Draft Revised Recovery Plan for the Eastern Indigo Snake

©Dirk J. Stevenson

Prepared by:

U.S. Fish and Wildlife Service, Athens, Georgia
and Jackson, Mississippi Ecological Services Field Offices

For:
Southeast Region
U.S. Fish and Wildlife Service
Atlanta, Georgia
2019

ACKNOWLEDGEMENTS

The eastern indigo snake Draft Revised Recovery Plan was prepared by the U.S. Fish and Wildlife Service Athens, Georgia and Jackson, Mississippi Ecological Services Field Offices. The Orianne Society helped author early drafts of this Plan. In addition to the Orianne Society, we thank many organizations and individuals for their dedicated efforts to protect the eastern indigo snake. These organizations include, but are not limited to: Alabama Department of Conservation and Natural Resources, Altamaha Environmental Consulting, Auburn University, Birmingham Zoo, Cardno, Central Florida Zoo and the Orianne Center for Indigo Conservation, Conservation Southeast, Department of Defense, Florida Fish and Wildlife Conservation Commission, Florida Gulf Coast University, Georgia Department of Natural Resources, Georgia Sea Turtle Center, Joseph W. Jones Ecological Research Center, Kennedy Space Center, Private Landowners and Foundations, The Nature Conservancy, University of Florida, University of Georgia, U.S. Forest Service, U.S. National Park Service, U.S. National Wildlife Refuge System, Welaka National Fish Hatchery, Zoo Atlanta, and Zoo Tampa.

DISCLAIMER

Recovery plans delineate reasonable actions that are believed necessary to recover and/or protect the species. Plans are prepared by the U.S. Fish and Wildlife Service, sometimes with the assistance of recovery teams, contractors, State agencies, and others. Plans are reviewed by the public and subject to additional peer review before they are adopted by the U.S. Fish and Wildlife Service. Objectives will only be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints. Recovery plans do not obligate other parties to undertake specific tasks. Recovery plans do not necessarily represent the views nor the official positions or approval of any individuals or agencies involved in the plan formulation, other than the U.S. Fish and Wildlife Service. They represent the official position of the U.S. Fish and Wildlife Service only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in species status, and the completion of recovery tasks. By approving this document, the Regional Director certifies that the information used in its development represents the best scientific and commercial data available at the time it was written. Copies of all documents reviewed in development of the plan are available in the administrative record, located at the U.S. Fish and Wildlife Service's Southeast Regional Office, Atlanta, Georgia.

Suggested literature citation:
U.S. Fish and Wildlife Service. 2019. Draft Revised Recovery Plan for the Eastern Indigo Snake. Atlanta, Georgia. 8 pp.

Draft Revised Recovery Plan for the Eastern Indigo Snake

This Draft Revised Recovery Plan describes criteria for determining when the eastern indigo snake should be considered for delisting from the Federal *List of Endangered and Threatened Wildlife* (50 CFR 17.11). It also lists actions that will be necessary to meet those criteria, and estimates the cost for implementing recovery actions. Brief descriptions of the species' status, habitat requirements, and limiting factors are included. A detailed discussion of these and other topics pertinent to the recovery of the eastern indigo snake can be found in the Species Status Assessment (SSA) (USFWS 2018) and the Draft Recovery Implementation Strategy. These supplemental documents are available at https://www.fws.gov/athens/. The Recovery Implementation Strategy and SSA are finalized separately from the Recovery Plan and will be updated on a routine basis.

Current Species Status: The eastern indigo snake (*Drymarchon corais couperi*, hereafter recognized by its currently accepted name, *Drymarchon couperi* [Collins 1991, Wüster *et al*. 2001, Crother 2012]) was federally listed as threatened on March 3, 1978 (USFWS 1978) under the Endangered Species Act (ESA), and is also state listed as threatened in Georgia and Florida, and as endangered in Alabama and Mississippi. The first Recovery Plan was published in 1982 (USFWS 1982) and since that time progress has been made to better understand the species' life history and to conserve the species. However, the exact number of extant populations is unknown. The current distribution for the eastern indigo snake includes the coastal plain of Georgia and Florida which has contracted from its historical distribution. Historical records exist for Alabama and Mississippi; however no naturally-occurring populations remain in these states. Some of the range contraction has occurred since listing under the ESA, particularly in the Florida panhandle due to the decline of gopher tortoise (*Gopherus polyphemus*) populations (Enge *et al.* 2013), where eastern indigo snakes depend on the tortoise burrows for shelter during the winter. Conservation efforts are underway to repatriate eastern indigo snake populations in the Florida panhandle and Alabama. According to the SSA, overall, current population resiliency is medium to low and is predicted to decline in the future without targeted conservation efforts (USFWS 2018).

