State of Georgia Protected Species Habitat & Presence/Absence Survey Methodologies Manual

Prepared by and for the Georgia Department of Transportation

Version: 3.0

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Rationale

In compliance with the Endangered Species Act (ESA), the Georgia Department of Transportation (GDOT) must identify the presence of proposed or listed threatened and endangered species and their habitat, as well as evaluate impacts to these resources. GDOT also considers potential impacts to habitat and species that are candidates for listing under the ESA and species which are protected under the Georgia Endangered Wildlife Act and the Georgia Wildflower Preservation Act.

A protected species survey (Phase 2 survey), when conducted according to these guidelines, serves to determine presence or probable absence of the species. These surveys do not provide sufficient data to determine population size or structure. Following the methods described within this manual will standardize survey procedures. Although detection of the target species confirms their presence, failure to detect individuals does not confirm their absence from the habitat. As additional information becomes available regarding survey techniques and effectiveness, these survey guidelines may be updated and revised.

Survey Standard Operating Procedures

The following applies to all federally and state protected species:

Prior to conducting any surveys, the surveyor shall determine if the Project area is in proximity to any documented element occurrences (EOs)—both recent and historical—of protected species by requesting these data in early coordination from the Georgia Department of Natural Resources Wildlife Conservation Section (GADNR) via the Georgia Natural Archeological Historical GIS Ecology Review and Survey Module (GNAHRGIS) website, the U.S. Fish and Wildlife Service (USFWS) via the Information for Planning and Consultation (IPaC) website, and the National Oceanic and Atmospheric Administration Fisheries office (NOAA Fisheries) via the NOAA ESA Section 7 Mapper. Habitat assessment surveys (Phase 1 surveys) shall be conducted for all state protected species returned on the GNAHRGIS list and all federally protected species returned on the IPaC and ESA Section 7 Mapper lists. Prior to conducting the general ecology resource survey, **which includes all applicable Phase 1 surveys[1]**, the surveyor shall consult the appropriate species detail sheets on the GADNR Georgia Biodiversity Portal in order to determine identification characteristics, similar species and how to decipher their differences, and any associate species that may help determine suitable habitat presence. The use of other resources such as NatureServe Explorer, USDA-NRCS Plants database, herbaria, aerial imagery, topographical maps, and soil maps is encouraged as well. The surveyor shall then consult the appropriate, species-specific Phase 1 methodologies found within this manual.

*Any survey conducted under a USFWS Section 10(a)(1)(A) permit is obligated to comply with any reporting and advanced notification requirements under that permit **in addition to** the GDOT SOP and reporting requirements outlined below. It should also be noted that any survey (Phase 1 or Phase 2) on National Wildlife Refuge property requires a Special Use Permit.*

If the Phase 1 survey determines that no suitable habitat is present within the Project area, no Phase 2 survey shall be conducted.

If the Phase 1 survey determines the presence of suitable habitat within the Project area for any species which *does not* have a Phase 2 survey methodology associated, species presence should be assumed, and appropriate protective measures implemented via special provisions.

If the Phase 1 survey determines the presence of suitable habitat within the Project area for any species which also has a Phase 2 survey methodology associated and the Project could directly or indirectly impact the habitat, then:

- Conduct a Phase 2 survey to determine presence/probable absence of the target species[2]. Regardless of the outcome of the survey (i.e. negative or positive species detection), the appropriate species Survey Data Reporting Form(s) included within this manual and GADNR's Survey 123 EO Reporting Form shall be completed during this effort. Access guidance for the GADNR EO Reporting Form can be found in **Appendix A**.
    - If species presence **is** detected:
        - GPS points/polygons shall be collected where individuals were detected.
        - Photographs of the individuals and habitat shall be collected.
- Implement appropriate protective measures for habitat and/or species via special provisions.

Phase 2 re-surveys shall be conducted as defined in the species-specific protocols for all projects with active schedules per **Figure 1.** shown below[3-5]. This ensures all situations that require re-surveys will have one conducted at a minimum of every 5 years during active schedules. As part of the Phase 2 re-survey, a drive-through or walk-through of the entire project corridor shall be conducted to ensure any new areas of suitable habitat are identified and surveyed.

[1] USFWS and GADNR do not recommend GDOT to conduct Phase 1 or Phase 2 surveys for the following species, as they are considered extirpated from the state: rusty patched bumble bee (*Bombus affinis*), ivory-billed woodpecker (*Campephilus principalis*), American burying beetle (*Nicrophorus americanus*), and Florida panther (*Puma concolor coryi*). If any of these species are returned on Early Coordination, please add the following statement to the introduction paragraph within the federal species section of the report (no individual species tables are required for these species): "Despite being returned in Early Coordination, habitat and species presence and potential impacts were not evaluated for [insert species name], as USFWS considers the species to be extirpated from the state." Similarly, no surveys are required for Kirtland's warbler (*Setophaga kirtlandii*), as it only passes through Georgia during migration and there is currently no data to support what habitat they use during this period. If this species is returned in Early Coordination, please add the following statement in the same location previously described: "Despite being returned in Early Coordination, habitat and species presence and potential impacts were not evaluated for Kirtland's warbler (*Setophaga kirtlandii*), as USFWS currently has no data as to what habitat type supports the species as it passes through Georgia during its migrations." Phase 1 or Phase 2 surveys are also not required for monarch butterfly (*Denaus plexippus*) as all GDOT rights-of-way are presumed to be suitable habitat. Please refer to the latest Ecology Report template for guidance on how to address this species in reports.

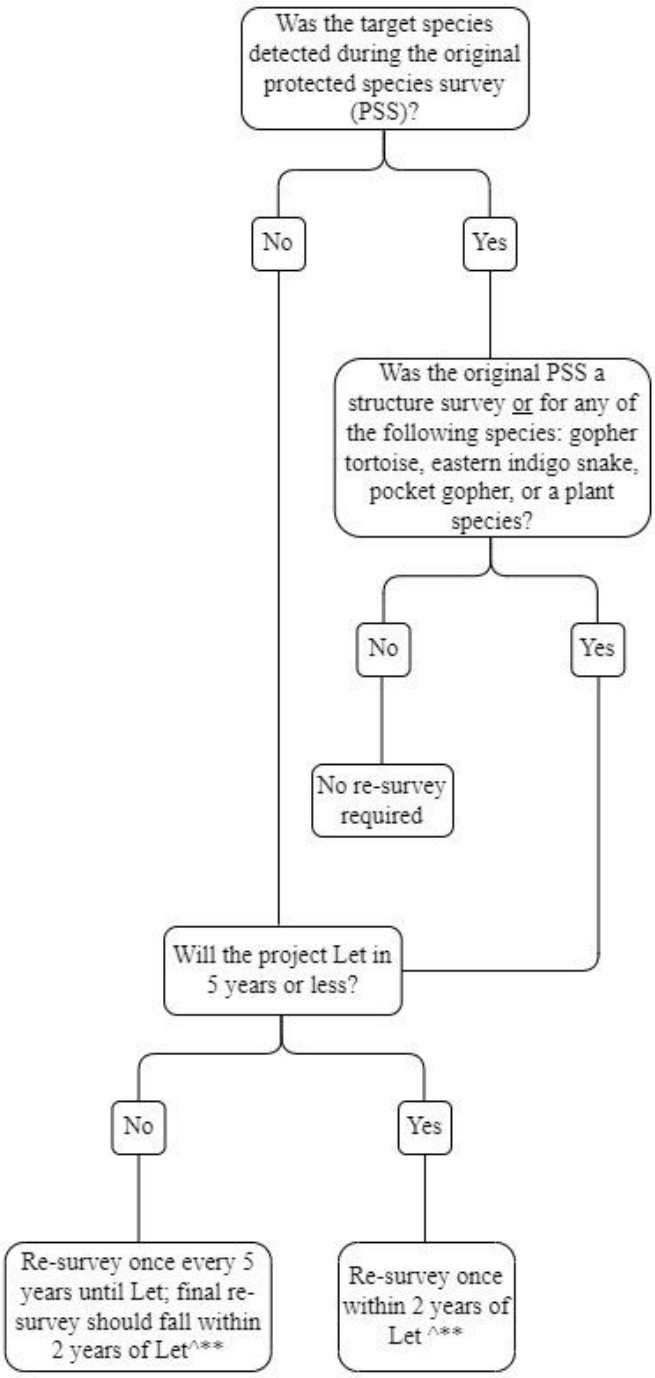
[2] Unless the species-specific methodology instructs that further requirements be met in order to trigger the necessity of a Phase 2 survey (e.g.: red-cockaded woodpecker, gopher tortoise, eastern indigo snake).

[3] For projects that "Let to Shelf", this chart can still be used as a general guidance for re-survey timelines; however, the survey frequency shall be determined by the GDOT Project Ecologist, in coordination with the GDOT Project Manager and applicable Agencies.

[4] This figure does not apply to fish, mussel, crayfish, and snail species. Please refer to the latest version of the GDOT Aquatic Survey Protocol for appropriate re-survey scenarios and timelines for these species.

[5] Structure surveys for bat species **either** need to follow this chart **or** can dictate pre-construction surveys via a Special Provision. Please refer to the latest version of the Collaborative Programmatic Agreement for appropriate re-survey scenarios and timelines for these species.

Figure 1. Phase 2 Re-survey Protocol Flow Chart



^Unless the original survey was within 2 years of let, in which case, no additional survey is needed.

**Scheduling of re-surveys for federally protected species should consider the potential for Formal Section 7 consultation requirements and timelines prior to Let (i.e. leave sufficient time to survey, write a BA, and conduct consultation if newly detected individuals can't be avoided).

Reporting, Timelines, and Deliverables

Reporting & Timelines

1. If species presence is detected during the Phase 2 survey, the GDOT Project Ecologist, GADNR, and USFWS/NOAA Fisheries (as appropriate) shall be notified **within 10 business days** (bd) of the detection.
    a. A complete notification involves 2 steps:
        i. Submittal of GADNR's Survey 123 EO Reporting Form
        ii. Email synopsis of the detection to the above-mentioned parties

    Within 10 bd of receiving the e-mail (or within 10 bd of the survey if conducted in-house), the GDOT Project Ecologist shall enter the survey data into the "EO Tracking" spreadsheet on the Ecology SharePoint.

2. A Protected Species Survey Report (PSSR) shall be delivered in accordance with the Project's P6 Baseline Schedule and shall include the species-specific Survey Data Reporting Form located within the individual methodology, any additional field notes taken, photos of suitable habitat from the day of the Phase 2 Survey, photos of any individuals detected, a Protected Species Habitat Map (specific to the target species only), and, if species presence is detected, a Protected Species Location Map.
    a. The species-specific Survey Data Reporting Form shall note than an approved methodology was used by indicating the version of the Methodologies Manual used. Additionally, it shall note whether a re-survey is required per Figure 1. above; and if so, give an estimate as to when that survey will be conducted based on the current Project schedule.
    b. It should be noted that the PSSR will be transmitted within the Ecology Resource Survey Report or the Assessment of Effects Report, thus those documents should include further supporting information including: early coordination responses, introductory discussion of background research, methods, results, discussion of Phase 2 Survey results, description of the habitat observed within the survey area, why these areas are suitable for supporting the target species, and recommended measures to minimize species impact. If the target species was not found in the survey area, the report shall include a brief discussion of any factors that may contribute to the absence of the target species based on the surveyor's professional expertise.

3. All maps shall be produced in an 8.5" x 11" format based on 7.5 minute USGS quad maps and graphics shall be reproducible black and white format.

4. Reporting for conducted re-surveys that are necessary per Figure 1. above shall adhere to the following protocol:
    a. If the re-survey discovers more individuals than what was detected during the original Phase 2 survey or a change in distribution of individuals, steps 1 – 4 outlined above shall be followed again.

b. A Memo shall be submitted in lieu of a PSSR in instances where equal or fewer individuals are detected and there has been no change in species distribution across the landscape during the re-survey.

   i. The Memo shall include the date the re-survey was conducted and summarize the survey findings in comparison to the previous Phase 2 survey. If fewer EOs are detected, a discussion as to what environmental factors may have negatively impacted the population since the original Phase 2 survey (e.g. draught, commercial development, heavy invasive species colonization, etc.) should be included. If these factors are determined to be permanent in nature (i.e. conditions are not likely to return to their former state), an argument can be made for why further surveys would not be necessary if the Project schedule would otherwise dictate one, per Figure 1.

   ii. Within 10 bd of receiving the Memo (or within 10 bd of the re-survey if performed in-house), the GDOT Project Ecologist shall enter the latest survey data into the "EO Tracking" spreadsheet on the Ecology SharePoint.

      1. This step is only needed if the original survey detected individuals

Deliverables

1. One full set of copies of all Project field notes and data forms.

2. One clean set of aerial photo survey area layouts, undamaged by field use, with clear labeling and delineation of sightings and occupied or utilized habitat(s) of the target species. Aerial photo Project layouts shall be labeled with landmark positions that indicate habitat and sighting locations in relation to the Project corridor. If plans are available, an 8.5" x 11" copy of each area which contains any impacts shall be provided. GPS point locations shall be labeled on the aerials.

3. The PSSR/Memo shall be included in the ERSR (if Phase 2 survey was completed prior to V1 submittal), AOE, or ADDM and submitted to GDOT Ecology Submittals Inbox (Ecology_submittals@dot.ga.gov) in draft form for comments and corrections, after which, a Final PSSR/Memo shall be submitted to the GDOT Project Ecologist for distribution to the appropriate Agencies.

AMPHIBIANS

Habitat & Species Survey Methodology for Reticulated Flatwoods Salamander & Frosted Flatwoods Salamander (*Ambystoma bishopi* & *Ambystoma cingulatum*)

Survey Techniques

Habitat Survey for Reticulated and Frosted Flatwoods Salamanders (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Broad habitat is defined as open-canopy pine uplands with embedded, seasonally ponded wetlands.
    - All seasonally ponded wetlands identified as suitable habitat shall be classified as either “active habitat” or “inactive habitat” based on whether there is enough water to allow larvae to inhabit the site during the current season.
- Suitable upland, terrestrial habitat for adults meets the following characteristics (Palis, 1996):
    - Topographically flat or slightly rolling
    - Seasonally saturated, poorly drained sandy soils
    - Ideal upland habitat consists of open (widely scattered), mesic longleaf pine (*Pinus palustris*) woodlands maintained by frequent fire with wiregrass-dominated groundcover and little to no mid-story (See: **Image 1.**).
        - Groundcover may also contain low-growing shrubs such as saw palmetto (*Serenoa repens*), gallberry (*Ilex glabra*), and blueberries (*Vaccinium* spp.).

Image 1. Example of upland habitat used during the terrestrial adult/subadult life stages of *A. bishopi* and *A. cingulatum*
Source: https://www.fs.fed.us/pnw/sciencef/scifi152.pdf

- Due to losses in ideal habitat, areas that have been converted to slash pine (*Pinus elliottii*) flatwoods can also be considered suitable habitat, so long as the soil isn’t heavily disturbed by bedding, root-raking, etc.
    - For this same reason, wiregrass isn’t the only groundcover that could be deemed suitable habitat—other similar grass species may serve as a supplemental habitat.

- Suitable depressional wetland habitat for breeding and larvae/juvenile life stages meets the following characteristics:
    - Occur within or immediately adjacent to suitable terrestrial habitat as previously described
    - Occur in areas with 0-2% slopes
    - Isolated from other water bodies via overland flow
    - Ephemeral/seasonal in nature
        - Most completely dry-down annually
        - Standing water in winter through early spring in years with average or surplus rainfall levels
    - Obtain only a small accumulation of organic matter
    - Canopy and mid-story often dominated by pond cypress (*Taxodium distichum* var. *ascendens*), with a smaller component of swamp blackgum (*Nyssa biflora*) and slash pine (See: **Image 2.**)
        - Red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), sweetbay magnolia (*Magnolia virginiana*), and loblolly bay (*Gordonia lasianthus*) saplings may be present as well if fire has been suppressed in the area.

Image 2. Example of wetland habitat used during the terrestrial larval/juvenile life stages of *A. bishopi* and *A. cingulatum*
Source: http://www.sas.usace.army.mil/Portals/61/docs/Regulatory/EDGES/2018-08-16_EDGES_Flatwoods_Salamanders.pdf?ver=2018-08-16-150317-777

        - Most often occurs with the aforementioned species in addition to myrtle-leaved holly (*Ilex myrtifolia*), titi (*Cyrilla racemiflora*), sweet pepperbush (*Clethra alnifolia*), fetterbush (*Lyonia lucida*), and bamboo vine (*Smilax laurifolia*) (Palis, 1996).

