

# Visual Encounter Survey Protocol for the Eastern Indigo Snake (*Drymarchon couperi*) in Georgia U.S. Fish and Wildlife Service

Version 2 November 2024

NOTE: Check U.S. Fish and Wildlife Service Georgia Ecological Services website for protocol version updates: <https://www.fws.gov/media/visual-encounter-survey-protocol-eastern-indigo-snake-drymarchon-couperi-georgia>. A summary of version updates is provided in Appendix 1.

## **Purpose and Scope**

The purpose of this Eastern indigo snake (*Drymarchon couperi*) survey protocol is to provide guidance to project proponents and improve the review of permit applications and proposed land disturbance activities for potential effects on the federally threatened Eastern indigo snake, in accordance with Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.). The survey protocol is applicable to the U.S. Fish and Wildlife Service (USFWS) Georgia Ecological Services Field Office (GAES) geographic area of responsibility, which includes the entire range of the Eastern indigo snake in Georgia.

Use of this visual encounter survey protocol (Protocol) is recommended for project proponents or their designees to evaluate the possible presence of the Eastern indigo snake at a proposed project site. The results of the Protocol can be used by Federal and non-Federal entities in evaluating permit applications and proposed activities for compliance with the ESA. The GAES encourages the use of this Protocol by any project proponent, and Federal and non-Federal permitting entities in situations where habitats that may support Eastern indigo snakes may be affected. If Eastern indigo snakes are determined to be more likely than not to occur based on available data, surveys to document presence may not be necessary. Further, this Protocol may not be best suited for some project types (e.g., linear projects). *If any other survey method is proposed for the Eastern indigo snake the USFWS should be consulted.*

**This Protocol does NOT authorize the handling or collection of Eastern indigo snakes. Therefore, the USFWS does not intend to issue Section 10 (a)(1) (A) scientific enhancement and collecting permits for the capture, handling, or relocating of Eastern indigo snakes in conjunction with the implementation of this Protocol.**

If implemented appropriately, this Protocol is not expected to pose a risk of mortality, injury or harassment to Eastern indigo snakes; therefore, a federal permit is not required. However, a **Georgia Department of Natural Resources (GADNR) scientific collection permit is required to scope Gopher tortoise (*Gopherus polyphemus*) burrows.** Additional information on applying for state permits can be found at <https://gadnrle.org/special-permits>.

This Protocol explains visual encounter survey methodology that includes pedestrian transect surveys and inspection of above-ground and underground refugia commonly used by Eastern

indigo snakes. An Eastern indigo snake survey conducted according to this Protocol is an attempt to determine presence of the species within the project boundary (or area of interest) of a proposed project site. Determining Eastern indigo snake(s) presence during the project's planning stage provides project proponents an early opportunity to develop avoidance, minimization and/or compensation measures and to consult with the USFWS. Failure to detect Eastern indigo snakes does not confirm their absence. However, even negative survey findings will be informative for coordination and consultation with the USFWS. This Protocol represents the best available and recommended techniques for surveying for the Eastern indigo snake in a manner which does not include handling, trapping, or potentially injuring the snake. This Protocol will work best in xeric upland habitats occupied by Gopher tortoises.

We recommend this Protocol as a measure to help the USFWS (or lead federal agency) obtain necessary information to make informed regulatory decisions relative to the recovery and management of this federally threatened species. It is the intent of the USFWS to recommend this protocol until such a time that better survey methodologies are available for project proponents.

**Habitat** (excerpt from USFWS 2019)

The Eastern indigo snake occurs in a wide range of upland and lowland habitat types throughout the species' range, including mesic pine flatwoods, scrubby flatwoods, longleaf pine sandhills, oak scrub, sand pine scrub, dry prairie, tropical hardwood hammocks, freshwater and saltwater marshes and swamps, coastal dunes, and some human-altered habitats (USFWS 1982, Moler 1992, Stevenson et al. 2008, Hyslop et al. 2009, Enge et al. 2013). They may move seasonally between upland and lowland habitats, especially in northern portions of their range (*i.e.*, Georgia and northern Florida). However, across its range, Eastern indigo snakes exhibit a strong preference year-round for upland habitat types (Hyslop et al. 2014, Bauder et al. 2018).