Habitat Requirements and Limiting Factors: Eastern indigo snake habitat consists of a wide range of upland and lowland habitats. Upland habitats in the northern portions and in some southern portions of the snakes' range include xeric sandhills and scrub habitats that support gopher tortoise populations where the snake depends on the tortoise burrows for winter shelter sites. Longleaf pine (*Pinus palustris*) – wiregrass (*Aristida stricta*) ecosystems are utilized where they are intact and in good condition (i.e., managed with prescribed fire). Eastern indigo snakes are habitat generalists in the southern two-thirds of peninsular Florida and use a wide variety of natural and anthropogenic habitats. Across the range, the most important factor limiting the suitability of these environments as habitat for the eastern indigo snake is their size. Size estimates of contiguous habitat (i.e., patch size) needed to support an eastern indigo snake population range from 5,000 to >20,000 acres (2,023 to 8,094 hectares). Currently, primary threats to the eastern indigo snake include habitat loss, degradation and fragmentation. Direct

mortality by people and their domestic pets and from vehicle strikes on roads is an increasing risk (USFWS 2008, 2018).

Recovery Strategy: The recovery strategy for the eastern indigo snake is to ensure the long-term viability of the species by maintaining and enhancing existing populations via habitat conservation, restoration and management; monitoring the status of existing populations; identifying and securing additional eastern indigo snake populations and habitat; repatriating populations through translocations or reintroductions; and supporting research that guides land management and provides demographic and ecological data. The recovery strategy for the eastern indigo snake requires that habitat is protected and managed and, that populations are connected to promote the stability and growth of multiple populations across the species' range.

Recovery of the eastern indigo snake is based upon the ecological principles of resiliency, redundancy, and representation (Smith *et al.* 2018). **Resiliency** is positively related to population size and growth and describes the ability of a population to withstand stochastic disturbance. Highly resilient populations are better able to withstand disturbances such as random fluctuations in birth rates (demographic stochasticity), variations in temperatures (environmental stochasticity), or the effects of anthropogenic (human-driven) activities. **Representation** describes the ability of a species to adapt to changing environmental conditions over time as characterized by the breadth of genetic and ecological diversity within and among populations. The more representation, or diversity, a species has, the more it is capable of adapting to changes in its environment. **Redundancy** spreads the risk among multiple populations and describes the ability of a species to withstand catastrophic events. Redundancy gauges the probability that there is a margin of safety for the species to withstand or bounce back from catastrophic events. It is measured by the number of populations, and their resiliency, distribution, and connectivity.

The SSA (USFWS 2018) estimated fifty-three (53) extant eastern indigo snake populations based on verified species occurrence records buffered by the snake's estimated maximum home range width (5 mi or 8 km). The SSA highlighted the importance of maintaining large, unfragmented patches of good quality habitat (e.g., shelter sites and habitat diversity) and that eastern indigo snake populations need to be connected to support highly resilient populations. Habitat loss, degradation and fragmentation from development and sea level rise were identified as the primary negative factors influencing resiliency of populations. The populations were distributed across four (4) geographic regions (North Florida; Panhandle; Peninsular Florida; Southeast Georgia) that represented the species' genetic and ecological diversity. Therefore, we defined 16 Conservation Focus Areas (CFAs) (USFWS 2018), with the greatest chance of maintaining or restoring sufficient habitat (quality and quantity) and connectivity among populations, to target recovery criteria and actions.

Habitat protection and management plans should be developed and implemented for all recovery populations. Appropriate habitat management includes maintaining corridors with low road density allowing dispersal between occupied upland and lowland habitats; minimizing soil disturbance and loss of native herbaceous ground cover vegetation; conducting prescribed burning, particularly during the growing season; maintaining appropriate lowland habitat; and restoring degraded upland habitat. Tracts of habitat in private ownership that could be managed

for eastern indigo snakes need to be identified. Site analyses and habitat management actions that improve the connectivity between upland and lowland habitats utilized by eastern indigo snakes are needed. Population data for eastern indigo snake populations are poorly known. Long-term monitoring programs to better define populations, track population trends and the response of this species to habitat management activities are needed for all recovery populations. Gopher tortoise populations should be regularly monitored, and augmented if necessary, at areas where both eastern indigo snakes and tortoises co-occur. Monitoring programs should be critically evaluated and revised as needed. Since recovery of the eastern indigo snake will necessitate finding new or repatriating populations, assessment of potentially suitable habitat within the range of the species and additional presence/absence surveys are needed. Suitable habitat for repatriating populations needs to be identified, and programs developed and implemented to establish and monitor these new populations and manage the habitat that supports them. A range-wide monitoring protocol needs to be developed and implemented so it can be used to determine when delisting criteria have been met.

