this area holds the greatest promise for potentially maintaining a viable black pine snake population across the extreme southern portion of Mobile County.

Additional areas of west Mobile County that continue to escape large scale development pressures extend from an area just north of Wilmer to the Washington-Mobile County line. Embedded within this area is a continuous landscape exceeding 10,000 ha of forested uplands and intervening riparian areas. This mostly wooded area primarily occurs within the Escatawpa River watershed and includes a small number of landowners. A large proportion of the area is managed for timber but large-scale clearcuts and extensive pine plantations are absent from much of this region. Based on aerial photographs of 1992 and site visits, much of the uplands in this area continue to support open pine woodlands with the intervening lowlands and stream bottoms comprised of dense hardwoods. However, a large proportion of the landscape that was examined during this study has not been burned recently. As a result, the canopy is maintaining a percent cover that ranges from 20 to 60% but hardwood encroachment in the midstory is prevalent. Implementing fire as a management tool into these areas is essential for maintaining and enhancing black pine snake habitat.

One area in particular of northwest Mobile County that has produced recent, anecdotal reports of black pine snakes is the vicinity of Citronelle. However, these accounts have been kept confidential by biological consultants due to contractual obligations with area industries. With permission granted, private lands of this area warrant priority for future black pine snake surveys.

A large extensive area of very little development continues along the Mobile-Washington County line west and north of Citronelle. However, this area has received more intensive silvicultural practices and a patchwork of open fields, clearcuts, and pine plantations are apparent from aerial photographs taken in 1997.

The Boykin WMA lies along the county line to the northeast of Citronelle. What once supported extensive open, pine woodlands throughout the managed area's upland slopes and ridges are now under intensive conversion to pine plantations. Black pine snake sightings have come from this area and surveys are needed to ascertain the species' presence and abundance. However, given the level of landscape alteration, the population is likely to be comprised of few individuals, if still extant.

Washington County

One area in Washington County that supports a large tract of undeveloped land and is managed as a private wildlife preserve is the Annie Jordan Trust Property (one of the eastern indigo snake introduction sites discussed above). This property has received some of the highest recorded black pine snake sightings in the county (Appendix 1, Table 4; records 54-57). Pine snake habitat abounds on the trust property. Based on aerial photos, it is felt that other areas in Washington County may support similar community and landscape characteristics as the Jordan property.

The southwestern portion of Washington County in the Escatawpa River watershed continues to have large continuous tracts that have not been developed or cleared for agriculture. This region has received timber harvesting, but many areas maintain open stands of upland pines. Presently, it is not known whether this portion of Washington County has been biologically surveyed. A specimen from this largely rural region was collected near the community of Tibbie in 1973 (Appendix 1, Table 4, record 53). Aerial photographs and USGS 7.5 topographical maps indicate that a large area to the south and southwest of Tibbie has escaped large-scale development and/or intensive conversion to agriculture. Aerials suggest that many of the uplands south of Tibbie may support conditions suitable for supporting pine snakes. This area should receive surveys to ascertain *Pituophis* presence.

Another relatively continuous landscape occurs throughout the area of Chatom. Large tracts occur to the south and northeast of Chatom that, although timbered, have received very little development pressures. Portions of this area have been degraded through rather intensive timber harvesting, but a large proportion of the area has been spared conversion to agricultural pine plantations. Additionally, aerial photos indicate that much of the uplands have retained a moderately open canopy. This is another area that warrants surveying for black pine snakes.

Clarke County

Black pine snake sightings have come from two areas in Clarke County. Observations as well as voucher specimens (Appendix 1, Table 4, records 1, 2, 4, and 5) have come from an area associated with the Scotch WMA in north central Clarke County. Other than a

1940 observation east of Meridian, Mississippi (Duran and Givens, 2001), records from this area represent the northernmost localities of any known occurrence of *lodingi*. Reports of recent sightings in the managed area are encouraging, but conversion of upland habitats to loblolly pine plantations with short harvest rotations and intensive site preparations places any existing pine snake population(s) at risk (Duran, 1998). Aerial photographs taken in 1992 reveal that several large tracts (in excess of 200 ha) supporting closely planted pines are distributed throughout the WMA. Based on these photographs, over 60% of the land surface appears to have been converted to "tight-row" pine plantations. After excluding heavily forested riparian areas, less than 30% of the uplands appears to support open pineland habitat. This doesn't take into account the structure or character of these upland areas. It should be noted that the above estimates are based on aerial photographs from 1992 and do not reflect current conditions. Additionally, extensive loblolly pine plantations are abundant across properties bordering Scotch WMA.

Recent reports of black pine snake sightings have come from a second area in Clarke County, the Fred T. Stimpson State Game Sanctuary. One confirmed and a second highly probable sighting was reported from the property with the most recent observation occurring in 1997 (Duran, 1998; see Appendix 1, Table 4; records 3 and 6). The sanctuary was recently visited to examine habitats and to assess the potential for supporting black pine snakes. A mosaic of community and cover types occurs throughout the sanctuary. Steep, mesic ravines supporting mature, mixed hardwood forests dissect the sandy loam uplands. The topography varies from gentle to steep sloping hillsides that primarily support a mixture of longleaf pine and southern hardwoods with several wildlife food plots scattered throughout. Along the eastern border of the sanctuary, numerous mature longleaf pines were observed throughout the upland ridgetops and hillsides. However, this portion of the preserve is severely fire suppressed. Judging from the spacing of the pines, this area most likely supported an open, longleaf pine savanna, but hardwood encroachment of *Liquidambar styraciflua*, *Quercus*, spp. and *Carya* spp. have created canopy closure and a reduction in herbaceous ground cover. The low concentration of forbs and herbaceous cover, so indicative of the "classic" longleaf pine community, limit foraging opportunities for small rodents, a preferred food source of pine snakes (Duran and Givens, 2001). There are, however, portions of the property that continue to support relatively open, longleaf pine stands. These areas continue to hold the greatest promise for supporting the black pine snake as well as other associates of open, woodland communities.

Zone of Intergradation

Conant (1956) was the first to bring to light that pine snakes east of Mobile Bay and the Alabama River delta represent a form intermediate to that of the black pine snake and the Florida pine snake. He examined specimens from Baldwin County and noticed patterning that was absent in all *P. m. lodingi* west of the delta. Yet, these individuals were darkly colored and could not be convincingly identified as *P. m. mugitus*. It was implied that gene flow between the two subspecies was occurring and a geographical zone of intergradation to the east of Mobile Bay and the river delta was assumed. Mount

(1975) reports additional “intermediate” forms from Escambia County and several specimens are housed at Auburn University Herpetological Museum. Duran (1998) and Duran and Givens (2001) give the most complete account of individuals from this zone of intergradation. Records compiled thus far indicate that intergrades occur from west Baldwin County eastward to the Escambia-Covington County line in Alabama. Appendix 2, Figure 2 depicts the distribution of all known intergrades (a listing of these accounts are not provided in this report). The easternmost occurrence of this intermediate form was documented in May 2000 when a gravid female was observed on the Solon Dixon Forestry Education Center’s complex. More recently, an adult intergrade was killed on the road leading into Solon Dixon in spring 2001.