Throughout their range, Eastern indigo snakes may also use underground shelter sites for shelter, breeding, feeding, and nesting (Speake et al. 1978, Stevenson et al. 2003, Hyslop et al. 2009, Stevenson et al. 2010). In summer, Eastern indigo snakes use burrows as protection from heat and dry conditions since they have been shown to be susceptible to desiccation (Bogert and Cowles 1947). Reliance on xeric sandhill habitats throughout the northern portion of the Eastern indigo snake's range in Georgia and northern Florida is due to the dependence on Gopher tortoise burrows for shelter during winter (Stevenson et al. 2003 and 2009, Hyslop et al. 2009, Bauder et al. 2017). Additionally, these sandhill habitats also serve as breeding habitat during the autumn and winter months, October through February. Few nest sites have been observed, but they have been found in open-canopied sandhill habitats associated with Gopher tortoise burrows (Stevenson et al. 2021). Hyslop (2009) found females using upland sandhills in early spring, after males had mostly dispersed to lowland habitats, specifically using a higher proportion of abandoned Gopher tortoise burrows during what was assumed to be just prior to nesting. Eastern indigo snakes use active, inactive, and abandoned Gopher tortoise burrows and are more likely to

occupy sandhills that have high numbers of Gopher tortoise burrows. (Bauder et al. 2017). In Georgia, Eastern indigo snakes have been documented to have strong winter site fidelity, returning to the same sandhills and sometimes the same burrows over multiple winters (Stevenson et al. 2003, Hyslop et al. 2007, Hyslop et al. 2009). Eastern indigo snakes may also take shelter in hollowed root channels, hollow logs, stump holes, or the burrows of rodents, or armadillos (*Dasypus novemcinctus*) (Lawler 1977, Moler 1985, Layne and Steiner 1996, Hyslop 2007, Hyslop et al. 2009).

### **Survey Protocol**

This Protocol is intended to locate Eastern indigo snakes in xeric upland habitats occupied by Gopher tortoises during winter months.

### ***Survey Area***

- *The survey area (or area of interest) should include, at minimum, all potential Gopher tortoise habitat within the project boundary. However, surveying adjacent habitat (including areas outside of the limits of disturbance for the project), if possible, may provide a more comprehensive evaluation.*
- We recommend contacting the GADNR for guidance on assessing areas for potential Gopher tortoise habitat.
- Desktop review for potential Gopher tortoise habitat can be reviewed using the habitat suitability maps and resources found at the United States Geological Survey's [ScienceBase Catalog](#). A list of soils where Gopher tortoises may be found in Table 1 below. **NOTE:** *The soils list may not include all soil types where Gopher tortoises may be found. Desktop resources for identifying and mapping Gopher tortoise habitat may help inform fieldwork but are limited in scale and accuracy. Further, Gopher tortoises are known to use areas that may be considered marginal habitat. Therefore, site visits to verify presence and extent of potential Gopher tortoise habitat is strongly recommended. The entire project area should be ground-truthed for presence of Gopher tortoises and their burrows. All areas with evidence of Gopher tortoises should be included in the survey area.*
- On site ground-truthing of the entire project area to confirm and map full extent of Gopher tortoise habitat is strongly recommended.
- The survey area should include any underground refugia commonly used by the Eastern indigo snake such as active, inactive, and abandoned burrows excavated by Gopher tortoises or other species (e.g., armadillos, unknown burrows), natural ground holes (e.g., wood, rock, naturally forming on slopes), and hollows at the base of trees. Flooded burrows should also be included. Above-ground refugia include shrub thickets, thick grasses, and saw palmetto (*Serenoa repens*) clumps.

### ***Survey Period***

- In the northern part of the species' range (Georgia and northern Florida), Eastern indigo snake home ranges vary extensively on a seasonal basis ranging from less than 25 acres (10 hectares) in the winter up to 3,700 acres (1,500 hectares) in spring through autumn when more diverse habitats are occupied (USFWS 2019 and references therein). Thus, it is relevant for surveyors to note that Eastern indigo snakes are more likely to be detected during winter month surveys when the snakes' ranges are more condensed, rather than during the warm seasons when their movement activity and ranges are increased.
- Eastern indigo snake surveys should be conducted November 1st through March 31st when snakes are exhibiting regular use of Gopher tortoise burrows and other refugia and their daily movements, on average, are limited (Stevenson et al. 2003; Bauder et al. 2017). The best survey months are December through February due to annual variation in fall and spring weather patterns.
- Eastern indigo snake surveys should be conducted when temperatures are between 50°F (10°C) and 70°F (21.1°C) (Bauder et al. 2017, Stevenson, pers. obs.), and not raining.