Recovery Goal: The goal of this recovery plan is to assure the long-term viability of the eastern indigo snake which will allow for its removal from the *List of Endangered and Threatened Wildlife* (50 CFR 17.11). Therefore, this recovery plan establishes delisting criteria for the species. Criteria will be reevaluated as new information becomes available.

RECOVERY CRITERIA:

Criteria for Delisting:

1) At least fourteen (14) populations exhibit a stable or increasing trend evidenced by natural recruitment, and multiple age classes (Addresses Factors A, C, and E).

2) Populations (as defined in criteria 1) are distributed across at least 12 Conservation Focus Areas (CFAs) with at least 2 populations within each of the 4 representative regions (North Florida; Panhandle; Peninsular Florida; Southeast Georgia) (Addresses Factors A, C, and E).

3) Populations within the North Florida, Peninsular Florida, and Southeast Georgia regions naturally maintain their genetic and ecological diversity (Addresses Factors A, C, and E).

4) Conservation measures (e.g., habitat protection and management) and commitments are in place to manage threats of habitat loss, degradation and fragmentation such that sufficient habitat quantity and quality exists for the species to remain viable into the foreseeable future (Addresses Factors A, C, D and E).

Justification for Delisting Criteria:

Criterion 1: This criterion addresses population resiliency. Stable or increasing populations can be based upon a population's resiliency. Medium to highly resilient populations are expected to persist into the foreseeable future (see the SSA, USFWS 2018) and therefore assumed to be stable or increasing. Populations would need to be of sufficient size (population factors) with adequate habitat (habitat quantity and quality [low fragmentation and road density, and adequate shelter availability (e.g., gopher tortoise burrows)]) to be medium to highly resilient (i.e., stable or increasing). The fourteen (14) populations required for recovery is based on the SSA

(USFWS 2018). Currently, there are 17 populations that are in medium to high condition however in 30 to 50 years (i.e., the foreseeable future) resilient populations are significantly reduced without targeted conservation actions, due to development and sea level rise. Recovering 14 medium to highly resilient populations ensures sufficient numbers of stable, increasing populations (ensures sufficient spread across known range and reduces threats) such that the species no longer warrants listing under the Act when combined with the other Criteria. This criterion addresses Factors A, C, and E.

Criterion 2: This criterion addresses the species' redundancy and representation by ensuring multiple populations are distributed across the species' range and within representative units (ecological and genetic). Multiple (2 or more) populations in the 4 geographic representative regions will ensure that the species' ecological and genetic diversity (representation) is maintained across the historical distribution of the species. Populations in the Panhandle region will need to be repatriated via captive propagation and reintroduction efforts. Because source populations for the repatriated Panhandle populations are from other representative units, populations in this region primarily support redundancy of populations across a broader geographic range within the species' historical distribution. At least 2 populations within each region provide the minimum threshold for redundancy within each representative unit. The CFAs (summarized here from the SSA (USFWS 2018)) were chosen because they contain potentially viable populations or because they will contribute to the connectivity of occupied eastern indigo snake habitat and thus increase dispersal potential and improve opportunities for new population establishment. The primary factors used in delineating boundaries of CFAs (inclusive of the same factors that support medium to high resiliency of individual populations) were presence of: (1) intact, unfragmented (by major roads or river systems), naturally-functioning habitat representative of that area's physiographic province with low habitat fragmentation; (2) areas that contain multiple, large acreages (greater than 2,500 ac (1,000 ha)) of conservation land such as public lands or property with conservation easements capable of undergoing adequate management (e.g., prescribed fire, wildlife corridors); and (3) diverse natural habitat types (e.g., scrub, sandhills, riverine, sand ridges, etc.). The rationale for requiring 12 of the 16 CFAs provides flexibility should some (up to 4) CFAs not support viable populations in the foreseeable future due to challenges with conservation efforts (e.g., land protection and management) or unavoidable impacts (e.g., sea level rise and invasive species). Requiring viable populations within 12 CFAs would ensure that populations are widely distributed across the historical range and within the 4 representative units, supporting genetic and ecological integrity of the species. This criterion addresses Factors A, C, and E.

Criterion 3: This criterion supports resiliency, representation and redundancy. Connectivity among populations ensures the species can withstand stochastic and catastrophic events. For larger populations this would maintain genetic diversity and for smaller populations would reduce risk of extirpation (i.e., genetic rescue and recolonization after extirpation). The North Florida, Peninsular Florida, and Southeast Georgia regions represent the current ecological and genetic diversity of the species; therefore maintaining connectivity among populations in these regions is essential for long-term viability. Populations in the Panhandle region will need to be repatriated using source populations from the other regions. Panhandle populations provide important redundancy for the species but are geographically disconnected from the other regions.