Duran and Givens (2001) suggest that the intermediate form of the black pine-Florida pine snake should be considered as a clinal gradation in the Florida pine snake rather than as intergrades between the two taxa. Recent records of *P. m. mugitus* from western Baldwin County present evidence that challenges this supposition. Photographs were received during this survey of what appears to be a “true” Florida pine snake from an area northwest of Bay Minette. The individual was a roadkill that was found in an area known to support the intermediate form. Additionally, a second roadkill *mugitus* was discovered at this same locality in June 2002 (Kevin Dodd, pers. comm.). Documentation of Florida pine snakes exhibiting no *lodingi* characteristics or melanistic traits similar to the intermediate form in western Baldwin County suggests that an overlap in geographic distribution likely occurred between *lodingi* and *mugitus*. The extensive Mobile - Tensaw River Delta likely serves as a geographical barrier between the two taxa today, and it seems improbable that gene flow between black pine snakes west of the delta is extending to areas east of the delta. Until genetic studies are pursued or "true" black pine snakes found in the purported intergradation zone (which seems unlikely), questions will remain concerning the origin of the "intermediate form." Based on the recent records of the Florida pine snake from west Baldwin County, the recognition of the intermediate form as a cline (i.e., a geographical character gradient) of *mugitus* is challenged. If clinal gradation in the Florida pine snake was the sole explanation for the intermediate form in the Baldwin-Escambia County area, it seems improbable that individuals possessing typical *mugitus* patterning and coloration (characteristic of populations to the east of this area) would exist inside this region. The most plausible factor that resulted in the appearance of a form intermediate to the black pine snake and Florida pine snake stems from a historical overlap in distribution between the two taxa in which gene flow gave rise to an intergrading population. This debate could be effectively resolved through the employment of genetic research, which is highly recommended.

Southern Hognose Snake

Life History Overview

The southern hognose snake is a short, stocky snake that typically attains total lengths of 36-56 cm; maximum recorded length is 61 cm (Conant and Collins, 1998). Coloration varies from a gray, tan, or yellowish background overlain with a heavy pattern of mid-dorsal dark blotches that alternate with smaller dorsolateral blotches (Mount, 1986). A key character for this species is its sharply upturned snout.

Little information exists on the southern hognose snake to complete a thorough and detailed life history account. This small, southeastern reptile is considered to be highly fossorial and infrequently encountered (Mount, 1986), partly explaining the paucity of information on this species. Recorded accounts suggest that *H. simus* is closely associated with sandy, xeric habitats (e.g., Goin, 1947; Ashton and Ashton, 1981; Jensen, 1996; Stevenson, 1999; Tuberville et al., 2000). In North Carolina, the species is reported from xeric, oak-pine forests (Palmer and Braswell, 1995). In Florida, the species is reported to be more common in sand pine-rosemary scrub, longleaf pine-turkey oak, and xeric oak hammock but less frequently encountered in pine flatwoods, farmlands, fields, disturbed areas, and coastal beaches and dunes (Ashton and Ashton, 1981). Mount (1986) states the habitat for *simus* is "open woods, fields, and waste places having relatively sandy soils."

The burrowing ability of this species is briefly noted in Goin (1947) where he reports observing a southern hognose snake digging to a depth of 11.5 cm in pursuit of a preferred food item, the spadefoot toad (*Scaphiopus h. holbrookii*). Palmer and Braswell (1995) reported that individuals have been found to depths of 20 to 30 cm below soil surface. Apart from these brief burrowing accounts, there is little information on the movements or activities of this species. Tuberville et al. (2000) report that the southern hognose snake has seasonal activity peaks with the majority of observations in North Carolina occurring in May to June and September to October (North Carolina information from Palmer and Braswell, 1995). Thirteen records from Alabama suggest that the species is more frequently found from late April to late October with 77% of these occurring in May to July (Appendix 1, Table 5).

Currently, very little information exists on reproduction or nesting behavior of the southern hognose snake. Based on limited observations, breeding occurs in spring, particularly from May to June, with oviposition occurring in late spring through summer (Palmer and Braswell, 1995; Tuberville et al., 2000).

Distribution and Status

The historical range of the southern hognose snake extends from southeastern North Carolina to central Florida and westward to the Pearl River in southern Mississippi (Meylan, 1985; Conant and Collins, 1998; Tuberville et al., 2000). The species is closely associated with the Lower Coastal Plain; however, records and observations have come from physiographic regions outside of the Coastal Plain. Occurrences are known from the Upper Coastal Plain in Georgia and South Carolina and from the Lower Piedmont of North Carolina (Palmer and Braswell, 1995; Tuberville et al., 2000). In Alabama, occurrences have been documented from the Gulf Coastal Plain, Upper East Gulf Coastal Plain, and Cumberlands and Southern Ridge and Valley. A search of museum records and published literature revealed 23 records from 10 Alabama counties (Appendix 1, Table 5). Range maps and distributional information suggest that the Alabama occurrences north of the Fall Line represent disjunct populations (Mount, 1975; Conant and Collins, 1998; see Appendix 2, Figure 3).

The current and future status of the southern hognose snake rangewide is discouraging.

Historical accounts indicate that there are at least 126 county records from a combined six states across the species' range, but in the last 15 years, only 41 counties in four states have documented occurrences. The majority of the recent records have come from southeastern North Carolina, portions of South Carolina, and central and north Florida (Tuberville et al., 2000). Range retraction appears to be occurring along the periphery of the species' distribution, but nowhere is the apparent retraction more severe than along the western edge. The last reported sighting of *simus* in Mississippi was 1981 (Tuberville et al, 2000), and the last documented occurrence in Alabama was 1970 (Appendix 1, Table 5). Mount (1986) mentions one sighting (observed by Ed Wester) of an individual swimming near the Georgia shoreline of Lake Eufaula in 1984 but none have been documented within state lines, particularly in areas that produced former records. Despite several herpetological surveys and activities occurring statewide over the last 30 years, no confirmed sightings or reliable anecdotal reports have been received. There is growing concern among herpetologists that the species may be extirpated from Alabama (Mike Duran pers. comm.; John Jensen pers. comm.; Tuberville et al., 2000).

Historical Sites and Accounts

The southern hognose snake has an interesting distribution in Alabama. Although the species is more commonly associated with xeric coastal plain habitats, 11 specimens have been collected from the Cumberlands Southern Ridge and Valley ecoregion. Aerial photos for each of these occurrences were examined to help determine the extent of potential habitat left in these northern sites.

Three specimens were collected from Calhoun County in the late 1960s. These records represent the northernmost occurrences of the species in Alabama. Aerial photographs taken in 1992 of the general area where specimens were collected near Anniston (Appendix 1, Table 5, records 5 and 6) reveal a landscape that has been greatly modified and altered. Today, the occurrences from the Anniston vicinity are best defined as dense residential areas supporting a high concentration of roads or agricultural lands. The record from the Jacksonville area (Appendix 1, Table 5, record 7) has more promise. Aerials of this occurrence reveal a large unbroken forest in excess of 6000 ha to the east and northeast of the 1968 record. This is the area abutting the rolling foothills and highlands associated with Choccolocco Mountain. It is highly questionable that this large area currently supports extensive *simus* habitat. Much of this area now supports a maturing mixed hardwood-pine forest with nearly complete canopy closure.

A second county in the Cumberlands Southern Ridge and Valley that historically supported the southern hognose snake is Shelby County. In a one-year period, eight specimens were collected from a single locality. No other single site in Alabama has produced more documented occurrences of this species than the area of Longview (Appendix 1, Table 5, records 16-21). This area is now heavily fragmented due to limestone quarries, industrial impacts, and high road density (I-65 within 1 km). According to county soil maps, several soil types in the area of Longview may have supported the habitat and physical conditions necessary for sustaining this population. A series of deep, well-drained soils that were formed in residuum of cherty limestone (Stevens, 1984) occur in the vicinity of these historical accounts. However, given the

level of disturbance in the vicinity of Longview over the past 30 years this population is likely extirpated.

Six county records of the southern hognose snake have come from the Lower Coastal Plain. Aerial photographs and site visits to some of these localities revealed considerable habitat degradation and fragmentation.

In an early publication of Alabama amphibians and reptiles, Löding (1922) reported the southern hognose snake from Perdido in Baldwin County. Aerial photographs of the Perdido community depict a patchwork of landscape conditions. Within a 5-km radius of Perdido, approximately 30 to 40% of the landscape supports intense agriculture and another 45% is comprised of short-rotation pine plantations. The remaining landscape consists of residences and roads, including I-65. Very little habitat appears suitable for supporting *H. simus* in the Perdido area of Baldwin County.