- Wetlands often appear marsh-like with groundcover dominated by graminaceous species, including beakrushes (*Rynchospora* spp.), sedges (*Carex* spp.), panic grasses (*Panicum* spp.), witch grasses (*Dichanthelium* spp.), bluestems (*Andropogon* spp.), jointtails (*Coelorachis spp.*), three-awned grasses (*Aristida* spp.), plumegrasses (*Erianthus* spp.), nutrush (*Scleria baldwinii*), hatpins (*Eriocaulon* spp.), and yellow-eyed grasses (*Xyris* spp.) (Palis, 1996 [See: **Images 3.** & **4.**]).
    - In sinkhole ponds, however, herbaceous vegetation can be patchier, often only occurring around the edges.
    - These herbaceous communities within the wetlands are of more significance to the suitability of the habitat than the canopy and mid-story story species within the wetland.

Image 3. Herbaceous cover within suitable wetland habitat
Source: https://www.usgs.gov/science/adaptive-habitat-conservation-flatwoods-salamanders?qt-science_center_objects=0#qt-science_center_objects

- Average water depths less than 24 inches
    - Acreage of the wetland is not a determining factor in suitability; the species have been found in wetlands as small as 0.074 acres (ac) and as large as 31 ac (Palis, 1997b).

- Roadside ditches and borrow pits near natural isolated wetlands with the aforementioned herbaceous communities that are only inundated late winter through spring may be suitable habitat in drought years when there may be more limited fillings of ideal habitats (Palis 1996; Anderson and Williamson 1976).

Image 4. Larval *A. cingulatum* within herbaceous wetland surrounded by upland pine-wiregrass system

- Presence of the following species likely notes the lack of suitable habitat for *A. bishopi* and *A. cingulatum*:
  - Large predatory fish such as bass (*Micopterus spp.*), sunfish (*Lepomis spp.*), and bowfin (*Amia calva*) (Palis, 1997a)
    - It should be noted, however, that smaller fish species such as pygmy and dwarf sunfishes (*Elassoma* spp.), pigmy killifish (*Leptolucania ommata*), least killifish (*Heterandria formosa*), mosquitofish (*Gambusia* spp.), grass pickerel (*Esox americanus vermiculatus*) and redfin pickerel (*E. americanus americanus*) may coexist with *A. bishopi* and *A. cingulatum*.
  - Green treefrog (*Hyla cinerea*)

Reticulated and Frosted Flatwoods Salamanders Species Survey (Phase 2 Survey)

A scientific collector's permit will be required since animals will be captured or handled during this type of survey effort.

Due to the fossorial nature of adult and subadult flatwoods salamanders, Phase 2 surveys are best conducted during the larval stage (See: **Image 5.**). Phase 2 surveys for *A. bishopi* and *A. cingulatum* shall be conducted during late January through April as follows.

Dipnetting (Preferred method)

- Each isolated depressional wetland previously determined to be suitable habitat shall be sampled via walking transect lines throughout the wetland using a 4 millimeter or less mesh

Image 5. Larval *A. bishopi* (it should be noted that larvae are virtually indistinguishable between the two species)

dipnet (See: **Image 6.**), focusing only on portions of the wetland with emergent and/or submerged vegetation.

  - For smaller wetlands (≤0.1 ac), it is preferred that transects are spaced tightly enough that the entirety of the resource's surface area is sampled.
  - For larger wetlands, transect spacing does not need to be a set distance; however, at least 50 transects should be sampled throughout the resource.
  - The dipnet bag should be initially submerged adjacent to the beginning of the first transect to be sampled.
  - The dipnet should be thrusted forward through the emergent and submerged vegetation while the surveyor uses their hand or foot to create quick, sweeping motions in the opposite direction they are moving (i.e. towards the net) in an effort to direct species into the net rather than the net pushing individuals away.

- In deeper, less heavily vegetated wetlands, the dipnet can instead be vigorously swept back-and-forth in a zig-zag pattern through the inundated vegetation (Palis, 1997a).

Funnel Traps (See: **Image 7.**)

- Place traps in water depths ranging from the minimum depth necessary to allow amphibians to swim into the opening of the trap.

Image 6. Suggested dipnet product. Manufactured by Loki Nets—Stock # SH-2D: 16"x18" Monorail bow, D-shape (38cm width, interior dimension of frame), 48" aluminum handle, ace (nylon) netting, knotless; mesh size: 1/8" (4 mm); mesh depth: 18" or 24". (Thomas Floyd, GADNR Biologist)
Source:
https://www.lokinets.com/assets/lokinets_catalog_web_12779169512.pdf

  - Should be no more than 1 meter below surface
- Traps shall be left out overnight when amphibians are most active.
- Time duration that traps are left in the water should be roughly standardized and should range from 12 to 24 hours.

Image 7. Funnel trap
Source: http://www.dnr.sc.gov/fish/devices/minnowtrap.html

- **DISCLAIMER** – Funnel traps can result in mortality if neglected. Trap locations should be well-marked and secured so that traps are not lost. Traps should never be left unchecked for more than 24 hours (Adams et al., 1997). When available, plastic is preferred over metal wire traps to reduce the chance of amphibians rubbing off their skin while trying to escape.
- Regardless of presence/absence determination, the species-specific data form provided with this methodology shall be completed.

Ambystoma bishopi & *Ambystoma cingulatum*
Survey Data Reporting Form

Dipnetting Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Collection Permit #: _____

Species Information

Target species (Circle)**:** Reticulated/Frosted Flatwoods Salamanders Striped Newt Gopher Frog

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Wetland Characteristics

Wetland Name: _____ **Lat:** _____ **Long:** _____

Type: Dome Swamp Sinkhole Pond Depression Marsh Basin Marsh
Flatwoods Pond Sandhill Lake Wet Prairie Borrow Pit Ditch

Hydrology: Permanent Semi-permanent Ephemeral Very ephemeral

Total # of individuals detected: _____

% of basin filled during survey: _____ **% Canopy closure:** _____

Dominant canopy spp.: _____

% Shrub cover: _____

Dominant shrub spp.: _____

Basin vegetation spp.: _____

Basin vegetation density: Extensive Throughout Basin Over Most of Basin Scattered Patches
Around Basin Edges Sparse None

Substrate composition: _____ **Water color/turbidity:** _____

Disturbance/fire history: _____

Other notes: _____

_____

_____

_____

Surrounding Upland Terrestrial Habitat Characteristics

Community type: Sandhill Scrub Xeric Hammock Mesic Hammock Scrubby Flatwood
Mesic Flatwood Dry Prairie Upland Pine Mixed Pine-Hardwood

% Canopy closure: _____

Dominant canopy spp.: _____

% Shrub cover: _____

Dominant shrub spp.: _____

% Ground cover: _____

Dominant ground cover spp.: _____

W**iregrass present?** **Yes** **No** **% Bare sand:** _____

Disturbance/fire history: _____

Other notes: _____

_____

_____

_____

Other Fauna Observed:

Herps: _____

Fish: _____

Crayfish: _____

Other: _____

Habitat & Species Survey Methodology for One-toed Amphiuma (*Amphiuma pholeter*)

Survey Techniques

Habitat Survey for One-toed Amphiuma (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat (AmphibiaWeb, 2018; Hammerson and Jackson, 2004; Jensen, 2009).

- Suitable habitat (See: **Images 1.** & **2.**) for *A. pholeter* is found in areas within:
    - Alluvial swamps
    - Bottomlands and floodplains of small, low gradient, perennial or nearly perennial streams
    - Seepage areas or spring runs
- Suitable micro-habitat for this species consists of:
    - A build-up of deep, organic and liquid muck beds formed from accumulation of decayed hardwood debris
    - Occasionally, refugia in the form of woody or other debris that could provide cover in these areas
- The following threats are the most common to eliminate suitable habitat:
    - High agricultural activity and associated herbicides, pesticides, and fertilizers
    - Drainage and impoundment alterations of stream hydrology which can reduce the amount of suitable habitat available in both seepage areas and muck beds by diverting water away or flooding these areas
    - Siltation from surrounding development which reduces quality of mucky substrates
    - Feral hog and cattle access which may cause increased mortality through predation and incidental injury

Image 1. Suitable muck bed habitat for *A. pholeter*
Photo By: John Jensen, GADNR, Senior Wildlife Biologist

Image 2. Suitable muck bed habitat (red arrow) for *A. pholeter*
Photo By: John Jensen, GADNR, Senior Wildlife Biologist

One-toed Amphiuma Species Survey (Phase 2 Survey)

A scientific collecting permit will be required, as this survey methodology requires capturing and handling of animals.

- Species presence (Phase 2) surveys shall occur between April and September.
- Survey methods for this species consist of the following:
    - Dig/sort through suitable mucky substrate by hand. Due to the low detectability of this species, sorting through as much suitable mucky substrate as possible is key to a valid survey.
        - No tools should be used for digging in order to prevent injury to any individuals located during the survey. This method also allows for tactile detection of *A. pholeter* in the substrate while digging.
    - Manually flip potential refugia such as woody or other debris of all sizes that could provide cover within suitable habitat.
    - All mucky substrate and refugia shall be returned or replaced to as close to its original position and condition as possible when surveys are complete.

Amphiuma pholeter
Survey Data Reporting Form

One-toed Amphiuma (*Amphiuma pholeter*) Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Habitat & Survey Data

Habitat Unit #: _____ **Habitat unit centroid point** (Lat/Long)**:** _____

Habitat type (circle one)**:** Alluvial swamp Bottomland forest/Floodplain Stream seepage/run

Microhabitat (circle all that apply)**:** Muck bed Under woody debris

Total # of individuals detected: _____

Other spp. detected: _____

_____

Other notes: _____

_____

_____

_____

Habitat & Species Survey Methodology for Green Salamander (*Aneides aeneus*) & Pigeon Mountain Salamander (*Plethodon petraeus*)

These species share a Phase 2 survey methodology that follows the individual Phase 1 directions.

Green Salamander (*Aneides aeneus*)

Survey Techniques

Habitat Survey for Green Salamander (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Throughout *A. aeneus* range, the following should be identified as suitable habitat (Jensen et al., 2008):
    - Shaded, moist sandstone and limestone outcrops with abundant cracks and crevices primarily, but not exclusively, on east-facing slopes (See: **Image 1.**)
    - Exposed sandstone, limestone, schists, and granite cliffs
    - Trees within 100 feet of shaded rock outcrops and cliffs

Image 1. Rock outcrop habitat in Walker County
Source:
https://www.flickr.com/photos/chucksutherland/10315329335

Pigeon Mountain Salamander (*Plethodon petraeus*)

Habitat Survey for Pigeon Mountain Salamander (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Throughout *P. petraeus* range, the following should be identified as suitable habitat (Jensen et al., 2002):
    - Sandstone and limestone outcrops with abundant cracks and crevices (See: **Image 1.**)
    - Cave walls (See: **Image 2.**)
    - Exposed sandstone, limestone, schists, and granite cliffs
    - Hardwood forests within 100 feet of above-mentioned sites

Image 2. Petty John's Cave in Walker County
Source: https://home.mycha.us/outdoor-chattanooga/wp-content/uploads/sites/2/2017/08/pettijohns_cave_sm-300x218.jpg

Green Salamander & Pigeon Mountain Salamander Species Survey (Phase 2 Survey)

A scientific collection permit is not required since animals shall not be captured or handled during this type of survey effort.

- Surveys shall occur in July-August or October-November.
    - October-November surveys may be more successful.
    - Warm temperatures during October-November and cool temperatures during July-August are preferable.
    - Surveys may be conducted day or night, though high humidity provides the best conditions.
- Visual encounter surveys aided by flashlight:
    - Look for individuals in all accessible crevices in rock outcroppings and exposed cliffs, with special attention to narrow/tight crevices (See: **Image 3.**).
    - In caves for *P. petraeus*, check along wall surfaces and in crevices within the entrance and twilight zones.
    - Within forested areas within 100 feet of rock outcrops, cliffs, or caves, check the following microhabitats for each species:
        - *A. aeneus*: surfaces of live trees and behind the bark of rotting trees
        - *P. petraeus*: under rocks and logs

Image 3. Visual Survey of Crevices in Rock Outcrop
Source: https://meanderingnewt.wordpress.com/page/2

Aneides aeneus & *Plethodon petraeus*
Survey Data Reporting Form

Green Salamander (*Aneides aeneus*) & Pigeon Mountain Salamander (*Plethodon petraeus*) Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Target Species (Circle)**:** Green Salamander Pigeon Mountain Salamander

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Humidity %: _____

Typical weather conditions during survey: _____

Habitat & Survey Data

Habitat Unit #: _____ **Habitat unit centroid point** (Lat/Long)**:** _____

Habitat type (circle all that apply)**:** Rock outcrop Cave Cliffside Surrounding hardwood forest

Microhabitat (circle all that apply)**:** Rock crevice/crack Under tree bark Exposed rock surface

Tree surface Under log Under rock

Total # of individuals detected: _____

Total # of juveniles detected: _____

Total # of subadult detected: _____

Total # of adults detected: _____

Other salamander spp. detected: _____

Other notes: _____

Habitat Survey Methodology for Eastern Hellbender (*Cryptobranchus alleganiensis alleganiensis*)

Image Source: https://blogs.scientificamerican.com/extinction-countdown/hellbender-head-start-raising-giant-salamanders-in-the-bronx/

Survey Techniques

Habitat Survey for Eastern Hellbender (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Cool streams with swiftly flowing water, rocky bottoms, and minimal sedimentation (See: **Image 1.**)
    - *C. a. alleganiensis* can inhabit smaller streams and creeks but is more strongly associated with streams wider than 5m (16 ft) (Jensen, 1999); however smaller streams should not be discounted if appropriate habitat components are present. In Georgia hellbenders have been found within streams < 1 m wide and with water depths of < 10 cm (Floyd, 2018)
    - Preferred water depths range from 30-60 cm (Jensen et al., 2008)
    - Rocky substrates (particularly deep gravel bottoms) provide the most secure habitat for *C. a. alleganiensis* while it is in its larval stage (Nickerson et al., 2003)

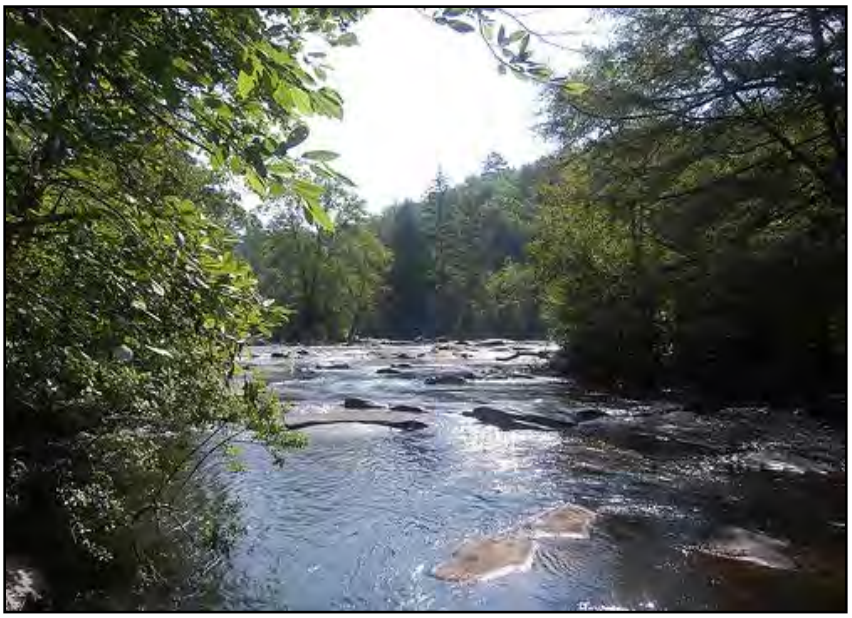


Image 1. Example of suitable stream habitat for *C. a. alleganiensis*
Source: https://georgiainfo.galileo.usg.edu/topics/geography/article/georgia-rivers/toccoa-

- Within suitable streams, *C. a. alleganiensis* utilizes large, flat rocks and logs submerged within swiftly flowing riffles for breeding and shelter (Hillis & Bellis [See: **Image 2.**])
    - Males will excavate depressions under large, flat rocks or holes in bedrock as their dens
        - Dens will have minimal entrances (often just one) facing downstream and away from a direct current

Image 2. Suitable shelter rocks for *C. a. alleganiensis*
Source: http://www.marshall.edu/herp/Salamanders/hellbender/hellbenderphotos.htm

If suitable habitat is identified:

- Photograph the reach, making sure to include pictures of the streambed, suitable shelter areas, and riffle areas.
- Document the stream conditions including bankfull and wetted width, depth, geomorphology, and dominant substrates.

Habitat Survey Methodology for Tennessee Cave Salamander (*Gyrinophilus palleucus*)

Image Source: http://www.louisianaherps.com/other-locations-tennessee/tennessee-cave-salamander-4.html

Survey Techniques

Habitat Survey for Tennessee Cave Salamander

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys can be conducted year round.