Populations in the panhandle will need to be of sufficient size to maintain stable or increasing populations over time. This criterion addresses Factors A, B, C, and E.

Criterion 4: Abatement of threats to the eastern indigo snake will allow populations to become stable and contribute to the recovery of the species into the foreseeable future. Management plans will need to require maintenance, enhancement, and monitoring procedures so that threats are alleviated. This criterion addresses Factors A, C, D and E.

Actions Needed: The recovery actions identified below (Table 1) are those that based on the best available science, we believe are necessary to bring about the recovery of the eastern indigo snake.

Table 1. Recovery actions with Estimated Cost and Priority Number[1].

Recovery Action	**Estimated Cost**	**Priority Number**
1. Protect existing eastern indigo snake populations via land protection and using appropriate habitat management and conservation techniques identified in site-specific management plans.	$1,770,000	1
2. Monitor known eastern indigo snake populations and the habitat that supports them.	$1,650,000	1
3. Expand knowledge of basic ecology and demography of eastern indigo snakes.	$1,550,000	1
4. Repatriate populations within habitat historically occupied by eastern indigo snakes where feasible.	$3,520,000	2
5. Develop range-wide habitat suitability models incorporating pertinent results from a Population Viability Analysis (PVA) analysis.	$175,000	2
6. Establish a centralized range-wide Geographic Information System (GIS) database for data storage, analyses, and recovery review.	$180,000	2
7. Develop and distribute public educational materials and outreach programs supporting eastern indigo snake recovery.	$150,000	3
8. Coordinate all recovery activities, evaluate success, and revise recovery plan as appropriate	Costs will be absorbed under existing State and Federal programs	3
Total Estimated Cost: $8,995,000		

[1] Recovery actions are assigned numerical priorities to highlight the relative contribution they may make toward species recovery (48 FR 43098):

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly.

Priority 2 – An action that must be taken to prevent a significant decline in species population/habitat quality or some other significant negative impact short of extinction.

Priority 3 – All other actions necessary to provide for full recovery of the species.

Estimated Cost of Recovery: The cost to recover and ultimately delist the eastern indigo snake will total approximately $8,995,000 (Table 1). Some costs for recovery actions are not determinable at this time (e.g., land protection); therefore, the total cost for recovery will be higher than this estimate.

Date of Recovery*:* If all actions are fully funded and implemented, including full cooperation of all partners needed to achieve recovery, delisting could be met by 2048. Repatriation of populations is likely to take at least 10 years to be achieved. Additionally, recovery requires that eastern indigo snake populations be stable or increasing into the foreseeable future. Therefore, a 20-year monitoring period is recommended to cover multiple generations (4 to 6 generations) to provide a reliable estimate of population change.

Literature cited:

Collins, J.T. 1991. Viewpoint: A new taxonomic arrangement for some North American amphibians and reptiles. Herpetological Review 22:42-43.

Crother, B. I. (ed.). 2012. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. Society for the Study of Amphibians and Reptiles, Herpetological Circular No. 39. Shoreview, Minnesota. Iv + 92 pp.

Enge, K.M., D. J. Stevenson, M.J. Elliott, and J.M. Bauder. 2013. The historical and current distribution of the eastern indigo snake *(Drymarchon couperi)*. Herpetological Conservation and Biology 8:288−307.

Smith, D.R., Allan, N. L., McGowan, C. P., Szymanski, J. A., Oetker, S. R., and Bell, H. M. 2018. Development of a Species Status Assessment Process for Decision under the U.S. Endangered Species Act. Journal of Fish and Wildlife Management. Volume 9 (1): 1-19.

U.S. Fish and Wildlife Service (USFWS). 1978. Endangered and Threatened Wildlife and Plants. Listing of the eastern indigo snake as a threatened species. Federal Register 43:4026.

U.S. Fish and Wildlife Service (USFWS). 1982. Eastern indigo snake recovery plan. Atlanta, GA. 23 pp.

U.S. Fish and Wildlife Service (USFWS). 2008. Eastern indigo snake *Drymarchon couperi*. 5-Year Review: Summary and Evaluation. 30 pp.

U.S. Fish and Wildlife Service (USFWS). 2018. Species status assessment report for the eastern indigo snake (*Drymarchon couperi*). Version 1.0 November, 2018. Atlanta, GA.

Wuster, W., J.L. Yrausquin, and A. Mijares-Urrutia. 2001. A new species of indigo snake from north-western Venezuela (Serpentes: Colubridae: *Drymarchon*). Herpetological Journal 11:157-165.