A more recent sighting of the southern hognose snake in Baldwin County occurred in 1967 when a roadkilled specimen was collected northeast of Elsanor (Appendix 1, Table 5, record 4). Over the past several decades, the uplands of this area have undergone extensive conversion to short rotation pine plantations. Narrow corridors and small patches in the bottomlands and floodplains along the Styx River appear to be the only significant natural community occurrences left in the immediate vicinity of this historical record. Near the community of Elsanor, the landscape is predominantly open agriculture fields. The higher elevations in this area support deep, well-drained sandy soils, but the harvest intensity and subsequent mechanical preparation of the ground surface for planting pines may be too severe to support the species. It is questionable whether *simus* remains in this area.

Two records are documented for Covington County, and one of these represents the last confirmed account for the state (Appendix 1, Table 5, records 9 and 10). Of the two, the occurrence from the area adjacent to Conecuh National Forest (record 9) has a greater probability of supporting an extant population compared to the occurrence at Lake Jackson (record 10). The area encompassing the Conecuh record has undergone alteration such as agriculture and loblolly pine conversion, but there are xeric, open longleaf pine stands in the immediate vicinity that may continue to support the species. All attempts to relocate the species in this area during the tenure of this project were unsuccessful. Several herpetologists believe that the longleaf pine woodlands and scrub oak sandhills of the Conecuh National Forest support the best remaining habitat and conditions for the species in Alabama (Craig Guyer, pers. comm.; Mark Bailey, pers. comm.; Tuberville et al., 2000). Despite several intensive herpetological surveys in the Conecuh, no sightings of *simus* have been reported. Continued surveys and searches in this area should receive high priority.

A highly manipulated landscape now encompasses the historical Lake Jackson record. The community of Florala borders the lake to the north, east, and west and the landscape beyond the residential areas is a patchwork of open agriculture fields and timberlands. A very small portion of natural habitat is left.

Three specimens of *H. simus* have been reported from Dale County, one from an area near Ozark and two possibly from Fort Rucker Military Installation (Appendix 1, Table 5, record 11). The exact locality of the 1944 Dale County record in Ozark is unknown, but the widescale alteration and fragmentation of the landscape to commercial and residential development have reduced or eliminated the possibility of the southern hognose snake remaining. However, to the west of Ozark is the military installation of Fort Rucker, which supports open, longleaf pine woodlands and sandhill habitats. During his stay at Rucker, Snyder (1944) reported that he found two juvenile southern hognose snakes in preservative in a storage facility on base. Snyder made assumptions that the specimens were collected on Fort Rucker's base. Despite recent herpetological surveys at Fort Rucker, no southern hognose snakes have been reported from the installation (Mark Bailey, pers. comm.). Nevertheless, the natural habitats occurring on Fort Rucker appear suitable for supporting *simus* and warrant additional surveys.

One *simus* record is known for Escambia County and comes from an area that is sparsely populated and likely supports suitable habitat. Conecuh National Forest borders this occurrence to the east but lands to the west are privately owned. Aerial photographs of this locality depict a mosaic of habitat types. Open agricultural fields and pine plantations comprise much of what is privately owned. National Forest lands primarily support a semi-open longleaf pine woodland with a moderate understory density of shrubs and young hardwoods. The herbaceous ground cover was estimated at approximately 50%. Recent surveys through this woodland failed to locate the species but it is strongly recommended that future searches through this area be continued. To improve southern hognose snake habitat, this woodland requires small-scale thinning and periodic fire to improve and maintain an open, longleaf pine forest.

The southern hognose snake has been reported from four additional Alabama counties including Autauga, Choctaw, Mobile, and Tuscaloosa. The early accounts of the southern hognose from Autauga and Mobile counties have specimens associated with these records but lack specific locality information (Appendix 1, Table 5, records 1, 13, 14, and 15). Both counties support prominent sandhill habitats (although degraded from fire suppression) and conjecturally, it is likely that specimens were collected from this habitat type. However, no information has been garnered to support this supposition. The Choctaw and Tuscaloosa County records lack voucher specimens and should be treated as literary accounts that represent unconfirmed sightings (Appendix 1, Table 5, records 8 and 22). These accounts are given recognition as potential or plausible occurrences and have been mapped as valid records (Appendix 2, Figure 3).

CONSERVATION AND RECOMMENDATIONS

Over the past century, the decline and disappearance of the eastern indigo snake, the black pine snake, and the southern hognose snake in many areas of their respective former ranges have been well noted. Until the experimental reintroductions of the 1970s and 1980s, the eastern indigo snake was feared to have been extirpated from Alabama. Even with an intensive restocking program, the indigo snake's future in Alabama is still

in doubt. The same can be said for the black pine snake, which has already seen portions of its range in Alabama engulfed by urbanization and city sprawl. Of these three southeastern reptiles, the status of the southern hognose snake in Alabama looks particularly bleak. An absence of observations over a 30-year period, even with surveys into areas known to have supported the species, is very alarming.

The decline of these three species across the southeastern Coastal Plain has been attributed to several factors, but one factor stands above all: habitat loss and degradation. Frost (1993) estimates that 97% of the natural vegetation associated with the longleaf pine dominated uplands (includes xeric, pine-scrub oak sandhills) has been lost. This is habitat considered critical to the occurrence of all three species. These losses are attributed to intensive silviculture practices, conversion of diverse pinelands to monoculture pine plantations, conversion to croplands, expansion of cities and townships, increased roadways, and the absence of fire.

Aerial photographs examined and sites visited during this project revealed several large, continuous woodlands that remain undeveloped. Unfortunately, most of these areas have experienced many years of fire suppression, which has created conditions that are unsuitable for taxa requiring open habitats. Fortunately, these forested landscapes are restorable. Implementing management directives such as prescribed fire and tree thinning to restore and maintain open longleaf pine woodlands and longleaf pine-scrub oak sandhills would seemingly be of the most benefit to the eastern indigo, black pine, and southern hognose snakes. Additionally, other rare and sensitive species that are dependent on the structure of these ecological systems would be greatly benefited (e.g., the gopher tortoise).

The possibility for implementing alternative management practices have strong implications for landowners and land managers at nearly all of the indigo snake experimental introduction sites. With the exception of one area, snakes were released onto lands owned by timber companies or on lands managed for timber. There are several management options and procedures that could be implemented to help offset potential detrimental impacts from intensive silviculture. For example, low intensity site preparation such as burning could be used in preference to mechanical preparation such as root raking and drum-chopping. Windrows formed following a clear-cut or large-scale thinning should remain on site and not burned or destroyed. These brush piles are known to support eastern indigo snakes, which use them for foraging, shade, and refuge (USFWS, 1983; Speake, 1993). Another management strategy following a harvest is to allow a proportion of the tree stumps to remain on site. Stumps have been found to be very important structures for black pine snakes (Duran, 1998), and eastern indigo snakes have been observed using root channels of stumps as well (Smith, 1987). These management recommendations would appear to levy little burden on the industry associated with these lands and may ultimately create positive returns for both the species and the landowner.

Before an accurate assessment can be produced concerning the status of the eastern indigo snake, black pine snake, and southern hognose snake in Alabama, a considerable

amount of effort must be expended toward conducting future field surveys and implementing conservation strategies. The following are a series of recommendations and research directives that should be considered for each species.

For the indigo snake:

1) Each site where individuals were introduced needs additional surveys to fully assess the success of the initial releases. Release sites should receive survey priority based on recent observations by land managers and area foresters.

2) Management alternatives or considerations for improving indigo habitat should be discussed with landowners or area managers.

3) The localities where recent sightings were reported need further investigation and property access pursued to search for established populations that may remain unknown to science.