### ***Methodology***

The Protocol's complete survey methodology consists of three components:

1. Pedestrian surveys along transects to locate snakes on the surface.
2. Inspection of above-ground refugia.
3. Inspection of underground refugia.

### **General Survey Method**

- A minimum of five (5) complete surveys conducted when daytime temperatures are between 50°F and 70°F and not raining, including a minimum of three (3) nonconsecutive survey days. Surveys can be conducted by one or multiple surveyors. *A complete survey is a survey of the entire survey area, which includes transects and inspection of above- and underground refugia.* Therefore, the entire survey area needs to be completely surveyed a minimum of **5 times which may require more than 5 days** for larger survey areas and or area containing many burrows/refugia. Should any Eastern indigo snakes be detected, surveys may discontinue since presence has been established. However, completed surveys may help inform relative abundance estimates.
- Since Eastern indigo snake activity can vary among years and detection of individuals is challenging, annual winter surveys until the project "breaks ground" are preferred on projects containing moderate to high-quality habitat.
- While Eastern indigo snakes are commonly associated with Gopher tortoises, the relationship is not exclusive; surveys within all potentially suitable winter habitat (uplands) should be conducted before it is determined that the species is not detected in the area of interest.

- Surveys should be conducted throughout all previously identified potentially suitable habitat (*i.e.*, the survey area) within the project boundary. However, surveying adjacent habitat (including areas outside of the limits of disturbance for the project), if possible, may provide a more comprehensive evaluation.
- Surveys should be facilitated by using a Global Positioning System (GPS) unit to track the survey paths and ensure sufficient coverage of the habitat.
- The surveyor should always carry a camera to photo-document any snake sightings and use a GPS unit to document the location.
- Locating Eastern indigo snakes involves walking along transects previously established on a map or graphic representation of the project parcel. These transects should be appropriately spaced (see below) to ensure that all areas inside of the survey area are inspected as described below.

#### Transects

- Visual encounter surveys should be conducted along transects to increase the detectability of potential above and underground refugia and the chance of observing a snake that is active or basking on the surface.
- The transects should be appropriately spaced to ensure 100 percent of the survey area is inspected. Transects may be conducted by more than one person and should be conducted at a maximum width of about 30 feet (9 meters). If the vegetation density is thicker, transect width should be narrower. The goal is to be able to fully scan the ground surface between the adjacent transects to increase detection of snakes on the surface and **all** potential underground refugia (*i.e.*, burrows).

#### Inspection of Eastern Indigo Snake Above-ground Refugia

- Above-ground refugia in the survey area should be inspected **in a non-destructive manner**.
- Above-ground refugia include shrubs, brush piles, trash piles, abandoned structures, rock piles, and other similar formations likely to serve as Eastern indigo snake refugia.
- Inspection of above-ground refugia includes inspecting trash piles and lifting and moving parts of structures on the ground (large cover objects such as plywood, tin, or car pieces) to locate Eastern indigo snakes in hiding.
- After inspections, refugia should be restored to a condition (placement and object integrity) like it was found. Note: if a snake is observed, do NOT place objects on top of the snake.
- Inspection of above-ground refugia may be conducted at the same time as transects.

#### Inspection of Eastern Indigo Snake Underground Refugia

- Inspection of underground refugia involves the visual inspection of Gopher tortoise burrows, burrows excavated by other species (*e.g.*, armadillos), and other holes in the ground (unknown burrows). Scoping a burrow or refugia with a camera can help with detection, but

camera scoping does not always detect Eastern indigo snakes when they are present. NOTE: **Scoping of a Gopher tortoise burrow requires a permit from the State of Georgia.**