- Surveyors assessing habitat suitability for *G. palleucus* should begin by reaching out to the Georgia Speleological Survey (Caves.org) to determine the proximity of the project to any known caves.
- As *G. palleucus* rarely metamorphose and are heavily reliant on subterranean streams throughout their life cycle, habitat surveys for this species should focus on perennial streams flowing through or adjacent the Project area.

Suitable habitat for *G. palleucus* is made up of stream and rimstone pools found in caves, usually associated with streams carrying organic matter underground (Godwin et al., 2009). However, *Miller and Neimiller 2008* indicates that *G. palleucus* may range throughout the interconnected subterranean aquatic system of extreme northwestern Georgia: therefore, the following shall be considered suitable habitat for *G. palleucus*:

- Any perennial stream that flows underground (See: **Image 1.**)
- Any perennial stream that emerges from underground
- Any perennial stream that exits (See: **Image 2.**) or enters (See: **Image 3.**) the mouth of a cave

Pedestrian surveyors should assess the following when stream meeting these criteria are present:

- 100 meters upstream and 300 meters downstream of all perennial streams that flow through the study area
    - As the pollution and siltation of streams connected to subterranean waters is a major threat to this *G. palleucus,* an extended survey area downstream of the project impact area is required to assess habitat possibly impacted by construction.
    - If caves are noted within the Project survey area, GDOT does not advise interior searches to determine stream suitability for *G. palleucus*.
        - A photo shall be taken of the cave entrance, and if a potentially undocumented cave has been discovered, a GPS point shall be taken for reporting.

Image 1. Stream flowing underground in an area of karst geology (Kentucky)
Source: http://www.uky.edu

Image 2. Entrance to Frick's Cave (known location for *G. palleucus*)
Photo By: Alan Cressler

Image 3. Stream flowing into the mouth of a cave (Russel Cave, Alabama)
Photo By: Alan Cressler

Habitat Survey Methodology for Georgia Blind Salamander (*Eurycea wallacei*)

Image Source: http://www.speleobiology.com/niemiller/wp-content/uploads/bsk-pdf-manager/Fenolio_etal_2013e_20.pdf

Survey Techniques

Habitat Survey for Georgia Blind Salamander (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Subterranean inland waters fed by the Floridan Aquifer of the Dougherty Plain. Suitable habitat should be considered present if the following systems are identified within a project area:
    - Subterranean streams and pools in caves, wells, sinkholes, and tunnels
        - Subterranean habitats are typically comprised of karst systems (limestone walls and ceilings; Hammerson, 2004).
        - If caves are noted within the Project survey area, GDOT does not advise interior searches to determine stream suitability for *E. wallacei*.
            - A photo shall be taken of the cave entrance, and if a potentially undocumented cave has been discovered, a GPS point shall be taken for reporting.
        - *E. wallacei* is an entirely aquatic species which prefers to rest on the sediment at the bottom of clear pools (Fenolio et al., 2013 [See: **Image 1.**]).
        - Bat guano in or near the water from cave-roosting colonies provides a nutrient source in these energy scarce environments (Jensen and Floyd, 2009).

Image 1. Preferred silt substrate for *E. wallacei*
Source: https://www.flickr.com/photos/nclarkii/3116477106/

- Presence of the following species is strongly associated with suitable habitat for *E. wallacei* (Jensen et al., 2008):
    - Dougherty Plain Cave Crayfish (*Cambarus cryptodytes*)
    - American Eel (*Anguilla rostrata*)
    - Brown Bullhead (*Ameiurus nebulosus*)

Habitat & Species Survey Methodology for Gopher Frog (*Lithobates capito*)

Image Source: http://herpsofnc.org/carolina-gopher-frog/

Survey Techniques

Habitat Survey for Gopher Frog (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- *L. capito* is restricted to sandy upland pine (*Pinus* sp.) and scrub oak habitats with open canopies and herbaceous ground cover, as well as more poorly drained longleaf pine (*Pinus palustris*) flatwoods (See: **Images 1.** & **2.**).
- *L. capito* is essentially terrestrial during the non-breeding season and extensively uses gopher tortoise (*Gopherus polyphemus)* burrows for retreats.
    - May also may use southeastern pocket gopher (*Geomys pinetis*) burrows, mouse burrows, stump holes, root mounds, and in soggier soils may be found in crayfish burrows.
- *L. capito* breeds during fall, winter, and early spring in temporary, shallow ponds that lack larger predatory fish and have an open canopy with emergent vegetation, including depression marshes, dome swamps, sinkhole ponds, Carolina bays, and borrow pits (See: **Image 3.**).

Image 1. Suitable xeric habitat for *L. capito*
Source: https://www.flickr.com/photos/41460075@N08/4291609372/

Image 2. Suitable mesic habitat for *L. capito*
Source: https://defenders.org/publications/defenders-annual-report-2012.pdf

Image 3. Suitable breeding habitat for *L. capito*
Source: https://www.coastalreview.org/2016/02/13112/

Gopher Frog Species Survey (Phase 2 Survey)

A scientific collector's permit will be required for the methods below that involve capturing and handling individuals during the survey effort.

- Calling surveys shall take place from late January to early April.
    - Surveyors shall be able to decipher the distinctive call of *L. capito* males from other species.
    - Surveys are most successful on a warm night after a rain event.
    - Audial surveys can be conducted in one of the following two ways:
        - In-person visit near a suitable breeding site after sunset
        - Automated recording devices may be set prior to sunset and checked the following day.
- Egg masses can be found from March through May using visual searches.
    - Only someone experienced in egg mass identification shall perform this technique; please contact the GDOT Project Ecologist for prior approval if this method is preferred.
- Tadpoles (See: **Image 4.**) can be found from March through May in suitable breeding habitats using a seine or dipnet
    - Each isolated wetland previously determined to be suitable habitat shall be sampled via walking transect lines throughout the wetland using a 4 millimeter (mm) or less mesh dipnet focusing only on areas with emergent or submerged vegetation.
        - For smaller wetlands (≤0.1 ac), it is preferred that transects are spaced tightly enough that the entirety of the resource's surface area is sampled.
        - For larger wetlands, transect spacing does not need to be a set distance; however, at least 50 transects should be sampled throughout the resource.
        - The dipnet bag should be initially submerged adjacent to the beginning of the first transect to be sampled.
        - The dipnet should be thrusted forward through the submerged vegetation while the surveyor uses their hand or foot to create quick, sweeping motions in the opposite direction they are moving (i.e. towards the net) in an effort to direct species into the net rather than the net pushing individuals away.
            - In deeper, less heavily vegetated wetlands, the dipnet can instead be vigorously swept back-and-forth in a zig-zag pattern through the inundated vegetation (Palis, 1997a).

Image 4. *L. capito* tadpole

- If no suitable breeding habitat is nearby and only terrestrial habitat is present:
    - Gopher tortoise and other species burrows can be scoped for the presence of *L. capito* year round.
    - Funnel traps can be set at the mouths of gopher tortoise burrows; contact the GDOT Project Ecologist if this method is preferred.

Lithobates capito
Survey Data Reporting Form

Dipnetting Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Collection Permit #: _____

Species Information

Target species (Circle)**:** Reticulated/Frosted Flatwoods Salamanders Striped Newt Gopher Frog

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Wetland Characteristics

Wetland Name: _____ **Lat:** _____ **Long:** _____

Type: Dome Swamp Sinkhole Pond Depression Marsh Basin Marsh
Flatwoods Pond Sandhill Lake Wet Prairie Borrow Pit Ditch

Hydrology: Permanent Semi-permanent Ephemeral Very ephemeral

Total # of individuals detected: _____

% of basin filled during survey: _____ **% Canopy closure:** _____

Dominant canopy spp.: _____

% Shrub cover: _____

Dominant shrub spp.: _____

Basin vegetation spp.: _____

Basin vegetation density: Extensive Throughout Basin Over Most of Basin Scattered Patches
Around Basin Edges Sparse None

Substrate composition: _____ **Water color/turbidity:** _____

Disturbance/fire history: _____

Other notes: _____

_____

_____

_____

Surrounding Upland Terrestrial Habitat Characteristics

Community type: Sandhill Scrub Xeric Hammock Mesic Hammock Scrubby Flatwood
Mesic Flatwood Dry Prairie Upland Pine Mixed Pine-Hardwood

% Canopy closure: _____

Dominant canopy spp.: _____

% Shrub cover: _____

Dominant shrub spp.: _____

% Ground cover: _____

Dominant ground cover spp.: _____

W**iregrass present?** **Yes** **No** **% Bare sand:** _____

Disturbance/fire history: _____

Other notes: _____

_____

_____

_____

Other Fauna Observed:

Herps: _____

Fish: _____

Crayfish: _____

Other: _____

Habitat & Species Survey Methodology for Striped Newt (*Notophthalmus perstriatus*)

Image Source: http://www.jacksonvillezoo.org/listingDetails.aspx?listingID=7023&pageID=15577

Survey Techniques

Habitat Survey for Striped Newt (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

A complete habitat survey shall assess all isolated wetland habitats within the survey area, including Carolina bays, limesink ponds, cypress domes, and wet meadows (i.e. ephemeral emergent wetlands).

- Habitat surveys should focus on the aquatic stages of the *N. perstriatus* life cycle, as *N. perstriatus* is extremely difficult to detect in uplands.
- The following broad habitat types, if present within a Project area, shall be surveyed for ephemeral breeding ponds (Means, 2008):
    - Xeric upland communities:
        - Sandhill – Natural habitat that typically consists of a deep sand substrate within a savanna of widely spaced longleaf pine (*Pinus palustris*) and/or turkey oak (*Quercus laevis*) with a wiregrass (*Aristida stricta*) understory.
            - Altered sandhills dominated by a variety of scrub oaks and/or planted pines that retain diverse herbaceous groundcover may still serve as suitable, though more limited, habitat.
    - Mixed hardwood-pine forest (fire-suppressed or planted sandhills)
    - Natural longleaf pine (*Pinus palustris*) forest (See: **Image 1.**)

Image 1. Longleaf pine system
Source: https://www.georgiaencyclopedia.org/articles/geography-environment/longleaf-pine-ecosystem

- Aquatic habitat types used by *N. perstriatus*:
    - Isolated, ephemeral wetlands with abundant emergent and submerged plants are the breeding grounds for *N. perstriatus* (See: **Image 2.**).
        - Other potential wetland habitat types include Carolina bays, seasonal ponds, cypress domes, freshwater marsh/wet prairies, sinkhole wetlands, seasonal marshes, intermittent ponds, pineland depressions, depressional wetlands, and vernal pools (Means, 2008).
        - The wetland must be ponded for at least six months in most years (with the exception of drought years where aquatic features may remain dry all year).
        - Can remain flooded for 2 to 3 years, but must eventually dry up to be considered suitable habitat (Means, 2008)
        - Must be comprised of herbaceous emergent and/or submerged vegetation
            - Maidencane (*Panicum hemitomon*) is often found at breeding ponds (Stevenson et al., 2018).
            - Woody vegetation often, but not always, found in striped newt wetlands include pond cypress (*Taxodium ascendens*), swamp blackgum (*Nyssa biflora*), and myrtle-leaf holly (*Ilex myrtifolia*).

Image 2. Ephemeral emergent wetland
Source: https://www.facebook.com/search/str/coastal+plains+institute/photos-keyword

Striped Newt Species Survey (Phase 2 Survey)

A scientific collector's permit will be required since animals will be captured or handled during this type of survey effort.

- A variety of sampling methods can be used to determine likely presence/absence of *N. perstriatus:*
    - Dipnetting (larval/juvenile/paedomorph adult/"normal" aquatic adult stages [See: **Images 3. – 5.**])
    - Minnow/funnel traps (larval/juvenile/paedomorph adult/"normal" aquatic adult stages)
    - Drift fence and pitfall traps (adults/efts [See: **Images 5.** & **6.**])
- Surveys shall be conducted for aquatic stages from April to June.

Image 3. Larval *N. perstriatus*
Photo By: Dirk J. Stevenson

Image 4. Juvenile *N. perstriatus*
Photo By: Dirk J. Stevenson

Image 5. Adult *N. perstriatus*
Source: https://www.joelsartore.com/keyword/striped-newt/

Image 6. Dipnetting in an ephemeral emergent wetland
Source: https://www.facebook.com/search/str/coastal+plains+institute/photos-keyword

Dipnetting (Preferred method)

- Each wetland previously determined to be suitable habitat shall be sampled via walking transect lines throughout the wetland using a 4 millimeter (mm) or less mesh dipnet (See: **Image 6.**) focusing only on areas with emergent or submerged vegetation.
    - For smaller wetlands (≤0.1 ac), it is preferred that transects are spaced tightly enough that the entirety of the resource's surface area is sampled.

- For larger wetlands, transect spacing does not need to be a set distance; however, at least 50 transects should be sampled throughout the resource.
- The dipnet bag should be initially submerged adjacent to the beginning of the first transect to be sampled.
- The dipnet should be thrusted forward through the submerged vegetation while the surveyor uses their hand or foot to create quick, sweeping motions in the opposite direction they are moving (i.e. towards the net) in an effort to direct species into the net rather than the net pushing individuals away.
    - In deeper, less heavily vegetated wetlands, the dipnet can instead be vigorously swept back-and-forth in a zig-zag pattern through the inundated vegetation (Palis, 1997a).

Funnel Traps (See: **Image 7.**)

- Place traps in water depths ranging from the minimum depth necessary to allow amphibians to swim into the opening of the trap.
    - Should be no more than 1 meter below surface
- Traps shall be left out overnight when amphibians are most active.
- Time duration that traps are left in the water should be roughly standardized and should range from 12 to 24 hours.

Image 7. Funnel trap
Source: http://www.dnr.sc.gov/fish/devices/minnowtrap.html

- **DISCLAIMER** – Funnel traps can result in mortality if neglected. Trap locations should be well-marked and secured so that traps are not lost. Traps should never be left unchecked for more than 24 hours (Adams, et.al., 1997). When available, plastic is preferred over metal wire traps to reduce the chance of amphibians rubbing off their skin while trying to escape.

Drift fencing and pit fall traps (See: **Image 8.**)

- Drift fences shall be installed between the *N. perstriatus* terrestrial habitat and breeding wetlands, adjacent to the wetlands.
    - These fences can be costly and labor-intensive.
- A hole large enough to embed a 5-gallon plastic bucket to be flush with the ground shall be dug and drift fencing installed immediately adjacent to the bucket in order to capture individuals which walk along the fence.
    - Bucket shall have around ten, 2-3mm holes drilled approximately 7-8 centimeters above the bottom in order to allow stormwater to percolate out while retaining a shallow level of water for species hydration.
    - Small sponges shall be placed within the bucket to reduce drowning chances.
    - Pitfall traps should be shaded (Means, et.al., 2016).
    - When traps are not in use, a plastic lid should be placed on top.
    - **DISCLAIMER** – Drift fences can result in mortality if neglected. Traps should never be left unchecked for more than 24 hours.

Image 8. Drift fencing and pitfall trap combination
Source: https://www.youtube.com/watch?v=X9v85LCsLTg

Notophthalmus perstriatus
Survey Data Reporting Form

Dipnetting Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Collection Permit #: _____

Species Information

Target species (Circle)**:** Reticulated/Frosted Flatwoods Salamanders Striped Newt Gopher Frog

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Wetland Characteristics

Wetland Name: _____ **Lat:** _____ **Long:** _____

Type: Dome Swamp Sinkhole Pond Depression Marsh Basin Marsh
Flatwoods Pond Sandhill Lake Wet Prairie Borrow Pit Ditch

Hydrology: Permanent Semi-permanent Ephemeral Very ephemeral

Total # of individuals detected: _____

% of basin filled during survey: _____ **% Canopy closure:** _____

Dominant canopy spp.: _____

% Shrub cover: _____

Dominant shrub spp.: _____

Basin vegetation spp.: _____

Basin vegetation density: Extensive Throughout Basin Over Most of Basin Scattered Patches
Around Basin Edges Sparse None

Substrate composition: _____ **Water color/turbidity:** _____

Disturbance/fire history: _____

Other notes: _____

_____

_____

_____

Surrounding Upland Terrestrial Habitat Characteristics

Community type: Sandhill Scrub Xeric Hammock Mesic Hammock Scrubby Flatwood
Mesic Flatwood Dry Prairie Upland Pine Mixed Pine-Hardwood

% Canopy closure: _____

Dominant canopy spp.: _____

% Shrub cover: _____

Dominant shrub spp.: _____

% Ground cover: _____

Dominant ground cover spp.: _____

W**iregrass present?** **Yes** **No** **% Bare sand:** _____

Disturbance/fire history: _____

Other notes: _____

_____

_____

_____

Other Fauna Observed:

Herps: _____

Fish: _____

Crayfish: _____

Other: _____

BIRDS

Habitat Survey Methodology for Red Knot (*Calidris canutus*)

Source: https://www.flickr.com/photos/briangratwicke/17949339585/

Survey Techniques

Habitat Survey for Red Knot (Phase 1 Survey)

USFWS and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- *C. canutus* are typically only absent from the coast between early June and mid-July, as they over-winter, and are passage migrants in spring and fall along Georgia's coast in the following habitats (Schneider and Winn, 2019):
    - Beaches with high wave-energy and currents
    - Mouths of bays, estuaries, or inlets
- Important microhabitat characteristics (USDOI, 2014):
    - Exposed intertidal sediments
    - Tidal flats
    - Dynamic ephemeral features
        - Sand spits
        - Islets
        - Shoals
        - Sandbars
    - Sparse vegetation
    - In spring where horseshoe crab spawn they can reach high densities. These are typically beaches with gentle slopes and low wave action.