4) A second captive rearing-reintroduction program into suitable localities should be considered. All potential introduction localities must meet strict guidelines that include area or size of release site (ca. 4,000 ha; see Speake, 1993), habitat complexity and structure, ongoing management activities, and landownership.

For the black pine snake:

1) Intensive field surveys using various methodologies (e.g., pedestrian surveys, snake trapping, burrow scoping) should be implemented in large, continuous tracts in Mobile, Washington, and Clarke counties.

2) Intergradation zone of Baldwin and Escambia counties should be surveyed and genetic studies pursued to elucidate the origin of the "intermediate form" between the black pine and Florida pine snakes. Additionally, individuals from Clarke County should be studied and examined for potential intergrading populations.

3) Areas should be surveyed where recent sightings have been reported.

4) Life history and ecological studies must be pursued.

For the southern hognose snake:

1) Survey efforts should target historical localities that still support suitable habitat.

2) If populations are detected or reported, begin studying the life history and ecology of this species should be studied.

3) Consider the possibility of a captive breeding and reintroduction program similar to that of the eastern indigo snake.

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APPENDIX 1

Records of the eastern indigo snake, black pine snake, and southern hognose snake in Alabama.

Table 1. Historical accounts of the eastern indigo snake in Alabama.

County	Date	Locality	Specimen, Museum Code*	Comments	Observer(s)/ Collector(s)
Baldwin	<1931	(county record only)		general distributional information (Haltom, 1931)	
Covington	<1954	ca. 12 miles N. of Florala		Neill (1954) reports two specimens were collected from this locality; date, deposition of specimens and observer(s) unknown	
Mobile	<1922	Satsuma		Löding (1922) reports records from this area but doesn't give specifics as to specimen deposition, date of observations, or observer(s)/collector(s)	
Mobile	<1922	"…on sandy palmetto covered hills at Grand Bay…" (Löding, 1922)		Löding (1922) mentions observing several specimens from this area but never collected any individuals.	H.P. Löding

Table 2. Alabama localities where eastern indigo snakes were reintroduced with notes on release and relocation efforts. Information on the reintroduction localities, number of snakes released, and relocation attempts are from Tom Jones (pers. comm.) and Speake (1990), unless otherwise noted.

County	Site	Landowner	Release Locality	Comments	Relocation Attempts
Autauga	Autauga County Community Hunting Area	International Paper	off County Rd. 57; T19N, R15E, Sec 22, 23, 26, or 27 (Old Kingston quadrangle)	Unclear of the precise release locality ; 15 hatchlings (sex unk.) released in Fall 1986	9.5 person-days spent searching for releases between 1 Oct. 1986 through 30 Sept. 1989. [No sightings or relocations]
Baldwin	Perdido River Hunting Club	International Paper	off Dodd Rd. T2S, R4E, Sec 25; SW1/4 (Dogwood Creek quadrangle)	2 juveniles (♂ and ♀) and 25 hatchlings (7 ♂ and 8 ♀; 10 sex unk.) released in 1978 and 1979	23.5 person-hours spent searching for releases in 1981 and 1.7 person-days spent searching between 1 Oct. 1986 through 30 Sept. 1989. 16 person-hours expended in 2000 [No sightings or relocations during all attempts]
Baldwin	Gulf State Park Preservation Area	ADCNR State Parks Division	T9S, R5E, Sec 07; NE1/4 (Orange Beach quadrangle)	2 juveniles (♂ and ♀) and 35 hatchlings (13 ♂ and 14 ♀; 8 sex unk.) released in 1978 and 1979	62.5 person-hours spent searching for releases in 1981 – no sightings during these attempts. An Auburn Univ. employee reported a tentative sighting in Feb. 1982. From 1 Oct. 1986 to 30 Sept 1989, 4.8 person-days was spent searching [no sightings]. 18 person-hours expended in 2000 [no sightings]

Table 2. (continued)

County	Site	Landowner	Release Locality	Comments	Relocation Attempts
Bullock	Swift Plantation, Private Hunting Preserve	Swift family	T12N, R24E, Sec. 11, NE ¼ (Midway quadrangle)	1 adult and 37 hatchlings released in 1980, 1981, and 1982	18 person-hours spent searching in 1981 and 7.0 person-days expended from 1 Oct. 1986 to 30 Sept. 1989 [no recorded sightings]
Covington	Blue Springs WMA, Conecuh National Forest	USDA Forest Service	T2N, R15E, Sec. 16 & 24 (Carolina quadrangle)	Snakes were released in two separate localities. 50 hatchlings (29 ♂ and 21 ♀) released in 1981 (13 in Sec 16 and 37 in Sec 24)	4.4 person-days spent searching from 1 Oct. 1986 to 30 Sept. 1989 [no sightings – Speake, 1990]. A local resident mentioned observing an adult years following the releases, but this sighting remains unconfirmed. 46 person-hours expended from 2000-2002 [no sightings]
Escambia-Covington	Solon Dixon Forestry Education Center	Auburn University	T3N, R13E, Sec. 36 (Dixie quadrangle) (Rhett Johnson, pers. comm.)	Releases were made from 1979 to 1986 with 33 adults (13 ♂ and 8 ♀, 12 sex unk), 10 juv., and 2 hatchlings released (sex unk.)	71 person-hours expended in 1981 with 3 recaptures. Residents of the center captured several in the early 1980s. From Oct. 1986 through Sept 1989, 6.8 person-days spent searching with 5 captures or sightings. No recent sightings despite heavy field activities
Escambia	T.R. Miller Hunting Area	T.R. Miller	Precise locality unknown; NE corner of county	3 juveniles and 39 hatch-lings released in 1983 (sex unk.)	2.6 person-days spent searching between Oct 1986 and Sept 1989 [no sightings]
Mobile	J.L. Hunting Club	Altmayer Property	West side of the Escatawpa River; general area of T1N, R4W, Sec 33 and T1S, R4W, Sec 5 (Brown Town and Earlville quadrangles)	50 hatchlings released in 1982 (sex unk.)	Uncertain of relocation attempts after releases. Property manager and forester has reported seeing individuals occasionally over the past several years. Most recent sighting was October 1999. (See Table 3 for recent sightings from this area)
Washington	Annie Jordan Trust Property	Marie Beech (caretaker)	T6N, R2W, Sec 2 (Bigbee quadrangle)	14 juveniles (sex unk.) were released in 1986	4.8 person-days spent relocating releases from Oct. 1986 to Sept 1989; 1 recapture was made during this period; also, "1 gravid female was captured sunning on a sandrock ridge 300 m from the release site in 1989" (Dan Speake, pers. comm.); additional sightings have been made by the property's caretakers since the original releases; (see Table 3 for recent sightings from this area)

Table 3. Probable and/or confirmed sightings of eastern indigo snakes in Alabama since 1986.