- Caution should be applied when placing hands, head, or feet on the ground near the entrance to Gopher tortoise burrows as Eastern diamondback rattlesnakes (*Crotalus adamanteus*) are frequent commensals in the burrows. Pigmy rattlesnakes (*Sistrurus miliarius*), Fire ants (*Solenopsis invicta*), Black widow spiders (*Latrodectus mactans*), and various wasp and stinging insect species may also be present.
- Inspection of underground refugia (burrows) may be conducted at the same time as transects.
- Marking burrows with flagging and/or GPS coordinates prior to conducting Eastern indigo snake burrow inspections may facilitate future survey efforts. *However, if inspection of previously marked burrows occurs three (3) or more months after marking, searches for new burrows may be necessary to ensure all (100 percent of) burrows are identified and inspected.*
- Surveyors shall approach refugia slowly so as not to encourage snakes in the area to flee prior to identification being made.
- More intensive searches should be conducted within a 30-foot (9-meter) radius of refugium entrance (Gopher tortoise burrows and other burrows) for snakes, shed skins, and tracks.
- Eastern indigo snake shed skins are commonly found on the ground near Gopher tortoise burrows, especially during the winter months (See: **Image 1.**). The shed skins may persist for weeks to months. Surveyors should look for intact or partial sheds close to downed logs, in saw palmetto clumps, and on the ground within 30-feet (9-meters) of burrows. Shed skins can be confused easily with several other species of sympatric snake species; therefore, consulting an expert to confirm identification is recommended. A GPS point should be recorded, and high-quality photographs should be submitted to USFWS, GADNR, or another Eastern indigo snake species expert for identification. Photographs for shed skins should include: 1) the overall skin in situ, 2) clear close-up of dorsal scales, and 3) clear close-up of ventral scales. Details of the communication and identification should be included in the survey report. Shed skins should not be removed from the site and should left in place where it was discovered.
- Since juvenile Gopher tortoises tend to dig burrows under vegetation around the margins of open areas (e.g., wiregrass clumps, palmetto fronds, cactus—See: **Image 2.**), using a snake hook or stick to lift vegetation gently, increases detectability of shed skins under vegetation.
- A mirror or flashlight can be used to illuminate the upper portion of a burrow. Thoroughly scan the ground surface before kneeling down or placing your hands on the ground. Do not extend head or hands into burrows.
- Monitor for snake slides (tracks) that may be evident in loose sand at the openings of burrows (See: **Image 3.**). Tracks can also be observed in burrows as snakes often push sand into mounds when exiting the burrow.

- **All** Gopher tortoise burrows (active, inactive, and abandoned) and other burrows that are greater than about 2 feet (0.5 meters) in length should be scoped. Scoping may reveal Eastern indigo snakes and other commensal species of interest (See: **Image 4.**). The burrow can be probed with a stick to determine if it is of a length that warrants scoping with a camera.
- Surveyors should take caution as to not stand on top of burrows (ground above the burrow and behind the opening) during scoping procedures due to risk of collapse. Therefore, burrows should be scoped with the surveyor positioned on the apron/burrow opening.
- Burrow scopes can be different lengths and include camera sizes suited for both juvenile and adult burrows.
- The burrow scope should be flexible so that it can be maneuvered until the back of the burrow is reached, or the scope cannot go farther (*e.g.*, if the burrow takes a sharp turn that cannot be negotiated) (See: **Image 5**). Contact GADNR for additional information regarding proper burrow scopes.
- Care should be taken while scoping to examine the entire width of the burrow chamber to not miss side channels or other places where Eastern indigo snakes might be hiding.

### **Survey Reports**

Reports documenting the implementation and results using this protocol should include:

- Dates and weather conditions for each complete survey.
- Map of survey area, location of transects, and underground refugia (burrows).
- Number of burrows scoped.
- Number of Gopher tortoises observed.
- Any evidence of Eastern indigo snakes or other rare/unusual species.

### **Equipment Disinfection Protocol**

Due to a concern regarding the transmission of highly contagious diseases, such as upper respiratory tract disease (URTD) and snake fungal disease (SFD), all organic debris and soils shall be wiped from the burrow camera and scopes shall be disinfected between sites (see Bletz et al. 2023). A 1:10 (10%) dilution of 5% household bleach is recommended for disinfection of URTD (ADCNR 2017, GADNR 2023) and has also been shown effective against SFD (Rzadkowska et al. 2016). The disinfectant should remain in contact with the equipment for a minimum of 2 minutes. Solutions should be stored in dark bins or in opaque bottles and should be made fresh regularly (*e.g.*, weekly, depending on storage conditions). Bleach should be purchased in small bottles or dispensed into small bottles to minimize deterioration from opening/closing the lid (ADCNR 2017).