Habitat Survey Methodology for Henslow's Sparrow (*Centronyx henslowii*)

Source: https://www.flickr.com/photos/kiskadee_3/8007870894/in/photostream/

Survey Techniques

Habitat Survey for Henslow's Sparrow (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Larger areas with dense grass 0.5-1 m tall with scattered forbs and a low percentage of shrubs and small trees.
- Wintering habitat includes:
    - Longleaf pine (*Pinus palustris*) stands with a dense grassy ground layer and low basal area of trees (See: **Image 1.**)
    - Wet pine flatwoods
    - Pitcherplant bogs

Image 1. Longleaf pine ecosystem
Source: https://www.fws.gov/ncsandhills/ by S. Miller/USFWS

    - Power line rights-of-way with dense grassy groundcover and little woody vegetation (See: **Image 2.**), and similar areas

- Clear-cut pine plantations, and upland savannas, in addition to the previously mentioned longleaf pine stands, burned within 1 to 3 years are preferred for wintering habitat (Bechtoldt & Stouffer, 2005).

Image 2. Power line rights-of-way with dense grassy groundcover and little woody vegetation

- Important microhabitat characteristics:
  - Low vegetation density near the ground (within a few inches)
  - Thick canopy of grasses above this
  - High seed abundance
  - These conditions are maintained by regular fire, particularly growing season fire, soil physiology, and soil moisture (areas that are damp or moist tend to perpetuate suitable habitat), all of which can maintain low vegetation density near the ground.

Habitat Survey Methodology for Piping Plover (*Charadrius melodus)*

Image Source: Craig Watson, U.S. Fish and Wildlife Service [Public Domain], via Wikimedia Commons

Survey Techniques

Habitat Survey for Piping Plover (Phase 1 Survey)

USFWS and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- The following coastal habitat types provide suitable foraging habitat for this species (Elliott-Smith and Haig, 2004 [See: **Images 1.** & **2.**])
    - Sparsely vegetated intertidal zones such as mud, sand, or algal flats
    - Sand spits
    - Tidal flats
    - Ephemeral pools
    - Wrack lines
    - Shoals
    - Sandbars
- *C. melodus* prefers inlets and areas with low wave energy for foraging in close proximity to sandy beaches above high tide for roosting (USDOI, 2017).

Image 1. Mud flat
Source: U.S. Fish and Wildlife Service [Public domain], via Wikimedia Commons

Image 2. Sand spit
Source: https://www.southernenvironment.org/news-and-press/news-feed/selc-partners-urge-corps-to-deny-federal-permit-for-sea-island-groin|© Megan Huynh/SELC

Habitat Survey Methodology for Wilson's Plover (*Charadrius wilsonia*)

Source: www.allaboutbirds.org

Survey Techniques

Habitat Survey for Wilson's plover (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Open areas along coastal beach habitats (See: **Image 1.**) such as (National Audubon Society, 2018; Cornell, 2017; Schneider and Winn, 2010);
    - Dry sand beaches
    - Dunes
    - Newly formed beaches
    - Intertidal sand flats
    - Mudflats
    - Saltpans
    - Coastal lagoons
    - Shell rakes
    - Dredge spoil islands
- Breeding habitat is primarily located on outer barrier island beaches with limited nesting occurring on dredge deposit sites (Schneider and Winn, 2010).
    - *C. wilsonia* nests also have been found on shell rakes, elevated berms of dead oyster shell that occur in various situations on the Georgia coast where wave action comes into contact with dead oyster shell, typically associated with salt marsh islands.
- Nest sites are found on dry parts of beaches often near driftwood, clump of grass, or other conspicuous objects (National Audubon Society, 2018; [See: **Image 2**.]).
    - These may be barely above high tide line, or well back among secondary dunes as long as they are not fully vegetated.
- *C. wilsonia* typically require wide or accreting beaches as opposed to erosional beaches that often have scarps formed along the high tide line.
- Foraging occurs in tidal sloughs, beach edges, as well as dune and marsh habitats.

Image 1. *C. wilsonia* coastal beach habitat in Georgia
Source: http://georgiacoastatlas.org/index.html

Image 2. *C. wilsonia* nesting habitat on Little St. Simons Island
Photo By: Dr. Abby Sterling

Habitat Survey Methodology for Common Raven (*Corvus corax)*

Survey Techniques

Habitat Survey for Common Raven (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

The following habitat types provide suitable nesting habitat for *C. corax*:

- Rocky cliff ledges, especially those well-shaded (Payne et al., 2010)
- Rock crevices that are isolated and inaccessible to mammalian predators, particularly bobcat (*Lynx rufus*) (Boarman and Heinrich, 1999)
- Nest sites have only been documented above 1,067m (3,500 ft.) in the Georgia Blue Ridge Mountains (Payne et al., 2010)
- Nests in the southern Appalachians have occasionally been built in trees (Payne et al., 2010)

If Phase 1 surveys happen to occur between March through May, habitat suitability may be confirmed by the observation of nesting *C. corax* individuals and/or young in nests (Payne et al., 2010).

Habitat Survey Methodology for Swallow-tailed Kite (*Elanoides forficatus*)

Tim Keyes - GADNR

Survey Techniques

Habitat Survey for Swallow-tailed Kite (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Habitat surveys should be focused on forested wetlands associated with coastal plain rivers (See: **Image 1.**), streams, and swamps.
    - These wetlands must also be associated with more open areas for foraging (open pine forests, agricultural fields, clear-cuts).
- Priority should be given to canopy-emergent pine trees on pine islands within a hardwood floodplain, or pines on a bluff at the edge of a flood plain.
    - It should still be noted that while the above are the more common nesting habits of *E. forficatus*, it has also been known to nest in sub-canopy hardwoods.
- Emergent clusters of pine within younger pine stand, typically associated with river or wetland system
- The Avian Research and Conservation Institute has created a habitat model for *E. forficatus* which may be useful for narrowing down potential areas with suitable habitat for this species for larger projects.

Image 1. Altamaha floodplain, suitable *E. forficatus* habitat
Photo By: Tim Keyes**,** GADNR, Wildlife Biologist

Habitat Survey Methodology for Peregrine Falcon (*Falco peregrinus*)

Image Source: https://www.allaboutbirds.org/guide/Peregrine_Falcon/media-browser/60410421

Survey Techniques

Habitat Survey for Peregrine Falcon (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for the peregrine falcon (*Falco peregrinus*). If habitat as noted below is determined to be present on a project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to determine if suitable nesting habitat exists within a given Project area. Habitat assessment surveys can be conducted year round.

- During spring migration, transitory individuals of *F. peregrinus* may be found throughout the state of Georgia in a variety of habitat types as they move from wintering habitat to nesting/breeding habitat (Williams et al., 2010).
- During fall migration individuals may be observed in a variety of habitats, but most observations are confined to the coast, especially the barrier islands. The species is a rare winter resident in Georgia.
- Habitat suitable for the nesting/breeding of *F. peregrinus* is rare and more specialized within Georgia. In the Southeastern United States, *F. peregrinus* historically nested on cliffs and occasionally in hollow cypress trees. A nesting population has become established in the Atlanta metro area as a result of a hacking program initiated on one of the city's high-rise buildings in 1989-1990. Habitat surveys should focus on the following suitable nesting/breeding habitat for *F. peregrinus*:
    - Isolated, tall (i.e., prefer 50-200 m), and broad cliffs characterized by mostly smooth surfaces featuring ledges, caves, rock overhangs, and limited vegetative cover.
        - Preferred nesting ledges are usually at least one-third of the way down from cliff peaks.
        - *F. peregrinus* prefer not to nest on cliffs featuring highly fractured rock.
        - Suitable wild eyrie sites in Georgia include Tallulah Gorge State Park (See: **Images 1.** & **2.**), Cloudland Canyon State Park, Mt. Yonah, Rabun Bald, and manmade quarries.
    - Tall human made structures (e.g., skyscrapers, church towers, cellular towers, smoke and power plant stacks, bridges, etc. [See: **Images 3.** & **4.**]).
        - Preferred structures usually feature isolated ledges, ventilation shafts, and decorative planters, all of which often with some degree of overhanging cover.
        - Shallow depressions on tall ledges, or planters on balconies, should ideally include a loose substrate of sand, gravel, or dirt (Cade et al., 1996).
- High quality roosting sites are found in close proximity to large areas of open habitat where prey may be taken on the wing, including:
    - Mud flats
    - Coastlines and beaches

- Lake edges
- River corridors
- Mountain chains
- Valleys

- Isolated ledges on skyscrapers and communication towers, especially in areas that remain brightly lit at night, also serve as quality habitat.

Image 1. *F. peregrinus* nesting within Tallulah Gorge State Park
Photo By: Georgia Department of Natural Resources

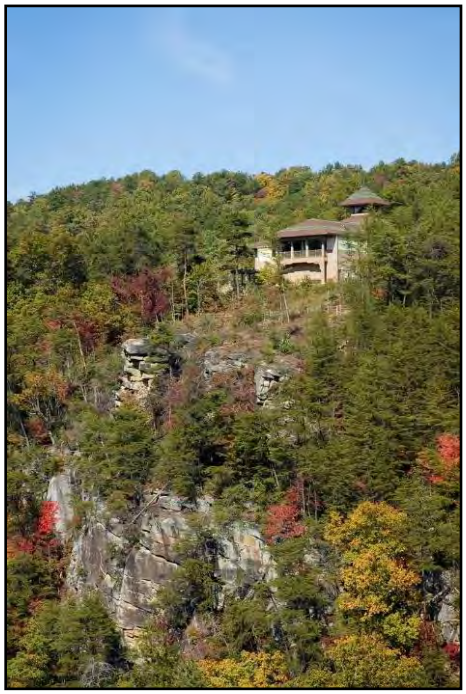


Image 2. Cliffs suitable for *F. peregrinus* roosting, Tallulah Gorge State Park
Source: https://gastateparks.org/TallulahGorge

Image 3. *F. peregrinus* nesting in a planter on a balcony of a skyscraper.
Photo By: Georgia Department of Natural Resources

Image 4. *F. peregrinus* nest in the ventilation shaft (red arrow) of a skyscraper.
Photo By: Georgia Department of Natural Resources

Habitat Survey Methodology for Southeastern American Kestrel (*Falco sparverius paulus*)

Image Source: Andy Reago & Chrissy McClarren [CC BY 2.0 (https://creativecommons.org/licenses/by/2.0)], via Wikimedia Commons

Survey Techniques

Habitat Survey for Southeastern American Kestrel (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- This species primarily utilizes abandoned woodpecker nest cavities (Raphael, 1985), but may also nest in abandoned or occupied buildings and in manmade nest boxes or other manmade structures such as utility poles, towers, etc. (Stys, 1993 [See: **Image 1.**])
    - Several nest box programs have been attempted in Georgia to benefit this species. Nest boxes for *F. s. paulus* are similar to wood duck boxes and can be found along roadsides away from water. GADNR shall be contacted if these nest boxes are observed within the project limits.

Image 1. Woodpecker nest cavity in longleaf pine
Source: https://www.flickr.com/photos/38514062@N03/14898835893/in/photostream/

- *F. s. paulus* forages in open areas with short vegetation, scattered perch sites, and suitable prey (See: **Image 2.**). Suitable foraging habitat may include:
    - Pine savannas (See: **Image 3.**)

- Pastures
- Sandhills
- Grasslands
- Open urban or suburban areas such as parks or golf courses

- Because *F. s. paulus* has a high degree of territory fidelity, nesting and foraging habitats must be in close proximity to each other (Stys, 1993).

Image 2. Suitable foraging habitat (open area with short vegetation)
Source: https://commons.wikimedia.org/wiki/File:Hunting_ground_-_geograph.org.uk_-_1426401.jpg

Image 3. Suitable foraging habitat (pine savanna)
Photo By: P. R. Hoar [Public domain], via Wikimedia Commons

Habitat Survey Methodology for Gull-billed Tern (*Gelochelidon nilotica*)

Tim Keyes - GADNR

Survey Techniques

Habitat Survey for Gull-billed Tern (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Habitat surveys should focus on the immediate coast on open sandy beaches, un-vegetated dredge spoil islands, and isolated offshore bars, typically near inlets.
    - This species typically requires wide, accreting beaches without scarps or vegetation.
- Presence of the following associate species is helpful in determining habitat presence for *G. nilotica*, as they often nest in vicinity or interspersed with these other colonial nesting birds:
    - Black skimmer (*Rynchops niger*)
    - Least tern (*Sternula antillarum*)
    - Royal tern (*Thalasseus maximus*)
- *G. nilotica* are colonial nesters which react aggressively to human encroachment.
    - Given this, nest presence should not be hard to confirm if habitat surveys happen to occur during the nesting season.

Habitat Survey Methodology for American Oystercatcher (*Haematopus palliatus*)

Survey Techniques

Habitat Survey for American Oystercatcher (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat (Harris et al., 2019a).

- *H. palliatus* can be observed during breeding season (March - August) when birds are paired, and while migrating/wintering within suitable coastal habitats.
- *H. palliatus* utilizes the edge of estuarine and coastal environments throughout its range, and never strays far from saltwater.
- Primary habitat includes:
    - Marsh islands
    - Beaches (See: **Image 1.**)
    - Sand bars and spits
    - Upland dunes
    - Shell rakes (See: **Image 2.**)
    - Dredge spoil sites

Image 1. Suitable, sparsely vegetated, beach habitat
Photo By: Tim Keyes, GADNR, Wildlife Biologist

- Foraging habitat includes:
    - Shellfish beds
    - Intertidal sand and mud flats (See: **Image 3.**)
- Breeding typically occurs at the northern or southern tips, sand spits, or accretional mid-island habitats of barrier islands, and dredge spoil sites with little to no development.
- Nesting sites are restricted to areas of beach with broad sandy berms, terraced flats, and shell rakes along the intercoastal waterway that sit above the mean high-tide line.

Image 2. Suitable shell rake habitat
Photo By: Tim Keyes, GADNR, Wildlife Biologist

Image 3. Suitable sand and mudflat foraging habitat
Photo By: Henry Mitchell

Habitat Survey Methodology for Bald Eagle (*Haliaeetus leucocephalus*)

Source: https://www.fws.gov/refuge/quivira/wildlife_and_habitat/bald_eagles.html

Survey Techniques

Habitat Survey for Bald Eagle

Habitat assessments should be conducted via pedestrian surveys and analysis of topographic maps or aerial imagery to determine if suitable nesting habitat exists. Habitat assessment surveys can be conducted year-round.

- *H. leucocephalus* forages primarily for fish and waterfowl in fresh and salt water along most major impoundments and rivers and can be seen scavenging in terrestrial habitats.
    - Occasionally found near small reservoirs, clusters of farm ponds, and aquaculture facilities in the Coastal Plain (See: **Image 1.**)

Image 1. Abandoned *H. leucocephalus* nest near a house and small reservoir in south Georgia.
Source: Georgia Department of Natural Resources, Wildlife Resources Division

- *H. leucocephalus* suitable nesting habitat typically consists of groups of super canopy pine trees (i.e. are taller than other trees in the surrounding landscape; >90% of nest trees in Georgia) within contiguous forest in close (often within 200-500 feet) proximity of foraging habitat.
    - Generally choose live, flat-canopied pine trees
        - Nests are also sometimes found in:
            - Isolated pine trees
            - Dead pine trees
            - Cypress trees growing in open waters
        - Very rarely are nests in oaks or other hardwoods.
        - This can help distinguish *H. leucocephalus* nests from osprey (*Pandion haliaetus*) nests, as osprey prefer dead trees and human-made structures (Audubon Center for Birds of Prey, 2018).
    - Nests are almost always located below the uppermost canopy of a tree, where the largest upper branches originate in a whorl about the trunk (See: **Images 2.** & **3.**).

- This nest location preference ensures protective screening from the sun for growing eaglets, and a strong foundation for nests that can sometimes exceed 1,000 pounds in weight.
- This is another distinguishing characteristic between the nests of *H. leucocephalus* and *P. haliaetus—P. haliaetus* nest in the tops of trees instead of at the trunk (Audubon Center for Birds of Prey, 2018).