County	Date	Locality	Comments	Observer(s)
Coffee	May 2000	Due south of Enterprise, 0.3 mile S. of jct of County Rds. 711/708 off rd. 711; 0.6 air mile S. of Hwy 192/ County Rd. 708 jct. T4N, R22E, Sec 33	A juvenile was sighted in a privet hedge along a narrow fencerow bordering open pastures to the north and south. Individual was estimated at ca. 3 feet in length. Several photographs were taken, one of which is now archived at Auburn University's Herpetological Lab (Craig Guyer, pers. comm.)	Bill Parker
Covington	early 1990s	Blue Springs WMA – Conecuh National Forest, on or near Forest Service Rd. 335; general area of T2N, R15E, Sec 16 and Sec 21	A local resident observed a snake just beyond Forest Service rd. 335 with a description that matches that of an adult indigo snake. Though unconfirmed, this account is included here because the observation is near a reintroduction site (see Table 2) of which releases were never relocated.	Resident near Shady Hill FW Baptist Church (name not known)
Escambia	Oct. 1986 to ca 1990	Solon Dixon Forestry Education Center; T2N, R13E, Sec 1; T3N, R13E, Sec 36; T2N, R14E, Sec 6; T3N, R14E, Sec 31	Several observations have been made following reintroductions, up until ca. 1990. Indigo snakes were observed over much of the Center's property N. of Hwy 29. The last confirmed observation was ca. 10 years ago (Rhett Johnson, pers. comm.). See Table 2 for information on relocation attempts	Rhett Johnson, Dan Speake, Dale Pancake, and several students and technicians
Mobile	11 May 2000	Wilmer, ca. 0.4 mile S. jct of US 90/Wilmer Rd. (CR 5) on Wilmer Rd.;T3S, R4W, Sec 2 and Sec 3	An adult observed crossing county rd.	Jim Godwin
Mobile	17 March 2000	Wilmer; ca. 0.7 mile N of Tanner Rd/Cemetery Rd. jct on Tanner Rd (sighting ca. 400 m W. of this point; 1.1 air miles NNW of Wilmer)	An adult observed by a Mobile County forester; observed snake retreating into a burrow; though unconfirmed, description of the snake strongly suggests a valid indigo sighting	Steve Lyda, Eugene Tanner
Mobile	Oct. 1999	Altmayer Property, Escatawpa River area in the vicinity of Earlville and Boothetown; T1S, R4W, Sec 37 (NE ¼), Sec 20 (NE ¼), Sec 4 (N ½), Sec 21 (NE ½), and Sec 11	Several observations have been made by the land manager and forester for Altmayer Properties. Sightings are primarily of snakes crossing logging or access rds. All observations in the sections indicated date from 1997 to 1999. These sightings are all within 5 miles of the 1982 reintroduction site (see Table 2).	Perry Malone, David Jellenc
Mobile	2001	Citronelle; county road near community; precise locality not known	An adult observed crossing county rd.	Mobile naturalist (name not known)
Washington	Fall 1998	Deer Park; near Bud Odom Road; precise locality not known	An adult observed on landowner's property	Dr. Blaine Crum
Washington	May 2000	Annie Jordan Trust Property, ca. 6-7 air miles NE of Chatom; area of T6N, R2W, Sec 4 and Sec 2	The most recent sighting was made by a caretaker of the property in May 2000 in the vicinity of T6N, R2W, Sec 4 (near Simmons Creek). Indigo snakes have been seen occasionally following the initial reintroduction. One gravid female, a juvenile when originally released in 1986, was captured ca. 300 m from the release site in 1989 (Speake, 1990).	Bonnie Onderdonk, Marie Beech, Dan Speake, (and others)

Table 4. Observation and museum records, including historical and recent accounts, of the black pine snake in Alabama. (Records of intergrades or the intermediate form between *P. m. lodingi* and *P. m. mugitus* in areas east of Mobile Bay not included.)

County (Record #)	Date	Locality	Specimen(s)/ Museum Code*	Comments	Observer(s)/ Collector(s)
1. Clarke	24 July 1956	16 miles E. of Coffeeville	adult female; UADB 56-1	Total length 1480 mm; "...topography was hilly, with sandy soil and a heavy forest association of *Pinus* sp and *Quercus* sp with fairly heavy undergrowth… snake was caught while crossing a rural dirt road and was ca. 30 feet from a small stream." (Conant, 1956)	
2. Clarke	July 1960	Clarke County Management Area	AUM 6348		J. Keeler
3. Clarke		Fred T. Stimpson State Game Sanctuary		account listed in Duran (1998)	Dan Speake
4. Clarke	1994	Scotch WMA, Hall Rd, 100 m SE of W. Boundary Rd. (T10N, R1E, Sec 11, NW ¼)		account listed in Duran (1998)	J. Reid
5. Clarke	1995	Scotch WMA, Knight-Shefield Rd. (T10N, R2E, Sec 23, NW ¼)		account listed in Duran (1998)	J. Reid
6. Clarke	1997	Fred T. Stimpson State Game Sanctuary		account listed in Duran (1998)	Fred Pringle
7. Mobile	1919	"…Hall's Mill Road, in the vicinity of high sandy hills near Hall's Mill Creek, about 14 miles southwest of Mobile." (Blanchard, 1920)	adult female, USNM 62340	discrepancy with Blanchard's locality and conversations between Löding and A.H. Wright; Löding tells Wright that the 1st specimen was collected just beyond Theodore between the latter and Irvington, near a bridge (Wright and Wright, 1957); plot based on Löding's verbal account	H.P. Löding, T.S. Van Aller
8. Mobile	ca. 1919	Grand Bay, 26 miles southwest of Mobile	adult female, Charles Mohr Museum, Mobile	locality and account from Blanchard (1920); specimens from the Charles Mohr Museum were supposedly sent to ALNHM (Conant, 1956)	E.D. King, Jr./ H.P. Löding
9. Mobile	28 July 1920	Irvington	adult; ALNHM, (cat. # unknown)	account from Blanchard (1920), Loding (1922), and Wright and Wright (1957)	H.P. Löding
10. Mobile	June 1924	Irvington	immature female	account in Conant (1956) and Stull (1940); Conant (1956) could not locate specimen	Dr. Van Aller
11. Mobile	ca. 1924	few miles N. of Dawes	adult male; Charles Mohr Museum, Mobile	account in Conant (1956) and Stull (1940); Conant (1956) could not locate specimen; not mapped – locality too general	
12. Mobile	30 April 1924	area between Irvington and Grand Bay	adult male; UMMZ 58800	Holotype (Blanchard, 1924)	H.P. Löding
13. Mobile	May 1928	Mobile	immature male; AUM 10667	not mapped – locality too general	H.P. Löding
14. Mobile	12 June 1929	Mobile		specimen obtained from Löding and described in species account in Wright and Wright (1957)	H.P. Löding

Table 4. (continued)

County (Record #)	Date	Locality	Specimen(s)/ Museum Code*	Comments	Observer(s)/ Collector(s)
15. Mobile		Mobile	USNM 75292	Based on catalog #, specimen most likely deposited prior to 1935, but this is unconfirmed.	
16. Mobile	26 Mar. 1939	Mobile, tributary creek of Dog River	USNM 307703	not mapped (locality too general)	
17. Mobile	<1940	Theodore	male; Ala. Mus. No. 1	account in Stull (1940)	
18. Mobile	<1940		adult male; MCZ 22373	account in Conant (1956) and Stull (1940); not mapped - county record only	
19. Mobile	<1956		MCZ 29215	account in Conant (1956); not mapped - county record only	
20. Mobile		Cottage Hill	UMMZ 84458	account listed in Duran (1998)	
21. Mobile	ca. 1953	Mobile County	USA 1122	account listed in Duran (1998); not mapped	
22. Mobile	19 May 1954	10 miles W. of Mobile	AMNH R-74739	account listed in Duran (1998)	C.G. Steadham
23. Mobile	27 June 1965	4.2 miles SE of Semmes	AUM 3014	"on hillside close to cornfield"	McHugh and Napier
24. Mobile	1968	Skyland area N. of US 90	AMNH R-110225	account listed in Duran (1998)	R.M. Johnson
25. Mobile	19 May 1969	Old Shell Rd., near Univ. South AL campus	USA 1303	account listed in Duran (1998)	B. Martin
26. Mobile	7 April 1970	Univ. South AL campus rd. to Hillsdale Heights	USA 1652	account listed in Duran (1998)	F. Scott
27. Mobile	14 April 1970	Univ. South AL campus (backwood)	USA 1654	account listed in Duran (1998)	R. Fussell
28. Mobile	1 June 1970		EAL 3021	Duran (1998) cites Jennings and Fritts (1983) as source for Earnest A. Liner (EAL) private collection; not mapped (no specific locality)	
29. Mobile	1970		EAL 3417	Duran (1998) cites Jennings and Fritts (1983) as source for Earnest A. Liner (EAL) private collection; not mapped (no specific locality)	
30. Mobile	1972		EAL 3416	Duran (1998) cites Jennings and Fritts (1983) as source for Earnest A. Liner (EAL) private collection; not mapped (no specific locality)	
31. Mobile	9 Sept. 1973	Theodore	LSUMZ 28961	account listed in Duran (1998)	J. McQueen
32. Mobile	21 April 1974	ca. 6 miles W. of Citronelle off County Rd. 96	AUM 32548		R.H. Mount
33. Mobile	May 1974	Dawes Road	USA 2125	account listed in Duran (1998); not mapped-general locality	C. Richards
34. Mobile	1975	Mobile County	USA 2214	account listed in Duran (1998)	K. Bliss