**Table 1. List of Suitable Gopher Tortoise Soils in Georgia**

Note: Gopher tortoises may burrow in soil types not included on this list

Best Soils	Moderate Soils	Moderate Soils Continued	Marginal Soils
Americus	Ailey	Lowndes	Agricola
Benevolence	Albany	Lynchburg	Alcovy
Blanton	Allen	Madison	Apison
Bonifay	Alluvial Land	Mandarin	Ashe
Bonneau	Altavista	Marlboro	Ashlar
Buncombe	Appling	Masada	Burton
Cainhoy	Augusta	Maxton	Chenneby
Centenary	Barth	Meldrim	Chestnut
Echaw	Bigbee	Minvale	Cowee
Edneyville	Bodine	Nankin	Docena
Eustis	Braswell	Nauvoo	Emory
Foxworth	Buckhead	Nella	Etowah
Fripp	Cahaba	Norfolk	Eulonia
Fuquay	Carnegie	Olustee	French
Galestone	Chandler	Ona Variant	Fruithurst
Kershaw	Cheoah	Ousley	Fullerton
Kureb	Chiple	Pacolet	Hartsells
Lakeland	Chisolm	Pettyjon	Helena
Lakewood	Clarendon	Porters	Junaluska
Lucknow	Clifton	Pottsburg	Lily
Lucy	Colvard	Ridgewood	Linker
Molena	Congree	Rigdon	Louisa
Norfolk	Cowarts	Rion	Maymead
Ochlockonee	Dekalb	Riverview	Ocilla
Orangeburg	Dillard	Rome	Pageland
Palm Beach	Dothan	Ruston	Pigeonroost
Paola Variant	Edgemont	Saunook	Poindexter
Rains	Ennis	Seneca	Rawlings
Red Bay	Etowah	Sequatchie	Salacoa
Ruston	Euharlee	Shack	Sipsey
Starr	Eunola	Shady	Steadman
Tifton	Evard	Shellbluff	Sweetapple
Toccoa	Faceville	Shelocta	Talladega
Troup	Fannin	Starr	Wateree
Uchee	Flomaton	Staser	Wax
Valdosta	Floral	State	
Wagram	Fuquay	Stilson	
	Georgeville	Subligna	
	Gilead	Suches	
	Goldsboro	Suffolk	
	Grover	Tate	
	Habersham	Thurmont	
	Halewood	Tidings	
	Hiwassee	Towaliga	
	Holston	Transylvania	
	Hurricane	Tusquitee	
	Irvington	Vaocluse	
	Luka	Watauga	
	Izagora	Waynesboro	
	Johns	Wedowee	
	Klej	Whitwell	
	Leefield	Wickham	
	Lily	Wicksburg	
	Louisburg		



### **Appendix 1. Summary of Version Updates**

The changes from version 1.0 (June 2023) and version 1.1 (October 2024) are minor and do not change the overall design of the survey protocol. The following edits were made:

1. A link to website location of current protocol for easy reference to ensure access to most recent version of this protocol.
2. Clarified if Eastern indigo snakes are more likely than not to occur on a project site based on available data, surveys to document presence may not be necessary.
3. Clarified and defined “survey area” and provided resources and guidance for delineating the survey area.
4. Clarified the entire project area should be ground-truthed for evidence of Gopher tortoises and their burrows to determine the survey area.
5. Clarified each of the 5 surveys should include pedestrian surveys along transects, and inspection of above and underground refugia.
6. Clarified transects should cover all (100 percent) of the survey area.
7. Clarified marking of underground refugia (burrows) may occur prior to inspection of burrows for Eastern indigo snakes but searches for new burrows may be needed if marking occurred three (3) or more months prior to survey for burrows.
8. Guidance on information to provide in survey reports.

## Images

Image 1. Eastern indigo snake shed skin Photo: Dirk Stevenson



Image 2. A hatchling Gopher tortoise burrow under a cactus. Photo: Lance Paden



Image 3. Fresh Eastern indigo snake slide (track) in loose sand at burrow opening. Photo: USFWS. Note: Snake tracks may be difficult to see or not evident for occupied burrows.



Image 4. Eastern indigo snake as seen on a burrow camera scope. Photo: Dirk Stevenson



Image 5. Example of adult Gopher tortoise burrow camera system.



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