Image 2. *H. leucocephalus* nest in a longleaf pine tree in an open forest
Photo By: Charley Tarver, Owner at Longleaf Plantation

Image 3. *H. leucocephalus* nest in dead pine
Source: Georgia Department of Natural Resources, Wildlife Resources Division

- *H. leucocephalus* prefer to avoid nesting near human structures, generally selecting nest trees that are hundreds of feet (often at least 1,000 feet) from potential disturbances.
    - It should be noted that despite this fact, there are a few instances in the state where nesting has occurred within 150-250ft of houses, parking lots, and busy roads (See: **Image 1.**).

- Nests are constructed of branches and sticks and are at least 4 feet in diameter and 3 feet tall (Audubon Center for Birds of Prey, 2018)
    - Can become significantly larger overtime as mating pairs add to them on an annual basis
    - Use of binoculars or a spotting scope can minimize the chance of a "witch's broom" being mistaken for a nest
        - Witch's brooms are a proliferation of shoots with short internodes that share a strong resemblance to a mass of twigs (See: **Image 4a.** & **b.**)
        - Use of these tools also allows for distance to remain between the surveyor(s) and the potential nests, so as not to disturb individuals that may be present. In addition to keeping as much distance as possible between themselves and suitable trees, surveyors should remain quiet during survey efforts for the same reason.

Image 4a. & 4b. Witch's brooms in pine trees
Source: Wikimedia Commons, public domain

If new nest(s) are detected during the survey, the GDOT Project Ecologist shall be informed immediately. He/she will then contact USFWS and GADNR to ensure the nest is included in the following annual aerial nest survey conducted by GADNR.

Important: Even if no suitable nesting habitat is detected in the survey area, USFWS shall always be contacted for technical assistance when there are records within one mile to determine whether protections are needed beyond the project limits but within the Action Area.

If no nests are detected in otherwise suitable nesting habitat, the project should follow the re-survey protocol flow chart in the manual's SOP section to ensure potential new nests do not go undetected as the project approaches Let.

Habitat Survey Methodology for Eastern Black Rail (*Laterallus jamaicensis jamaicensis*)

Source: http://www.avibirds.com/nahtml/Black_Rail.html

Survey Techniques

Habitat Survey for Eastern Black Rail (Phase 1 Survey)

USFWS and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat (Eddleman et al., 1994; NatureServe, 2018; USFWS, 2018).

- Herbaceous wetlands including:
    - Salt, brackish, and freshwater marshes
    - Pond borders
    - Wet meadows
    - Grassy swamps
- Microhabitats tend to be composed of fine-stemmed emergent plants (rushes, grasses, and sedges) with high stem densities and dense canopies characteristics include:
    - Areas where soil is moist or saturated and intersperse with shallow water that is 1-6 cm deep (but usually <2cm),
    - Dense, herbaceous cover generally <= 1 meter in coastal habitats, but taller in cattail and bulrush marshes.
        - Commonly associated plant species:
            - Within marshes:
                - Cordgrasses (*Spartina* spp.; particularly *S. patens* and *S. bakeri*)
                - Marsh spikegrass/saltgrass (*Distichlis spicata*)
                - Black needlerush (*Juncus roemerianus*)
                - Black rush (*J. gerardii*)
                - Olney's threesquare (*Scirpus olneyi*)
                - Chairmaker's bulrush (*Schoenoplectus americanus*)
                - Sturdy bulrush (*Schoenoplectus robustus*)
                - Plants indicating areas of more infrequent flooding within the marshes:
                    - Marsh elder (*Iva frutescens*)
                    - Groundsel tree (*Baccharis halimifolia*)
                    - Common reed (*Phragmites australis*)

- Within ponds and wet meadows:
    - Cattails (*Typha spp.*)
    - River bulrush (*Scirpus fluviatilis*)

- Subtle elevational differences in microtopography have been noted to have an importance to the species to provide refugia for adults, juveniles, and chicks to escape flooding and during predator avoidance efforts.

Habitat Survey Methodology for Wood Stork (*Mycteria americana*)

Survey Techniques

Habitat Survey for Wood Stork (Phase 1 Survey)

USFWS and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- *M. americana* nesting habitat occurs in the following freshwater and estuarine conditions (Harris et al., 2010):
    - Trees or shrubs in standing water (See: **Image 1.**)
    - Trees or shrubs on islands surrounded by water (See: **Image 2.**)
        - Some of Georgia's largest and most regularly used colonies are on islands within impounded ponds.
    - Trees along the edges of ponds or marshes

Image 1. *M. americana* nesting rookery
Source: https://river2sea72.wordpress.com/tag/mycteria-americana/

Image 2. *M. americana* nesting rookery
Source: https://river2sea72.wordpress.com/tag/mycteria-americana/

- Trees of all sizes may be used, as well as low shrubs (especially on islands).
- Many natural wetland colonies vary annually in occupancy and number of birds based on rainfall since *M. americana* require deep water under nesting trees.

- *M. americana* forage in the following habitat types (USDOI, 2012 & USDOI, 2013):
  - Depressional marshes and swamps where fish become isolated as water levels decrease
  - Freshwater ponds and marshes (See: **Image 3.**)
  - Narrow tidal creeks
  - Tidal wetlands on falling tide
  - Flooded tidal pools
  - Roadside ditches
  - These habitats serve as suitable foraging locations when they also contain the following characteristics:
    - Areas where water levels are 6-10 inches deep
    - Typically within 20km of breeding colony during the breeding season (March – August).
      - The 20 km distance is considered the core foraging area for breeding colonies of wood stork during the breeding season (Bryan *et al.*, 2012).
      - Post-breeding season wood storks can disperse throughout large portions of the state.
    - Little or no canopy cover

Image 3. *M. americana* foraging in shallow marsh waters
Source: https://www.flickr.com/photos/anitagould/2476792963/

Habitat Survey Methodology for Bachman's Sparrow (*Peucaea aestivalis)*

Photo By: Time Keyes, GADNR

Survey Techniques

Habitat Survey for Bachman's Sparrow (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- The following broad habitat types provide suitable nesting and foraging habitat for this species:
    - Mature stands of loblolly (*Pinus taeda*), longleaf (*P. palustris*), shortleaf (*P. echinata*), slash (*P. elliottii*), or mixed oak-pine that are burned regularly (<4 year burn interval) and have a grassy understory (See: **Image 1.**)
        - *P. aestivalis* can be found in similar habitat as the red-cockaded woodpecker (*Picoides borealis*); however, it is less tolerant of an encroaching understory than *P. borealis* (Schneider and Keyes, 2010)

Image 1. The Santee Experimental Forest in the Francis Marion National Forest provides ideal habitat for *P. aestivalis* due to frequent burns and a lack of vegetation in the second through fourth meters of vertical profile.
Source: U.S. Forest Service [Public Domain]

    - Intermediate-age and young pine woodlands
    - Old pastures (See: **Image 2.**)
    - Large regenerating clear-cuts (both pine and hardwood) less than 7 years old (Dunning et al., 1995 [See: **Image 3.**])
    - Utility rights-of-way
- *P. aestivalis* strongly prefers habitats with low volumes of vegetation occupying the second through fourth meters above ground (Dunning and Watts, 1990).

- A dense ground layer of bracken fern, native grasses (especially wiregrass, bluestem, and broomsedge), saw palmetto, or blueberries creates ideal nesting and foraging habitat (USDOI, 2018; Schneider and Keyes, 2010).

Image 2. Open areas (such as old pastures) with dense layers of native grasses also provide nesting and foraging habitat for this species
Source: U.S. Fish and Wildlife Service [Public Domain]

Image 3. Regenerating pine stand provides suitable habitat for *P. aestivalis.*
Photo By: Tim Keyes, GADNR, Wildlife Biologist

Habitat & Species Survey Methodology for Red-cockaded Woodpecker (*Picoides borealis*)

Image Source: www.audubon.org/field-guide/bird/red-cockaded-woodpecker

Survey Techniques

Habitat Survey for Red-cockaded Woodpecker (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

Suitable foraging habitat:

- Large expanses of open pine-hardwood forests, woodlands, or savannahs in which 50% or more of the dominant tree species are pine
    - Dominant pines are usually 30 years in age or older[1]
- Longleaf pine (*Pinus palustris*), slash pine (*Pinus elliottii*), or loblolly pine (*Pinus taeda*) stands are preferred.

[1] Stand data describing size classes may be substituted for age if the average size of 30-year-old pines is known — For example: at least 25.4 cm (10 in) diameter breast height or larger, for the local area and habitat type (USFWS, 2003).

Suitable nesting habitat:

- Large expanses of open pine, pine-hardwood, and hardwood-pine stands that contain pine trees 60 years in age or older or patches/clumps of older trees within younger stands (See: **Image 1.**)[2]
- Pine trees meeting the age requirement above may be adjacent to or within 0.5 mi (0.8 km) of stands considered suitable foraging habitat. Suitable nesting stands are characterized by the following (USFWS, 2003):
    - Large expanses of open pine or pine-hardwood forests, woodlands, or savannahs in which 50% or more of the dominant tree species are pine
    - The dominant pine trees are generally 30 years in age or older.[3]
    - Longleaf pine, slash pine, or loblolly pine stands are preferred, but other pine species can be used.
- Nest and roost cavities are excavated only in old living pines, and the process may take several years to complete. Trees selected for cavities are usually infected with red heart fungus, which softens the heartwood, making excavation easier (Ozier and Schneider, 2010).
    - Forest Service, state, and some private lands are managed for *P. borealis*. These properties are typically managed through prescribed burns. In these properties, artificial inserts may be used in stands of trees less than 60 years old to increase nesting opportunities for red-cockaded woodpeckers (See: **Image 2.**).

[2] Pines 60 years in age or older (60+) may be scattered or clumped within younger stands; mixed-age stands with scattered 60+ year-old pines are still considered suitable nesting habitat (USFWS, 2003).

[3] Stand data describing size classes may be substituted for age if the average size of 30-year-old pines is known – For example: at least 25.4 cm (10 in) diameter breast height or larger, for the local area and habitat type (USFWS, 2003).

If no suitable nesting habitat is found within the Project area, but suitable foraging habitat is present, potential use of this foraging habitat by *P. borealis* groups outside of the Project boundaries must be determined.

- This usage is determined based on whether any known nesting colonies are present within a 0.8km (0.5mi) radius of the suitable foraging habitat (USFWS, 2003).
    - Early coordination responses from USFWS and GADNR will contain this information.

If suitable nesting habitat is found *or* if suitable foraging habitat is found ***and*** there is a known nesting colony within 0.8km (0.5mi), the GDOT Project Ecologist shall be informed. He/she will then contact the land managing agency/person (when on land currently managed for *P. borealis*), USFWS, and GADNR to determine whether a Phase 2 survey is warranted.

Image 1. *P. borealis* habitat
Source: https://www.allaboutbirds.org/guide/Red-cockaded_Woodpecker/id

Image 2. Artificial nest cavity in longleaf pine
Source: https://www.moorecharitable.org/about-us/grantees/tall-timbers-research-station-and-land-conservancy/

Red-cockaded Woodpecker Species Survey (Phase 2 Survey)

If USFWS, GADNR, and GDOT determine that a Phase 2 Survey is warranted, a scientific collector's permit would not be required since animals would not be captured or handled during this type of survey effort. Phase 2 surveys shall be conducted as follows.

Tree Cavity Identification:

- Cavity entrances are typically oriented in a westerly direction.
- Cavities are usually 6.1 to 15.2 m (20 to 50ft) high from the base of the tree trunk (USFWS, 2003).
- Active cavities are typically accompanied with a conspicuous ring of resin dripping down the tree trunk.

Other Survey Considerations:

- Cavity tree surveys can be conducted year round.
- Surveys shall be conducted in a manner that minimizes disturbance to potential *P. borealis* individuals or nesting clusters.
- Surveyors shall be familiar with the *P. borealis* call (Burnam, 2018).
- **All** medium-sized and large pines within suitable habitat shall be visually inspected for evidence of cavity excavation by *P. borealis.*
- Since cavity entrances are typically oriented in a westerly direction, north to south line transects set with the aid of a hand compass are preferred as they maximize cavity visibility.

However, the transect bearing can be flexible in relation to the orientation of the proposed transportation project.

  - Transects must be spaced so that all trees are inspected and necessary spacing would vary with habitat structure and season from a maximum of 91 meters (m) (100 yards) between transects in very open pine stands to 46 m (50 yards) or less in areas with a dense mid-story (USFWS, 2003).

- Surveys are ideally performed in the early morning or late evening, as *P. borealis* individuals call in the morning when leaving their nests and, in the evening, when returning to them (Burnam, 2018); however, surveys are valid throughout the day.
- Cavity trees may be more easily observed on overcast days where there isn't a lot of glare from the sun. If possible, conduct Phase 2 surveys on cloudy days.
- When cavity trees are found, their location will be recorded in the field using a Global Positioning System unit, aerial photograph, or field map with their respective coordinates.
  - If cavity trees are found, more intense surveying within 457 m (1,500 feet) of each cavity tree will be conducted to locate all cavity trees in the area (USFWS, 2003).
  - The *P. borealis* activity status at each cavity tree, cavity stage (start, advanced start, or complete cavity), and any entrance enlargement shall be assessed and recorded at this time. If birds are actively excavating a cavity or travelling to and from a cavity tree, do not disturb the cavity or birds. Note behavior and information for the ecology report and Element Occurrence Reporting Form to be sent to USFWS and GADNR.

Picoides borealis
Survey Data Reporting Form

Red-cockaded Woodpecker (*Picoides borealis*) Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Species Data

Total # of individuals observed: _____ **Total # of calls detected:** _____

Behavior notes (e.g. nesting, flying/forging, excavating)**:** _____

_____

_____

Red-cockaded Woodpecker Cavity Tree Data

Cavity Tree #	**Tree Location** (Lat/Long)	**Cavity Orientation**	**Cavity Height** (from ground)	**Tree Species**	**DBH** (in)	**Cavity Status** (**S**tarted/**A**dvanced Start/**C**omplete)	**Cavity Activity** (**R**esin ring/**I**ndividuals/**N**one)

Habitat Survey Methodology for Black-capped Petrel (*Pterodroma hasitata*)

Image Source: https://www.flickr.com/photos/40928097@N07/36122197833

Version: 3.0

Survey Techniques

Habitat Survey for Black-capped Petrel (Phase 1 Survey)

USFWS and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Outside of its nesting season (nesting does not occur in Georgia), *P. hasitata* lives a completely pelagic lifestyle in oceanic warm waters—particularly along the continental shelf (NatureServe, 2018).

Habitat Survey Methodology for Black Skimmer (*Rynchops niger*)

Tim Keyes - GADNR

Survey Techniques

Habitat Survey for Black Skimmer (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Habitat surveys should focus on the immediate coast on the following, as preference is given to areas with sparse vegetation and sandy substrates (George et al., 2010):
    - Open sandy beaches
    - Un-vegetated dredge spoil islands (See: **Image 1.**)
    - Isolated offshore bars
    - *R. niger* may also nest on the wrack line in saltmarshes where primary habitat is lacking.

Image 1. Suitable *R. niger* breeding habitat with sandy substrate and sparse vegetation on dredge spoil site
Photo By: Beth Davis

- *R. niger* is best observed during the breeding season (late April – August).
- Presence of the following associate species is helpful in determining habitat presence for *R. niger*, as they often nest in vicinity or interspersed with these other colonial nesting birds (Gochfeld and Burger, 1994 [See: **Image 2.**]):
    - Gull-billed tern (*Gelochelidon nilotica*)
    - Least tern (*Sternula antillarum*)
    - Royal tern (*Thalasseus maximus*)
- *G. nilotica* are colonial nesters which react aggressively to human encroachment.
    - Given this, nest presence should not be hard to confirm if habitat surveys happen to occur during the nesting season.
- Rooftop nesting has occurred in other parts of the range but has not been documented in Georgia.

Image 2. Nesting colony on Pelican Spit
Photo By: Tim Keyes, GADNR, Wildlife Biologist

Habitat Survey Methodology for Cerulean Warbler (*Setophaga cerulea*)

Image Source: https://en.wikipedia.org/wiki/Cerulean_warbler

Survey Techniques

Habitat Survey for Cerulean Warbler (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

Breeding habitat for *S. cerulea* generically consists of mature broad-leaved deciduous forest, rich hardwood forests and cove hardwood forests; however, secondary growth forest may also be used as breeding habitat when a broken canopy is present. This species tends to prefer larger intact forested areas that includes at least some very large mature trees within a multilayered, gappy/heterogeneous canopy. In Georgia, *S. cerulea* predominately uses the following forested habitat types for breeding (DNR-WRD 2019).