Table 4. (continued)

County (Record #)	Date	Locality	Specimen(s)/ Museum Code*	Comments	Observer(s)/ Collector(s)
35. Mobile	1975	Cody Rd., ca. 7 km S. + 18 km W. of Mobile City Hall	USNM 218655	"found crossing sand road"	G. Duda
36. Mobile	Jan. 1976	Mobile County	USA 2200	account listed in Duran (1998); not mapped	G. Duda
37. Mobile	Spring 1976	4.8 km N. and 1.0 km E. of Dawes; near jct of Dawes Rd. and Jeff Hamilton Rd. (SW corner)	male USNM 218654	"found in pine woods"	Carl Richards
38. Mobile	1976	near Mobile	USNM 218657	"bought from pet shop 29 May 1976. Died and preserved July 1976." – not mapped	S. Blair Hedges
39. Mobile	<4 July 1975	near Mobile	adult male; USNM 219068	"Acquired from pet shop (Aquarius) in Mobile, on Spring Hill Ave., on 4 July 1975. Died Sept. 1976. 1620 mm before preservation."	
40. Mobile	1 Jan. 1980	Western Mobile city limits	MMNS 3412	account listed in Duran (1998); not mapped-general locality	
41. Mobile	<1995		MZA 11731	account in Reichling (1995); not mapped	
42. Mobile	<1995		MZA 11912	account in Reichling (1995); not mapped	
43. Mobile	<1995		MZA 13154	account in Reichling (1995); not mapped	
44. Mobile	1996	Mobile County		Duran (1998) reports a live specimen from the University of South Alabama (status of specimen unknown); not mapped	
45. Mobile	1997	West Mobile County		Duran (1998) reports that 5 to 6 individuals are observed per year; not mapped.	M. Casper (Duran, 1998)
46. Mobile	1997	Vicinity of Big Creek Lake and Tanner Williams		Duran (1998) reports several observations made by an area herpetoculturalist	J. Fogel (Duran, 1998)
47. Mobile	1997	Tanner Williams area		Duran (1998) reports observations from this general area by a Mobile herp enthusiast	B. Boswell (Duran, 1998)
48. Mobile	24 Oct. 2000	1.0 mile S. of the jct of Jeff Hamilton Rd. and Oyler Rd. on E. side of Oyler Rd.; 2.3 air miles due W. of Dawes; T5S, R3W, Sec 17 (SE ¼)		landowner reports seeing several black pine snakes from 1974 to present; largest observed ca. 6 feet; in summer 2000, 5 individuals were observed; on 24 Oct. 2000 a 30-inch individual was observed; several photos of black pines taken by landowner	Don Oyler, Richard Oyler
49. Mobile	June 2002	Big Creek Lake area; near Mobile Water Board and School Board property; near Sec 16, T3S, R4W		landowner photographed 3 large adults including a mated pair; landowner reports seeing black pine snakes frequently; photos and accounts received from Bill Finch, Mobile	Landowner (name unk.)

Table 4. (continued)

County (Record #)	Date	Locality	Specimen(s)/ Museum Code*	Comments	Observer(s)/ Collector(s)
50.Washington	12 June 1917	LeRoy, Alabama; straight N. of Mobile 50 or 60 miles		Wright and Wright (1957) print their journal notes from this date indicating that they "took *Pituophis melanoleucus* black phase. Saw another today normally (spotted) colored" (Included here to emphasize that this may have been the first black pine snake [or intergrade] to have been recorded by a herpetologist.)	A.H. Wright, A.A. Wright
51.Washington	19 Sept. 1963	Near Citronelle	AUM 21180	not mapped – locality too general	Ben D. Cole
52.Washington	17 Aug. 1966	Near Citronelle	AUM 21179	not mapped – locality too general	Ben D. Cole
53.Washington	22 May 1968	5 miles N. of Wagerville on Old Stoder Rd., 8 miles W. of Hwy 43	MMNS 1187	account listed in Duran (1998)	P.W. Sanders
54.Washington	28 April 1973	Tibbie, Rt. 17	male USNM 212249	collected alive; "died 30 May 1974"	Robert Wallen
55.Washington	ca. 1990	Annie Jordan Trust Property; T6N, R1W, Sec 26	adult		Dan Speake
56.Washington	ca. 1990	Annie Jordan Trust Property; T6N, R2W, Sec 11	adult		Dan Speake
57.Washington	ca. 1990	Annie Jordan Trust Property; T6N, R2W, Sec 2	adult	Note: same section as eastern indigo reintroductions	Dan Speake
58.Washington	ca. 1990	Annie Jordan Trust Property; T7N, R3W, Sec 22	adult		Dan Speake
59.Washington	1997	Near Boykin WMA		account listed in Duran (1998); not mapped	S. Barnette
60.Washington	<1999	Boykin WMA		Kevin Dodd (pers. comm.) observed an adult that was collected by a hunter	

Table 5. Records and accounts of the southern hognose snake in Alabama.

County	Date	Locality	Specimen(s), Museum Code*	Comments	Observer(s)/ Collector(s)
1. Autauga	1910	(county record only)	USNM 307561	account also in Holt (1924)	Ernest G. Holt
2. Baldwin	<1922	Perdido		account in Löding (1922)	Lenoir Thompson
3. Baldwin	<1931	(county record)		account in Haltom (1931)	
4. Baldwin	21 Oct. 1967	4 miles NE of Elsanor	AUM 6478	roadkill specimen	R.H. Mount
5. Calhoun	13 July 1966	7 miles W. of Anniston, 0.25 miles off Coldwater Pump Rd.	AUM 5091		L. Garnette
6. Calhoun	22 May 1968	9 miles W. of Anniston, off Hwy 78	AUM 9343	roadkill specimen	Payne, Yarborough
7. Calhoun	27 Sept 1968	just off Hwy 21; 2 miles N. Jacksonville	AUM 11190	found "in yard of home"	M. Yarborough
8. Choctaw	<1975	(county record only)		Mount (1975) indicates a Choctaw County occurrence on the distribution map. No specimen or other supporting information found. [not plotted on Map 3]	
9. Covington	7 May 1967	Conecuh Natl. Forest, AL 137 & Co. Rd. 24	AUM 4972		R.H. Mount
10.Covington	27 April 1970	E. shore of Lake Jackson	AUM 18453		Kelly Thomas
11.Dale	25 June 1944	Ozark		Snyder (1945) reports a 16-inch roadkill from Ozark. He also notes finding two 8-inch juveniles in preservative (presumably collected in 1943) that was collected at Camp Rucker.	Richard C. Snyder
12.Escambia	22 May 1966	4 miles SW of Parker Springs	AUM 4649	roadkill specimen	G. Folkerts
13.Mobile	<1931	(county record)		account in Haltom (1931)	
14.Mobile		Mobile County	MCZ A-294		
15.Mobile		Mobile County	MCZ A-177365		
16.Shelby	19 June 1965	Longview, 2 miles S. of Saginaw	AUM 2448 AUM 2450		R.H. Mount
17.Shelby	21 June 1965	Longview, 2 miles S. of Saginaw	AUM 2446		R.H. Mount
18.Shelby	17 July 1965	Longview, 2 miles S. of Saginaw	AUM 2447 AUM 2449		S. Lacy
19.Shelby	22 July 1965	Longview, 2 miles S. of Saginaw	AUM 2444		S. Lacy
20.Shelby	27 July 1965	Longview, 2 miles S. of Saginaw	AUM 2445		S. Lacy
21.Shelby	Summer 1966	Longview	AUM 4741		R.H. Mount
22.Tuscaloosa	<1931	(county record only)		account in Haltom (1931)	
23. —		Northern Alabama	USNM 220340	No additional information on specimen	

*Museum codes from the above tables.

ALNHM	Alabama Natural History Museum
AMNH	American Museum of Natural History
AUM	Auburn University Museum of Herpetology
EAL	Earnest A. Liner private collection
LSUMZ	Louisiana State University Museum of Zoology
MMNS	Mississippi Museum of Natural History
MCZ	Museum of Comparative Zoology, Harvard University
MZA	Memphis Zoo and Aquarium
UADB	University of Alabama Department of Biology
UMMZ	University of Michigan Museum of Zoology
USA	University of South Alabama
USNM	U. S. National Museum, Smithsonian

APPENDIX 2

Distribution maps of the eastern indigo snake, black pine snake, and southern hognose snake in Alabama.

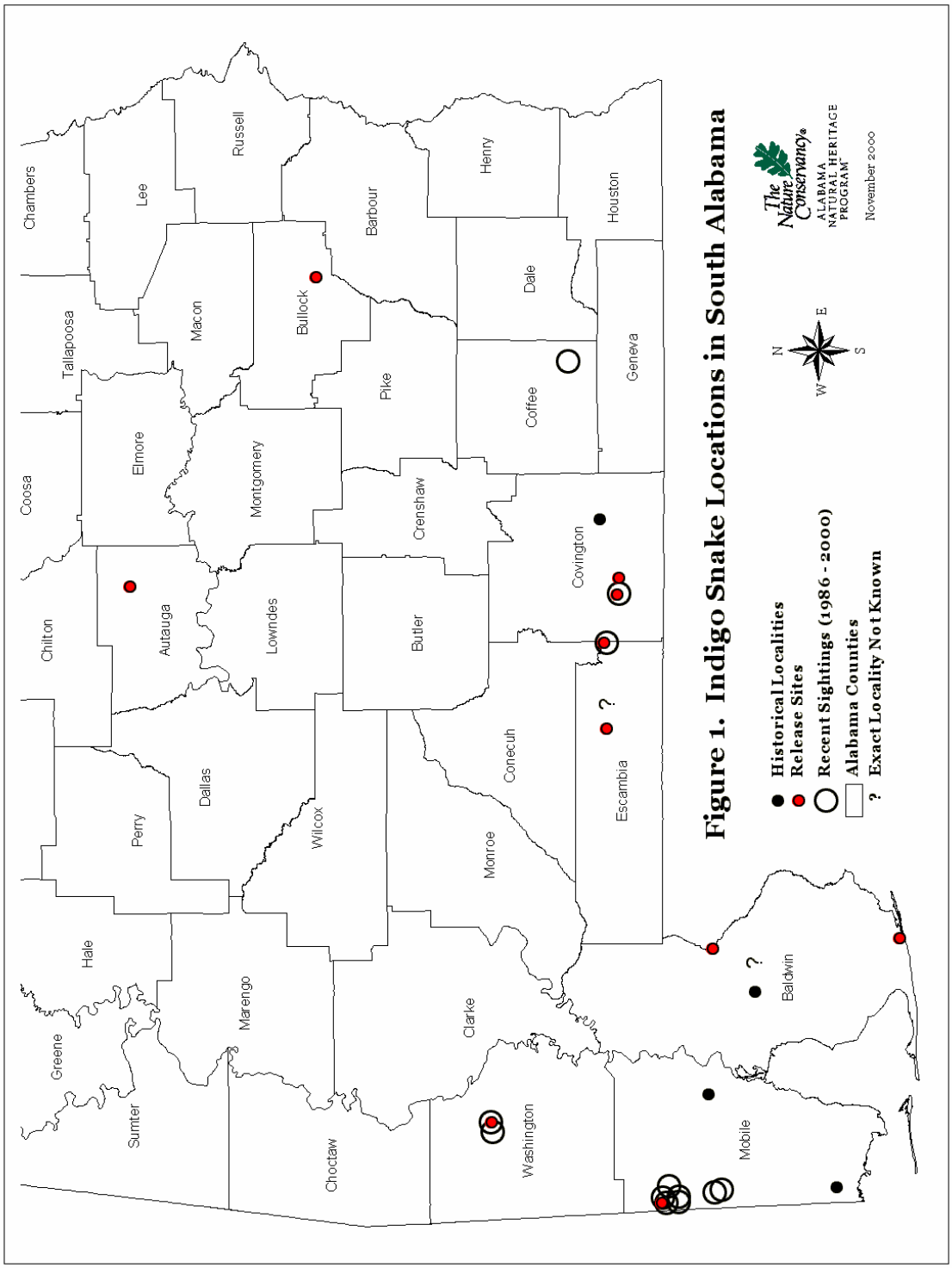


Figure 1. Indigo Snake Locations in South Alabama
Historical Localities
Release Sites
Recent Sightings (1986 - 2000)
Alabama Counties
? Exact Locality Not Known
The Nature Conservancy
ALABAMA NATURAL HERITAGE PROGRAM
November 2000
N
W
E
S
Chambers
Lee
Russell
Barbour
Henry
Houston
Tallapoosa
Macon
Bullock
Dale
Coosa
Elmore
Montgomery
Pike
Coffee
Geneva
Chilton
Autauga
Lowndes
Crenshaw
Butler
Covington
Perry
Dallas
Wilcox
Conecuh
Escambia
Hale
Monroe
Greene
Sumter
Marengo
Clarke
Baldwin
Choctaw
Washington
Mobile