- Rich oak-hickory forest [e.g. Blue Ridge oak (hardwood) forest (See: **Image 1.**)]; overstory tree species include white oak, (*Quercus alba*), scarlet oak (*Q. coccinea*), northern red oak, (*Q. rubra*), mockernut hickory (*Carya tomentosa*), pignut hickory (*C. glabra*), tulip-tree (*Liriodendron tulipifera*), black gum (*Nyssa sylvatica*), Frasier magnolia (*Magnolia fraseri*), black locust (*Robinia psuedoacacia*), sourwood (*Oxydendrum arboreum*), sweet birch (*Betula lenta*), and white pine (*Pinus strobus*) (NCG 2019).
- Cove forest [e.g. Blue Ridge cove forest (See: **Image 2.**)]; overstory tree species include northern sugar maple (*Acer saccharum*), yellow buckeye (*Aesculus flava*), sweet birch, musclewood (*Carpinus caroliniana*), bitternut hickory (*Carya cordiformis*), American beech (*Fagus grandiflora*), white ash (*Fraxinus americana*), silverbell (*Halesia tetraptera*), tulip-tree, Frasier magnolia, white pine, black cherry (*Prunus serotina*), northern red oak, and white basswood (*Tilia americana var. heterophylla*) (NCG 2019).

The following microhabitat characteristics are preferred by male *S. cerulea* when selecting territories (DNR-WRD 2019) and should also be considered when assessing the suitability of habitat.

- Rich oak-hickory or cove forests near ridge tops with canopy gaps ranging in size from 0.25 acre to 10 acres
- Presence of at least 1 to 4 very large trees per acre
- A thick understory of young trees

Image 1. Blue Ridge oak (hardwood) forest
Source: https://www.naturalcommunitiesofgeorgia.com/oak-forests.html

Image 2. Blue Ridge cove forest
Source: https://www.naturalcommunitiesofgeorgia.com/mesic-cove-forests.html

Habitat Survey Methodology for Least Tern (*Sternula antillarum*)

Survey Techniques

Habitat Survey for Least Tern (Phase 1 Survey)

USFWS and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat (Harris, et al., 2019b).

In Georgia, least terns have nested on barrier island beaches, dredge spoil sites, and on rooftops of several large building in Savannah, Brunswick, Kingsland, St. Marys, Kings Bay Naval Submarine Base, and well inland at Ft. Stewart. During the Breeding Bird Atlas project, they also nested in small numbers on a rooftop in Vidalia (Harris, et al., 2019b). Coordination should be conducted with GADNR on potential impacts to urban-nesting individuals when work may impact structures in the cities listed above.

- Ideal habitat for *S. antillarum*:
    - Barrier islands within the following microhabitats:
        - Bare or sparsely vegetated beaches, typically in areas of accretional beach, and typically near inlets
        - Sand flats and spits
        - Isolated offshore bars
        - Unvegetated dredge spoil islands (See: **Image 1.**)
        - Shell islands
    - Mainland coastlines beyond the high tide line in ephemeral habitats subject to wash-over from storm tides
- *S. antillarum* is also known to use the following for nesting habitat:
    - Agricultural fields
    - Gravel parking lots and rooftops
    - Sand/gravel pits
    - River sandbars
    - Dredge spoil sites (See: **Image 2.**)
    - Bare land associated with airports

Image 1. *S. antillarum* nest on a dredge spoil site

Image 2. Dredge spoil sites are among the more common locals where *S. antillarum* now nest.
Source: https://www.savannahnow.com/article/20140503/NEWS/305039829

Habitat Survey Methodology for Golden-winged Warbler (*Vermivora chrysoptera*)

Image Source: https://www.allaboutbirds.org/guide/Golden-winged_Warbler/media-browser/38454621

Survey Techniques

Habitat Survey for Golden-winged Warbler (Phase 1 Survey)

GADNR does not recommend GDOT perform species (Phase 2) surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Habitat surveys shall be focused in the mountains on early successional habitats for nesting areas.
- Disturbed patches of habitat within a forested matrix are important for nesting (See: **Image 1.**).

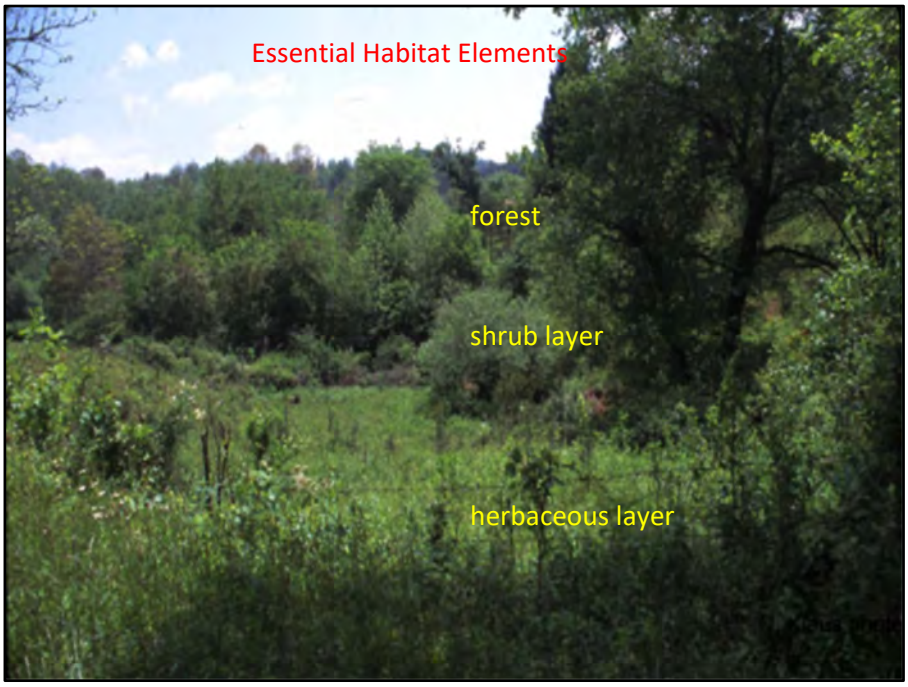


Image 1. Structural components of *V. chrysoptera* nesting habitat
Source: http://www.gwwa.org/resources/GWWAStatusReview19v2_Chap1.pdf

- Roadside edges often provide important habitat for *V. chrysoptera*, particularly where mowed roadsides join shrubby habitats.

- The following broad habitat types provide suitable nesting habitat for this species (See: **Image 2.**):
    - Young forests
    - Forest clearings
    - Old fields overgrown with scrubby underbrush
    - Clear-cuts less than 13 years old
    - Forest edges and openings
    - Utility and roadside rights-of-way that are maintained in a shrubby state or adjoin shrubby habitats
    - Swamp forests with partially open canopy (Klaus and Buehler 2001 & Buehler et al., 2012).
- Suitable habitat can also be found in areas that have been impacted by hurricanes, logging, prescribed burns and wildfires (Buehler et al., 2012).
- *V. chrysoptera* utilizes mature forest throughout its annual cycle and forage widely in mature deciduous or mixed forest and may prefer adjacent mature upland forests or northern forested wetlands during the post-fledging period (Buehler et al., 2012).

Image 2. *V. chrysoptera* may be found nesting in a variety of habitat types that comprise the basic three structural components pictured in Image 1. Habitat types include: (A) shrub-field (J. Lowe); (B) utility right-of-way (S. Barker Swarthout); (C) abandoned farm (C. Croy); (D) alder swamp (L. Johnson); (E) clear cut (M. Fowlds); (F) reclaimed mine (L. Bulluck); (G) bog (N. Nelson); (H) beaver wetland (J. Confer).

Source: http://www.gwwa.org/resources/GWWAStatusReview19v2_Chap1.pdf

INSECTS

Habitat & Species Survey Methodology for Say's Spiketail (*Cordulegaster sayi*)

Survey Techniques

Habitat Survey for Say's Spiketail (Phase 1 Survey)

Habitat assessments for Say's spiketail (*Cordulegaster sayi*) should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

C. sayi is found in and adjacent to perennial, mucky, seeps that would be delineated as part of the initial ecology resource survey. Suitable *C. sayi* habitat is generally considered a longleaf pine (*Pinus palustris*) ecosystem endemic but is found in two discrete habitat types based upon their age class (Stevenson et al., 2009):

Larval Stage Suitable Habitat:

- Perennial mucky seepages associated with wetlands or stream margins; typically 1st or 2nd order seepages/streams (See: **Images 1.** & **2.**)
- Often associated with steep, hardwood bluffs, sandhill-bay swamp seepages, and mesic hardwood forests embedded within longleaf pine habitat matrix
- Muck presence is key
- Shallow, almost imperceptible flow of water, if any flow, observed over the muck substrate
- Vegetative species associated with these habitats are characteristic of Sandhills Swamp Tupelo Hillside Seepage Forest (CEGL004645), Loblolly-bay Swamp Forest (CEGL007044), and Atlantic Coastal Plain Acidic Loam Beech – Magnolia Forest association types described by USNVC (USNVC, 2017)
- Upslope areas should meet requirements for adult stage suitable habitat
- Common associate species within larval habitat (Stevenson, 2014):
  - Gray petaltails (*Tachopteryx thoreyi*)
  - Red and mud salamanders (*Pseudotriton* spp.)

Adult Stage Suitable Habitat:

- Located proximal to larval stage suitable habitat
- Characteristic habitat is open canopy xeric sandhill areas frequently dominated by longleaf pine, turkey oak (*Quercus laevis*), and wiregrass (*Aristida stricta*) or mesic hardwood bluffs and ravines embedded within such communities (See: **Images 3.** & **4.**). However, populations may persist in areas where this preferred habitat has been altered (e.g., silvicultural areas)
- Adults frequent forest edges, openings, fields, and weedy areas adjacent to larval habitat
- Possesses sandy soil types
- Exhibits evidence of recent or historical fire

- May support gopher tortoise (*Gopherus polyphemus*) or meet suitable habitat requirements for this species

Image 1. Suitable larval habitat for *C. sayi* associated with muck seepage stream
Photo By: Dirk J. Stevenson, Keppner Biological Services

Image 2. Suitable larval habitat for *C. sayi* associated with mucky wetland pockets
Photo By: Dirk J. Stevenson, Keppner Biological Services

Image 3. Suitable adult habitat for *C. sayi* associated with longleaf pine savannah
Photo By: Dirk J. Stevenson, Florida Native Plants Society

Image 4. Suitable adult habitat for *C. sayi* associated with mesic slope forest
Photo By: Dirk J. Stevenson, Florida Native Plants Society

Say's Spiketail Survey (Phase 2 Survey)

C. sayi individuals may be surveyed for as larvae or adults (See: **Images 5.** & **6.**) but are more easily surveyed for as larvae (Beaton, 2008b). It should be noted, however, that larval surveys require a scientific collector's permit since animals are captured handled during the survey effort, whereas, adult surveys do not require a permit.

Larval Survey Protocol:

Image 5. *C. Sayi* nymph
Photo by: E.J. Keppner

- Prior to larval surveys, it is recommended that at least one surveyor has experience distinguishing *C. sayi* larvae from *T. thoreyi*.
    - The Georgia Museum of Natural History at the University of Georgia has specimen available for comparison.
- Nymph surveys of seep habitats may be conducted year round due to the species being semivoltine (utilize their larval habitat for more than one year before emergence; Stevenson et al., 2009).
- 10% of the suitable habitat identified in Phase 1 of the species survey should be manually sifted through by hand to search for larvae.
    - Muck should be turned, swirled, and sifted by hand to identify nymphs as they kick or slowly move.
    - Tools (rakes, shovels, nets, etc.) or machinery should not be utilized to manipulate suitable habitat of this species due to the potential for destruction of the habitat.
    - A sorting tray and magnifying glass or hand lens may be necessary to positively identify individuals as *C. sayi* (Stevenson et al. 2009).

- Deeper sections of the seep should be prioritized.
- Field identification of *C. sayi* is possible; however, one (1) specimen should be collected and preserved if identified to document positive identification.
- Once a positive identification has been made within a discrete seep habitat, no further sampling is necessary, and no further collection or manipulation of the seep should occur.

Image 6. *C. sayi* adult
Photo by: Giff Beaton

Adult Survey Protocol:

- Surveys of suitable upland habitats for adult *C. sayi* should be conducted from mid-March to mid-April (Stevenson et al., 2009).
- Surveys shall be conducted on sunny or partly cloudy days when the temperature is above 75° Fahrenheit (F).
- Surveys should consist of point count transects starting at the larval habitat and extending into the adult habitat.
    - Transects should be spaced 10-m apart, oriented perpendicular to the larval habitat, and extending into and throughout the adult habitat.
    - The first point count should occur at the larval habitat with subsequent point counts spaced 10-m apart along the transect.
    - Point counts should consist of a 5-minute observation period where the surveyor(s) remains motionless and visually scan the surrounding area for adult specimens.
    - Binoculars are recommended to aid in positive identification.

- The following characteristics should be considered:
    - Adults typically remain close to larval habitat.
    - Adults are most often encountered while feeding in scrub oak sandhills where the perch low to the ground (Keppnerr and Keppnerr, 2015).
    - Bees and wasps are favored prey of *C. sayi*.
    - Males patrol low over hillside, trickling seepage areas during the middle of the day.
    - Females oviposit in the early afternoon by hovering over shallow water and driving the ovipositor vertically into the substrate in a motion resembling a sewing machine needle.
- In the event *C. sayi* is identified, extreme effort shall be made to take a quality photograph of the individual.

Cordulegaster sayi
Survey Data Reporting Form

Say's Spiketail (*Cordulegaster sayi*) Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Collection Permit # (if performing larval survey)**:** _____

Species Information

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Habitat & Survey Data

Habitat Unit #: _____

Habitat type (mucky wetland, pine savannah, mesic slope, etc.)**:**_____

Dominant vegetation: _____

% canopy cover: _____

Linear or square feet of area surveyed: _____

Total # of individuals detected: _____

Location of observation (latitude, longitude)**:** _____

Behavior when observed (perched/actively flying)**:**_____

Other notes: _____

Habitat & Species Survey Methodology for Cherokee Clubtail (*Gomphus consanguis*)

Survey Techniques

Habitat Survey for Cherokee Clubtail (Phase 1 Survey)

Habitat assessments (Phase 1 surveys) should be conducted via pedestrian surveys to identify suitable habitat. *G. consanguis* is found in and adjacent to relatively permanent waters that will be delineated as part of the initial ecology resource survey. Suitable habitat may be identified at any time of year; however, surveys completed during the growing season, while mature trees are fully leafed-out, will aid in identification of preferred microhabitats. In order for a Phase 2 survey to occur, both the basic and microhabitat requirements for the species must be met. Suitable *G. consanguis* habitat should be identified using the following information (Beaton, 2018):

- Basic requirements:
    - Adult *G. consanguis* are most often observed along relatively small 1st and 2nd order perennial streams.
    - Suitable streams may vary in width from approximately 2 feet to 25 feet. Depths can range from a few inches to around 2 feet. However, typical *G. consanguis* sites are in the lower ends of these spectrums.
        - Although the species may be found along small streams, these streams must have moderate to swift flow rates. Streams with stagnant or slow velocity flow are not suitable. The species is rarely found near slow-moving pools. Areas affected by beaver activity are unlikely to harbor the species.
    - Edges of old fields (See**: Image 1.**), unmowed roadside rights-of-way (ROWs), and powerline cuts adjacent to suitable streams may also provide suitable habitat. These areas most often contain flowering plants that attract pollinator species which *G. consanguis* feed on.

Image 1. Old field habitat adjacent to stream suitable for *G. consanguis*.
Photo By: Matt Carroll, GDOT, Senior Ecologist

        - Well-maintained ROWs with only low-growing grasses are not suitable.
        - High-traffic roadside ROWs are not suitable; however, seldom used ROWs on county roads are often suitable.
        - Unlike many other Odonate species, many of which can often be found perching in tree canopies or the top of the shrub layer, *G. consanguis* typically perches relatively low to the ground (< 5 feet above ground level).

- Microhabitat requirements:
    - *G. consanguis* activity and, therefore, visibility is highly dependent on existing weather conditions. The species is fairly inactive and very difficult to locate during periods of low sunlight and cool to moderate temperatures.
    - *G. consanguis* prefers to perch on objects protruding from the streambank within 2 feet of the water's surface (See**: Image 2.**).
        - Broad leaves, exposed roots, and twigs are frequently used as perch sites (See: **Images 3.** & **4.**).
    - Streambanks adjacent to runs are the preferred perching sites.
        - Banks along slower moving riffles may be used, but the species is unlikely to be found near rapid, turbulent waters.
        - Transitional areas between pools and riffles or runs may also be used, but the species is less likely to be found on the bank adjacent to a large pool.
            - However, given appropriate weather conditions and suitable perch sites, individuals may be found adjacent to pools with moderate flow, especially if there is a high density of *G. consanguis* in the area.
            - Channelized streams with little diversity of in-stream habitat are not suitable.
    - Streambanks with available sunlight are a requirement for the species.
        - Completely shaded streams with dense canopy cover are not considered suitable habitat.
        - The species is attracted to pockets of sunlit areas along streambanks.
    - In general, *G. consanguis* prefers streams with a substrate primarily of small rocks, gravel, and silt. Adults and juveniles will often be concentrated in mud bottomed sections of the creek.
        - The species is unlikely to inhabit streams with turbid or polluted water, such as those affected by nearby development.

- Ideal Habitat:
    - Small, spring fed coldwater streams in remote areas
    - Sunny streambanks adjacent to runs
    - Exposed roots, sturdy leaves, or twigs protruding from the streambank

Image 2. When sunlit, exposed roots shown provide high quality perching habitat for *G. consanguis*.
Photo By: Matt Carroll, GDOT, Senior Ecologist

Image 3. Male *G. consanguis* perched on broad leaf
Photo By: Matt Carroll, GDOT, Senior Ecologist

Image 4. Male *G. consanguis* perched on twig
Photo By: Matt Carroll, GDOT, Senior Ecologist

Cherokee Clubtail Species Survey (Phase 2 Survey)

A scientific collector's permit will not be required since animals will not be captured or handled during this type of survey effort. *G. consanguis* is most easily surveyed for as an adult. It occupies fairly predictable habitats that are generally utilized by few other Odonate species. As such, the combination of the species' behavior, habitat preference, and physical features allow it to be distinguished from other Odonates without capture in most instances.

- Surveys shall be conducted between May 20th and June 20th when adults are most active.
    - Surveys shall be conducted on generally sunny days with no rainfall, or on days with occasional cloud cover, provided the average temperature during the survey is greater than 75˚ F.
        - Ideal temperatures range from 75˚-85˚ F.
    - On slightly overcast days, the species is likely to be more active and observable when temperatures are near or above 80 ˚ F.
    - Surveys shall not be conducted during any rainfall events.
- A minimum of two people is required for the survey unless consent is given by GADNR for the survey to occur with one.
- Surveys shall begin by walking the stream channel for a minimum distance of 100 meters upstream and 300 meters downstream of the proposed roadway/bridge alignment, looking for areas possessing the species' preferred microhabitat characteristics.

- While searching for preferred microhabitats, surveyors shall visually scan the streambanks for flying and perched Odonates.
- All streams suitable for *G. consanguis* should be wadable at the time the survey is conducted.

- When surveyors encounter a well-lit microhabitat adjacent to a run or slow-moving riffle, all suitable perching sites shall be intensively searched from a reasonable distance (at least 10 feet), so as not to disturb individuals that may be present.
  - Individuals of the species may be observed with the unaided eye, but binoculars should be used for identification verification and will aid in searching from a distance.
  - Contrary to most other Odonates, *G. consanguis* is found relatively low to the ground/water. It is unlikely to be found perching more than two feet above the water's surface.
  - The species is relatively conspicuous at these locations and can be easily observed.
- After a preferred microhabitat is reached, surveyors shall visually scan the area for ten minutes to ensure an individual does not return to perch within the area.
  - In the event an individual is located within the microhabitat, surveyors shall continue surveying the area until the initial ten minute time period has elapsed.
    - *G. consanguis* males are territorial and may compete for preferred microhabitats; thus, multiple individuals may be observed within the same microhabitat.
    - Adult *G. consanguis* are less sensitive to human presence than many other Odonates; however, surveyors should be careful to avoid standing so close to perch sites that their presence deters individuals from perching.
  - A photo of each microhabitat shall be included in the protected species survey report.
- Surveys shall continue in this manner until all preferred microhabitats within 100 meters upstream and 300 meters downstream of the proposed roadway/bridge alignment have been surveyed.
- If an open area immediately adjacent to the stream is identified as suitable habitat (old field, ROW, powerline cut), this habitat shall be methodically searched for the presence of adult *G. consanguis*, while considering the following:
  - Effort should be focused on the edges of large, open fields. The species is unlikely to be observed within the center of a field or wide ROW.
  - The entirety of narrow ROWs may be searched for the species; however, it will most often be found on or near riparian edges.
  - Surveyors should focus on broad leaves and small branches approximately 1-5 feet above ground level for perched individuals.
  - A photo of each non-stream habitat surveyed shall be included in the protected species survey report.
- In the event *G. consanguis* is identified, diligent effort shall be made to take several high-quality photographs of the individual.

Image 5. Adult male *G. consanguis*
Photo By: Matt Carroll, GDOT, Senior Ecologist

Image 6. Female *G. consanguis*. In females, typical coloration develops as individuals reach full maturity. Young males may also appear yellow-green, but usually develop typical coloration in two to three weeks.
Photo By: Giff Beaton

Image 7. Adult male *G. consanguis* with typical coloration.
Photo By: Giff Beaton

Image 8. Adult male *G. consanguis* with typical coloration.
Photo By: Giff Beaton

Image 9. *G consanguis* with typical juvenile coloration (both genders).
Photo By: Giff Beaton

Gomphus consanguis
Survey Data Reporting Form

Cherokee Clubtail (*Gomphus consanguis*) & Edmund's Snaketail (*Ophiogomphus edmundo*) Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Target Species (Circle)**:** Cherokee Clubtail Edmund's Snaketail

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

General Habitat Data

Stream name (as listed in ERS-AOER)**:** _____

Nearest road crossing: _____

Length of stream surveyed: _____
(If full 400m stretch was not surveyed, provide explanation)

Average stream wetted width x depth: _____

Average bankfull wetted width x depth: _____

Stream substrate: _____

Stream description (ex. in-channel structure, sinuosity, entrenchment ratio, sources of impairment)**:**
_____

_____

Number of preferred microhabitats surveyed: _____

Number of adjacent, non-stream habitats surveyed (fields, rights-of-way, powerline cuts)**:** _____

Other notes: _____

Microhabitat Stream Data

Microhabitat #:_____ **Distance up/downstream of proposed alignment** (meters)**:** _____

Location of microhabitat (latitude, longitude)**:**_____

Approximate length of microhabitat (ft)**:**_____

Microhabitat wetted and bankfull width x depth: _____

Light availability: _____ **In-channel stream structure:** _____

Flow rate (low, medium, high)**:** _____ **Total # of individuals detected:** _____

Description of potential perch sites (broad leaves, exposed roots, twigs)**:** _____

_____

Behavior when observed (perched/actively flying)**:**_____

Other notes: _____

_____

_____

Microhabitat #:_____ **Distance up/downstream of proposed alignment** (meters)**:** _____

Location of microhabitat (latitude, longitude)**:**_____

Approximate length of microhabitat (ft)**:**_____

Microhabitat wetted and bankfull width x depth: _____

Light availability: _____ **In-channel stream structure:** _____

Flow rate (low, medium, high)**:** _____ **Total # of individuals detected:** _____

Description of potential perch sites (broad leaves, exposed roots, twigs)**:** _____

_____

Behavior when observed (perched/actively flying)**:**_____

Other notes: _____

_____

_____

Non-stream Habitat Data

Non-stream habitat #:_____

Type of habitat surveyed (field, right-of-way, powerline cut)**:**_____

Location of habitat (latitude, longitude)**:**_____

Distance from stream channel: _____

Dominant vegetation: _____

Linear and square feet of area surveyed: _____

Total # of individuals detected: _____

Behavior when observed (perched/actively flying)**:** _____

Other notes: _____

_____

_____

Non-stream habitat #:_____

Type of habitat surveyed (field, right-of-way, powerline cut)**:**_____

Location of habitat (latitude, longitude)**:**_____

Distance from stream channel: _____

Dominant vegetation: _____

Linear and square feet of area surveyed: _____

Total # of individuals detected: _____

Behavior when observed (perched/actively flying)**:** _____

Other notes: _____

_____

_____

Sketch

Please provide a sketch of the stream indicating the locations of surveyed microhabitats, non-stream habitats, and sightings of target species individuals.

Habitat & Species Survey Methodology for Edmund's Snaketail (*Ophiogomphus edmundo*)

Survey Techniques

Habitat Survey for Edmund's Snaketail (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and should consider the following to be suitable habitat.

Throughout the range of *O. edmundo*, the following should be identified as suitable habitat:

- Medium to large-sized, clear streams and rivers with sand/gravel substrate and with moderately fast currents (See: **Image 1.**).
    - The Conasauga and upper Chattooga Rivers are examples of suitable stream habitat and have documented healthy populations of *O. Edmundo* (Beaton, 2008a).
- Adult males are found mostly on rocks in riffles or rapids where water depth is less than 18 inches (Beaton, 2007).
    - The males guard these territories during the breeding season but appear to spend much of their lives outside this timeframe in the treetops.

Image 1. Chattooga River showing suitable size and flow conditions for *O. edmundo*
Source: georgiainfo.galileo.usg.edu

- Females will not be at the water except when mating.
- Immature adults are more likely to be found in open habitat, such as shrubby fields or powerline cuts adjacent to a stream with suitable habitat (Beaton, 2018 [See: **Image 2.**]).
    - Perch on small bushes and/or broadleaf leaves in the sun
        - They are more likely to be in these areas if they are less frequently mowed.
        - They are also more likely to be in these areas if there are flowering trees that attract Hymenoptera.
    - Well-maintained rights-of-way with only low-growing grasses are not suitable.

- High-traffic roadside rights-of-way would not be suitable; however, seldom used rights-of-way on county roads are often suitable.

Image 2. Suitable *O. edmundo* open habitat, showing an area not frequently mowed with exposed bushes and trees for perching
Photo By: Matt Carroll, GDOT, Senior Ecologist

Edmund's Snaketail Species Survey (Phase 2 Survey)

A scientific collector's permit will not be required since animals will not be captured or handled during this type of survey effort.

- Surveying is best accomplished during the flight season in late April through late May.
- Larvae are difficult to find, so it is recommended to only survey for this species as adults.
  - It should be noted that this type of Phase 2 survey will require a scientific collector's permit
  - If larval surveys are the preferred option for a project, prior approval must be obtained by the GDOT Project Ecologist.
- A minimum of two people is required for the survey unless consent is given for the survey to occur with one.
- This species is notoriously difficult to survey and requires near perfect weather during the short flight season when the adults move from the treetops to the breeding habitat (Beaton, 2008a).
- Clear, sunny weather with a temperature above 24°C (75°F) is ideal for surveying, but it is also reasonable to survey when it is cloudy and at least 26.7°C (80°F) (Beaton, 2007).
- Timing of the flight season and appropriate weather conditions are essential and the most important factors to increase the likelihood of spotting this species (Beaton, 2018).

- Surveying for adults within suitable stream habitat consists of walking the banks of the stream in a line transect using standard ecological resource techniques, or wading in the stream, if possible, to survey previously identified perching spots.
- Surveying for adults within suitable adjacent field habitat consists of walking in a line transect using standard ecological resource techniques to survey previously identified perching spots.
- In the event *O. edmundo* is identified, extreme effort shall be made to take quality photographs of the individual.

Ophiogomphus edmundo
Survey Data Reporting Form

Cherokee Clubtail (*Gomphus consanguis*) & Edmund's Snaketail (*Ophiogomphus edmundo*) Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Target Species (Circle)**:** Cherokee Clubtail Edmund's Snaketail

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

General Habitat Data

Stream name (as listed in ERS-AOER)**:** _____

Nearest road crossing: _____

Length of stream surveyed: _____
(If full 400m stretch was not surveyed, provide explanation)

Average stream wetted width x depth: _____

Average bankfull wetted width x depth: _____

Stream substrate: _____

Stream description (ex. in-channel structure, sinuosity, entrenchment ratio, sources of impairment)**:**
_____

_____

Number of preferred microhabitats surveyed: _____

Number of adjacent, non-stream habitats surveyed (fields, rights-of-way, powerline cuts)**:** _____

Other notes: _____

Microhabitat Stream Data

Microhabitat #:_____ **Distance up/downstream of proposed alignment** (meters)**:** _____

Location of microhabitat (latitude, longitude)**:**_____

Approximate length of microhabitat (ft)**:**_____

Microhabitat wetted and bankfull width x depth: _____

Light availability: _____ **In-channel stream structure:** _____

Flow rate (low, medium, high)**:** _____ **Total # of individuals detected:** _____

Description of potential perch sites (broad leaves, exposed roots, twigs)**:** _____

_____

Behavior when observed (perched/actively flying)**:**_____

Other notes: _____

_____

_____

Microhabitat #:_____ **Distance up/downstream of proposed alignment** (meters)**:** _____

Location of microhabitat (latitude, longitude)**:**_____

Approximate length of microhabitat (ft)**:**_____

Microhabitat wetted and bankfull width x depth: _____

Light availability: _____ **In-channel stream structure:** _____

Flow rate (low, medium, high)**:** _____ **Total # of individuals detected:** _____

Description of potential perch sites (broad leaves, exposed roots, twigs)**:** _____

_____

Behavior when observed (perched/actively flying)**:**_____

Other notes: _____

_____

_____

Non-stream Habitat Data

Non-stream habitat #:_____

Type of habitat surveyed (field, right-of-way, powerline cut)**:**_____

Location of habitat (latitude, longitude)**:**_____

Distance from stream channel: _____

Dominant vegetation: _____

Linear and square feet of area surveyed: _____

Total # of individuals detected: _____

Behavior when observed (perched/actively flying)**:** _____

Other notes: _____

_____

_____

Non-stream habitat #:_____

Type of habitat surveyed (field, right-of-way, powerline cut)**:**_____

Location of habitat (latitude, longitude)**:**_____

Distance from stream channel: _____

Dominant vegetation: _____

Linear and square feet of area surveyed: _____

Total # of individuals detected: _____

Behavior when observed (perched/actively flying)**:** _____

Other notes: _____

_____

_____

Sketch

Please provide a sketch of the stream indicating the locations of surveyed microhabitats, non-stream habitats, and sightings of target species individuals.

MAMMALS

Habitat & Species Survey Methodology for Rafinesque's Big-Eared Bat (*Corynorhinus rafinesquii*)

Survey Techniques

Habitat Survey for Rafinesque's Big-eared Bat (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify potential roost sites. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Throughout *C. rafinesquii* range, the following should be identified as suitable roosting habitat:
    - Bridges and culverts
    - Dimly lit structures such as wells, cisterns and abandoned buildings
- In the Piedmont portion of *C. rafinesquii* range, the following should be identified as additional suitable roosting habitat:
    - Oak-hickory forests with peeling-barked tree species and large, hollow trees that are in or in close proximity to larger streams, rivers and bodies of water
    - Entrance zones of caves and mines
    - Rock shelters (See: **Image 1.**): recessed areas along cliff-sides that are sheltered from wind and rain
- In the Coastal Plain portion of *C. rafinesquii* range, the following should be identified as additional suitable roosting habitat:
    - Mature cypress/tupelo-gum swamps with large, hollow trees (See: **Image 2.**)
        - Roost trees are typically 18-25m tall, with an average diameter of around 125cm that contain large cavities and openings that allow for ease of entrance and exit to the cavity.

Image 1. Rock Shelter
Source: http://dnr.wi.gov/topic/Lands/naturalareas/index.asp?SNA=44

- Trees with basal openings are preferred, but there are occurrence records in trees with middle and upper bole openings as well (BCISBDN, 2013).
- Basal openings must be large enough for bats to freely fly out of, but not so large as to allow significant amounts of light into the cavity.

▪ Water tupelo (*Nyssa aquatica*) appear to be the most preferred roost species, as they seem to provide hollow cavities as potential roosting sites more frequently than other available species in the Georgia Coastal Plain (Morris and Coleman, 2017).

- These are followed by black gum (*Nyssa sylvatica*) and then bald cypress (*Taxodium distichum*)
- *C. rafinesquii* prefer darkness, so trees that are hollow from the basal opening all the way to a broken top are less likely to be used—a few males may be found but use by a maternal colony is unlikely.

Image 2. Cavity tree
Photo By: Trina Morris, GADNR, Wildlife Biologist

Rafinesque's Big-eared Bat Species Survey (Phase 2 Survey)

A scientific collector's permit will not be required since animals will not be captured or handled during this type of survey effort.

- Surveys may occur year round in the Coastal Plain, although high water periods may not be appropriate for checking basal hollows for bat presence. Surveys are best conducted during the spring-fall in the Piedmont regions, as individuals often seek caves and mines as winter roosting sites.
- Surveyors shall remain as quiet as possible while conducting surveys, as *C. rafinesquii* is a particularly skittish bat species.

- Abandoned structures, bridges, and rock shelters shall be visually inspected using spotlights to illuminate dark corners, high areas, crevices, etc.
    - Binoculars may be helpful for bridge surveys in order to see further distances.
- All large, hollow trees within the Project area shall be surveyed using the following method (Morris and Coleman, 2017):
    - Extend a large, hand-held mirror into the opening with the face of the mirror directed up into the trunk cavity.
        - If grounding is stable enough, a ladder may be useful to access tree openings that are not low to the ground.
    - Shine a spotlight onto the mirror from a slight angle above in order to illuminate the hollow (See: **Image 3.** & **Figure 1.**).
    - Slowly change the angle of the mirror in order to inspect 360° inside the tree cavity.
        - As *C. rafinesquii* is a particularly skittish species, the light will awaken them, and the distinctive ears will uncoil as they begin to echolocate—allowing species identification to be certain.
        - If many spider webs are covering the hollow opening, it is unlikely there has been recent bat use in the tree.