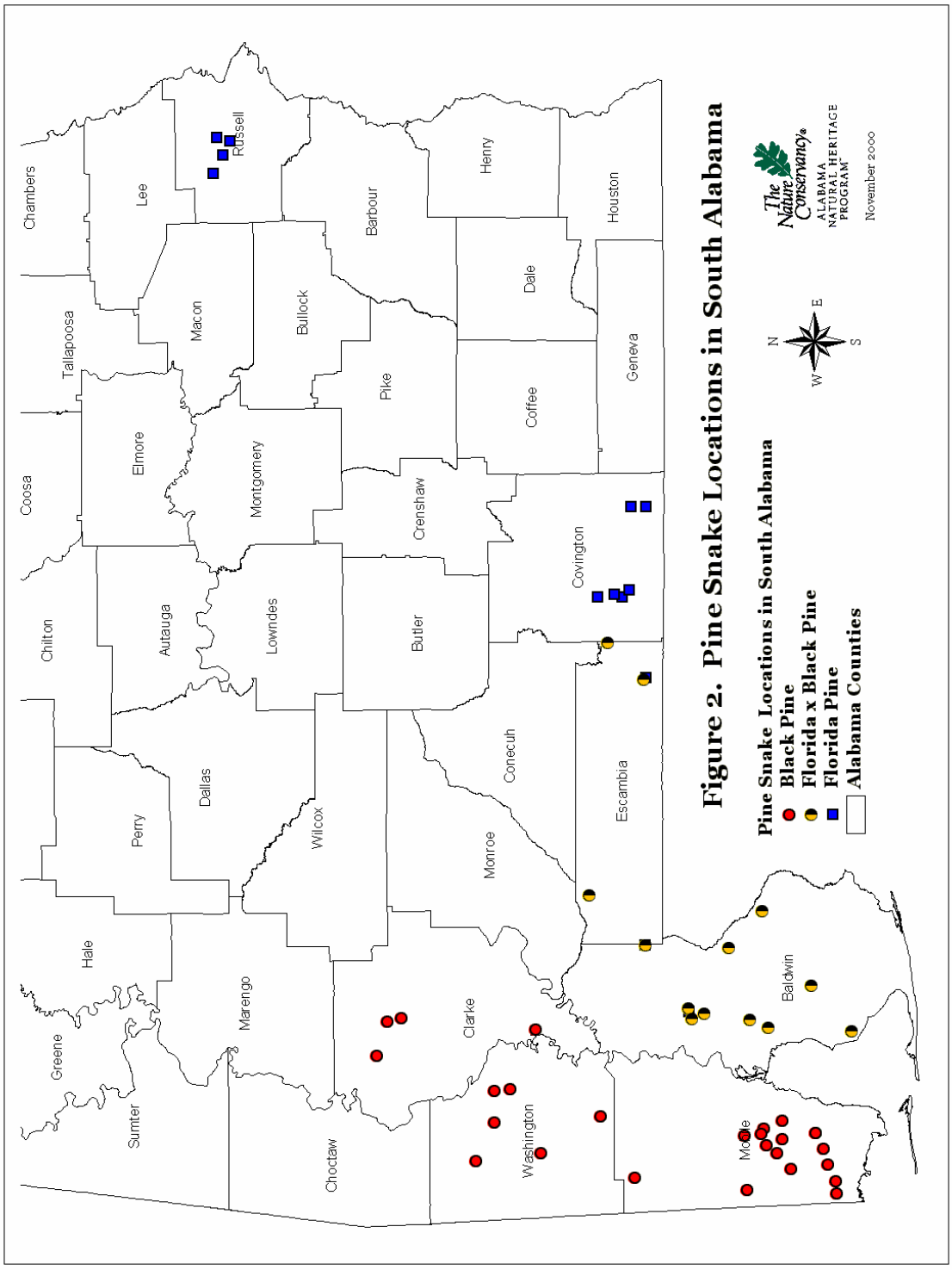
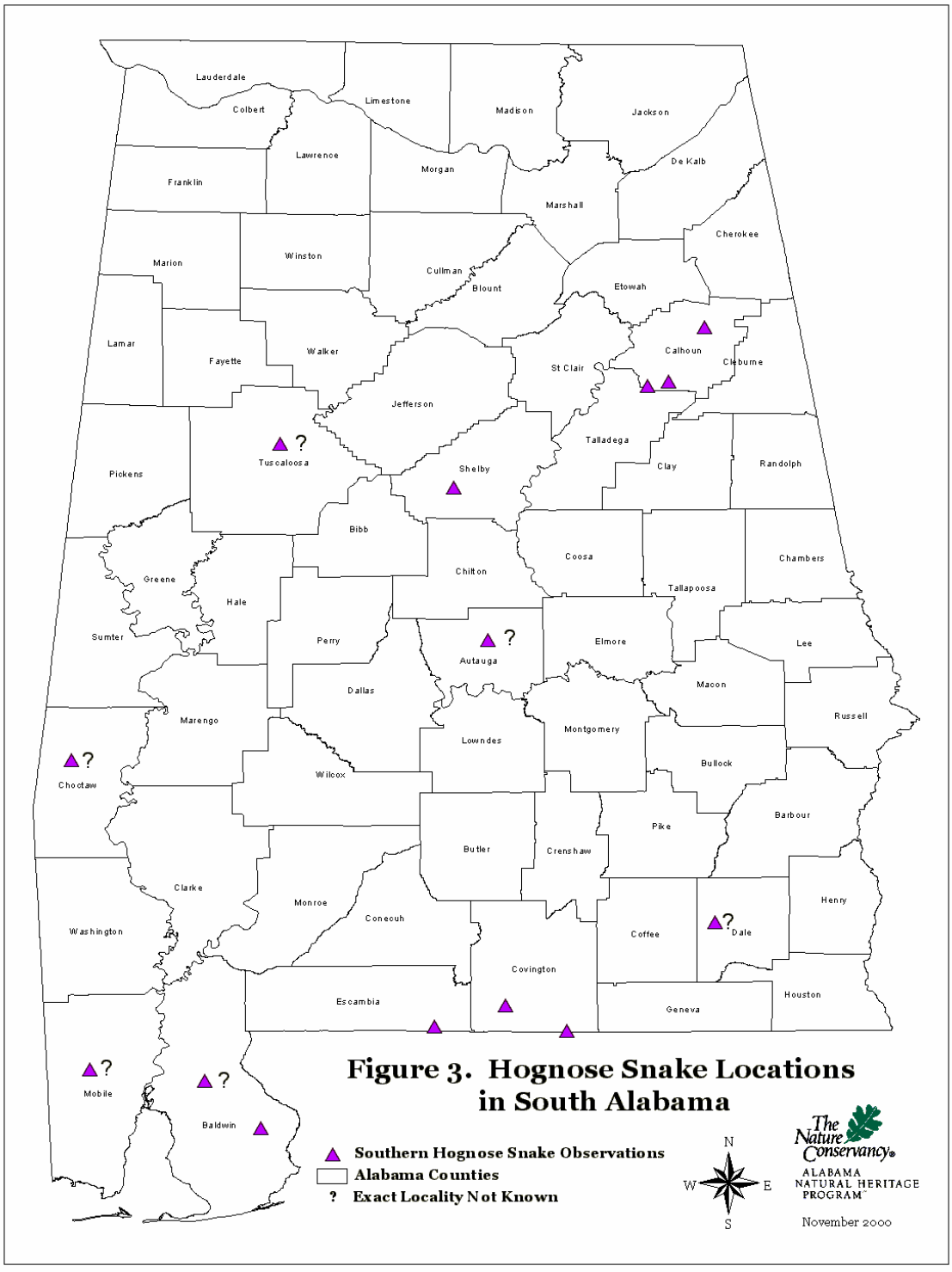


Figure 2. Pine Snake Locations in South Alabama
Pine Snake Locations in South Alabama
Black Pine
Florida x Black Pine
Florida Pine
Alabama Counties
The Nature Conservancy
ALABAMA NATURAL HERITAGE PROGRAM
November 2000
N
E
S
W
Chambers
Lee
Russell
Barbour
Henry
Houston
Tallapoosa
Macon
Bullock
Dale
Coosa
Elmore
Montgomery
Pike
Coffee
Geneva
Crenshaw
Covington
Chilton
Autauga
Lowndes
Butler
Conecuh
Escambia
Perry
Dallas
Wilcox
Monroe
Hale
Marengo
Clarke
Baldwin
Greene
Sumter
Choctaw
Washington
Mobile


Lauderdale
Colbert
Limestone
Madison
Jackson
Lawrence
Morgan
De Kalb
Franklin
Marshall
Cherokee
Marion
Winston
Cullman
Blount
Etowah
Lamar
Fayette
Walker
St Clair
Calhoun
Cleburne
Jefferson
Tuscaloosa
Talladega
Pickens
Shelby
Clay
Randolph
Bibb
Coosa
Chambers
Greene
Hale
Chilton
Tallapoosa
Sumter
Perry
Autauga
Elmore
Lee
Dallas
Macon
Marengo
Montgomery
Russell
Lowndes
Choctaw
Wilcox
Bullock
Barbour
Butler
Crenshaw
Pike
Clarke
Monroe
Conecuh
Henry
Washington
Coffee
Dale
Covington
Escambia
Geneva
Houston
Mobile
Baldwin
Figure 3. Hognose Snake Locations in South Alabama
Southern Hognose Snake Observations
Alabama Counties
? Exact Locality Not Known
N
W
E
S
The Nature Conservancy
ALABAMA NATURAL HERITAGE PROGRAM
November 2000