Image 3. Use of mirror/spotlight technique
Photo By: Trina Morris, GADNR, Wildlife Biologist

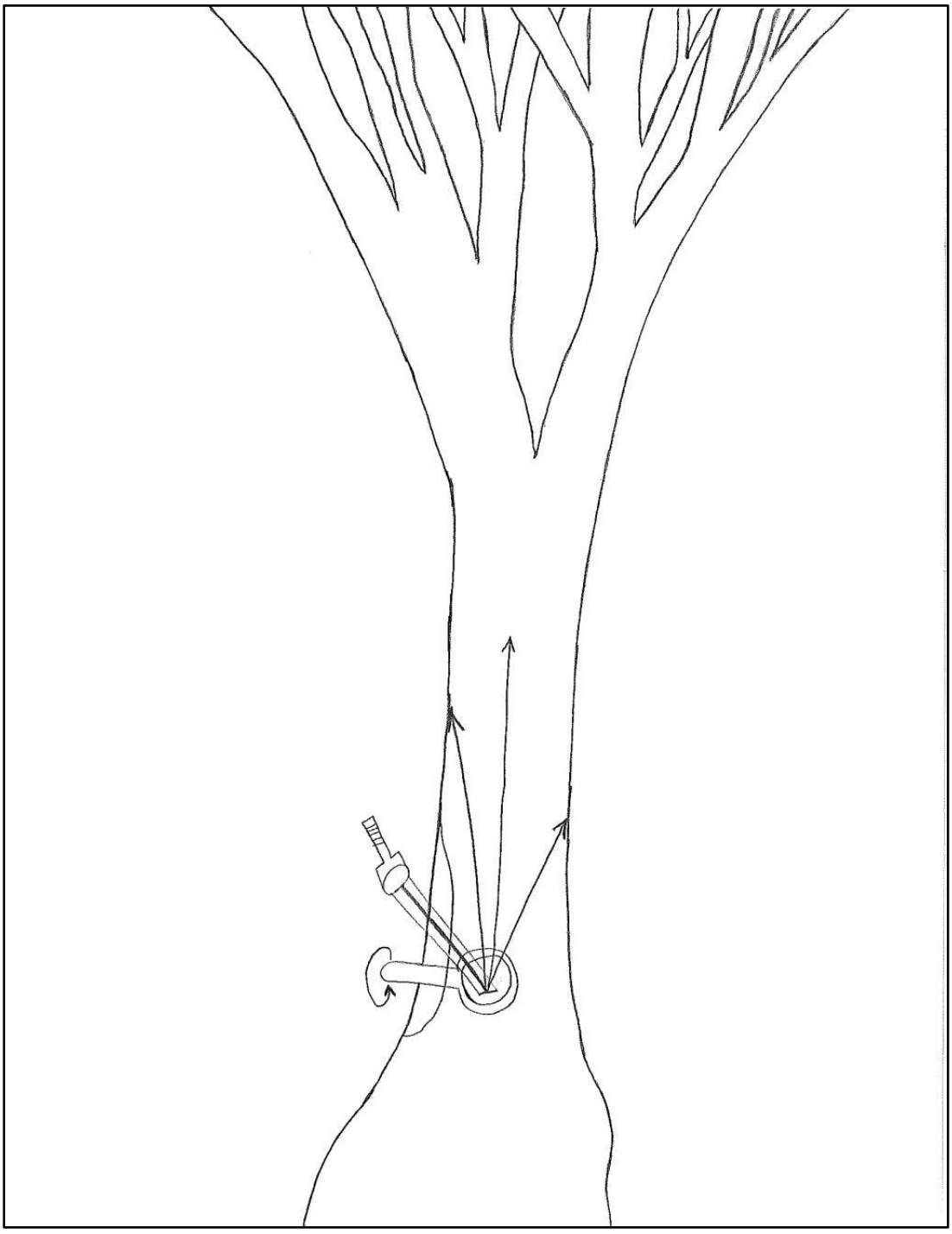


Figure 1. Mirror/spotlight technique diagram

Corynorhinus rafinesquii
Survey Data Reporting Form

Rafinesque's Big-Eared Bat Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Tree Survey Data

Tree #: _____ **Lat:** _____ **Long:** _____

Tree Species: _____ **DBH:** _____ **Alive/Dead** (Circle)

Decay stage: _____

1. **Live, Healthy**
2. **Live, usually unhealthy, obvious defects**
3. **Recently dead; dead leave present, very little decay**
4. **Dead; no leaves, few twigs; < 50% of branches lost**
5. **Dead; most branches and bark lost, top broken**
6. **Dead; no branches or bark; broken off along mid-trunk**

Interior cavity texture: _____

Smooth (<50% of the cavity surface is covered with projections larger than 2cm)
Rough (> 50% of the cavity surface is covered with projections larger than 2cm)

Available cavity height: _____ **Cavity width:** _____ **Top opening present?** (Circle)**:** Yes No

Total # of RBeB detected: _____ **Total # of other bat spp. detected** (& spp. if able to ID)**:** _____

Structure Survey Data

Structure details (e.g. bridge, abandoned building, rock shelter etc.)**:** _____
* If a bridge is on-site, the *Georgia Bats in Bridges Datasheet* should be completed during the Phase 2 Survey as well.

Total # of RBeB detected: _____ **Total # of other bat spp. detected** (& spp. if able to ID)**:** _____

Habitat Survey Methodology for Northern Atlantic Right Whale (*Eubalaena glacialis*)

Source: Wildlife Trust

Survey Techniques

Habitat Survey for Northern Atlantic Right Whale (Phase 1 Survey)

NOAA Fisheries, USFWS, and GADNR do not recommend GDOT to perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures. *E. glacialis* are most common in Georgia waters from November 15 to April 15. If activities can be scheduled from April 15 to November 15, the potential for *E. glacialis* impacts should be minimal.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat (George, 2009).

- *E. glacialis* can be found in all Atlantic Ocean waters east of the Georgia shoreline from November 15 to April 15.
    - Primary habitat consists of oceanic waters, usually along the continental shelf with depths between 100-200m.
    - During calving season, *E. glacialis* habitat usage shifts inland to the shallow (9-15m) waters 5-25mi off of the Georgia coastline.

Habitat & Species Survey Methodology for Southeastern Pocket Gopher (*Geomys pinetis*)

Survey Techniques

Habitat Survey for Southeastern Pocket Gopher (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat within the Project area. Habitat assessment surveys (Phase 1 survey) can be conducted year round and should consider the following information:

A complete habitat survey should assess all open areas dominated with grasses and forbs within the survey area, including hay fields, rights-of-way, scrub/shrub, and pine forests.

- Habitat surveys should focus on open grass/forb areas but can include areas with more limited ground cover.
- The following broad habitat types, if present within a project area, should be considered habitat:
    - Xeric upland communities:
        - Sandhill – natural habitat that typically consists of a deep sand substrate within a savanna of widely spaced longleaf pine (*Pinus palustris*) and/or turkey oak (*Quercus laevis*) or other shrub oaks.
            - Typically, but not exclusively with a wiregrass (*Aristida stricta*) understory
        - Mixed hardwood/pines – Hickory (*Carya* spp.), oak (*Quercus* spp.), and pine (*Pinus* spp.) dominated uplands with well-draining sandy loam soil.
            - Understory generally consists of sparse forbs such as blackberries (*Rubus* spp.) and asters (*Asteraceae*) as well as grasses such as panicgrasses (*Dichanthelium* spp.), bluestems and broomsedges (*Andropogon* spp.), and paspalums *(Paspalum* spp.).
        - Natural longleaf pine – communities dominated with longleaf pine and occasional other pines including loblolly (*P. taeda*), shortleaf (*P. echinata*), and slash (*P. elliottii*).
            - Soils are sandy loam.
            - Understories are diverse with many forbs, shrubs, and grasses (See: **Images 1.** & **2.**).
    - *G. pinetis* prefer moderately to excessively well-draining sand/loam soils with <20% clay—wetlands or wet soil areas should not be considered suitable habitat.

Image 1. Open pine/scrub system with diverse understory and pocket gopher mounds.
Photo By: JT Pynne

Image 2. Open longleaf pine system with diverse understory and mature trees.
Photo By: JT Pynne

Southeastern Pocket Gopher Survey (Phase 2 Survey)

A scientific collector's permit will not be required since animals will not be captured, handled or relocated during the Phase 2 survey.

- Pre-surveys can be done using Google Earth or other imagery using Bennett et al. (in press) method.
- Line transect surveys or transects performed in a square pattern (See: **Figure 1.**) should be conducted throughout the entirety of the previously identified suitable habitat within the Project area in order to detect *G. pinetis* mounds.
    - When conducting transects, sight the distance from the line to the center of mound clusters as one individual.
        - Mound clusters are defined by having ≥3 mounds and delineated by a 10-meter separation between mounds.
    - Distances can be recorded with a GPS (waypoints on the line and at the center of the mound cluster) unit or a rangefinder (citing from the line to the center of the mound cluster) without much difference in detection.
- Issues from detection most often occur when mound look-alikes are present: harvester ant mounds, fire ant mounds, old field mice, pyramid ant mounds, among others, but there are several distinct features for gopher mounds:

- Fresh pocket gopher mounds have a fluffy texture (See: **Image 3.**), but when old they can be more difficult to distinguish, but typically have a horse shoe or bean shape (See: **Images 4.** & **5.**).
- Generally, pocket gopher mounds have multiple mounds present, and when disturbed, no ants are found.

- If mounds are discovered and cannot be avoided during construction, the GDOT Project Ecologist should be contacted in order to discuss relocation efforts with GADNR.

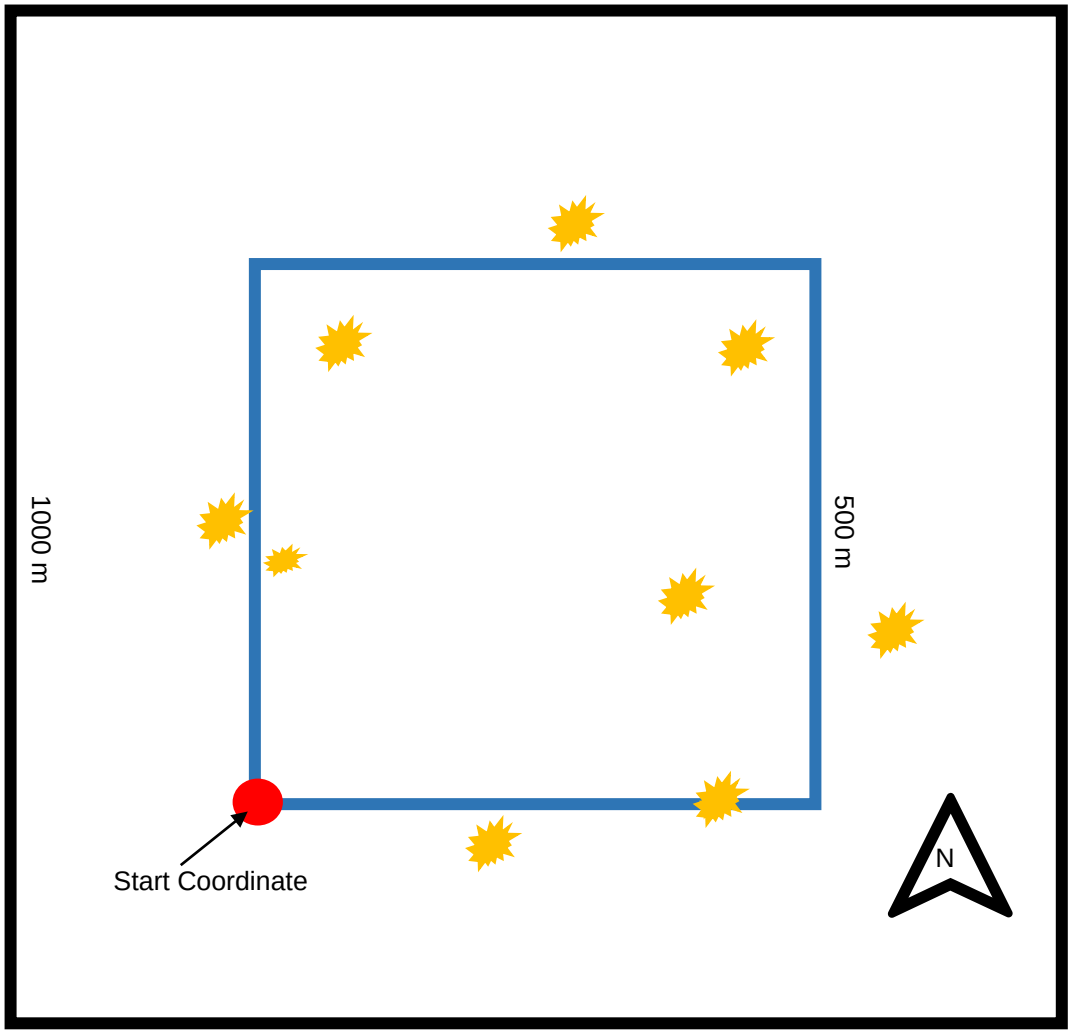


Figure 1. Example design for a transect (blue line) survey in a square pattern. Orange splotches are mound locations, which can be on the line (0 m) or up to any distance visible.

Image 3. *G. pinetis* mound exhibiting typical “fluffy” appearance.
Photo By: Hannah Held, GDOT, Senior Ecologist

Image 4. *G. pinetis* mound after a recent rain, though still exhibiting typical bean shape.
Photo By: Hannah Held, GDOT, Senior Ecologist

Image 5. *G. pinetis* mound after a recent rain, though still exhibiting typical bean shape.
Photo By: Hannah Held, GDOT, Senior Ecologist

Geomys pinetis
Survey Data Reporting Form

Southeastern Pocket Gopher (*Geomys pinetis*) Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Survey Data

Transect ID*	Cluster #**	Latitude	Longitude	Total # of Mounds	# of Fresh Mounds

***** Assign unique identifiers to all completed transects in each survey area.

****** Assign a number to each cluster and record the lat/long at the cluster center.

Habitat & Species Survey Methodology for Gray Bat (*Myotis grisescens*)

Image Source: https://www.fws.gov/midwest/endangered/mammals/grbat_fc.html

Survey Techniques

Habitat Survey for Gray Bat (Phase 1 Survey)

Please note: this methodology is pending updates once the bat programmatic is completed.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- Caves/mines/similar habitats (See: **Image 1.**)
    - Those that maintain average temperatures of 42°-52°F during the winter months and 57°-77°F during the summer months (KDFWR, 2014)
    - If caves, mines, or similar structures are noted within the Project survey area, GDOT does not advise interior searches to determine cave suitability for *M. grisescens* (It should also be noted that winter searches of potential hibernacula require an approved USFWS Section 10 permit).
        - If found, take exterior photos and a GPS point to include in reports.

Image 1. Cave entrance
Source: https://learning.blogs.nytimes.com/2015/08/28/student-crossword-rocks-and-minerals/

- Bridges
    - In rare instances, *M. grisescens* has been noted to use bridges as summer roosts (See: **Image 2.**).
        - Other human-made structures such as houses and barns are not believed to be used by the species (USDOI, 2018a).
    - When encountered, cracks/crevices/rough surfaces/guardrails in these structures shall be visually assessed for signs of bats and/or bat usage (e.g. individuals, urine staining, guano [See: **Images 3.** & **4.**]).
        - Use of a spotlight or other bright light sources is required for these assessments.

- The “Georgia Bats in Bridge Datasheet” shall be filled out for each structure inspected, and data entered into the GADNR database, either through the link provided on the datasheet or using the bats and bridges application.

Unlike most other species, the identification of suitable habitat does not automatically prompt a Phase 2 survey. If habitat is found within the Project survey area, the GDOT Project Ecologist shall be informed. He/she will then contact USFWS and GADNR to determine whether a Phase 2 survey is warranted.

Image 2. *M. grisescens* in a bridge joint
Source: https://fw.ky.gov/Wildlife/Pages/Gray-Bat.aspx

Image 3. Urine staining
Photo By: Anne Sexton, GDOT, Ecologist

Image 4. Guano pile
Photo By: Anne Sexton, GDOT, Ecologist

Gray Bat Species Survey (Phase 2 Survey)

Only ecologists prequalified in Area Class 1.06(h) shall conduct this type of survey effort.

Phase 2 surveys for *M. grisescens* will only be warranted in rare situations; for this reason, USFWS and GADNR shall be contacted on a case-by-case basis to establish a survey protocol for these instances.

Habitat & Species Survey Methodology for: Indiana Bat (*Myotis sodalis*) & Northern Long-eared Bat (*Myotis septentrionalis*)

These species share a Phase 2 survey methodology that proceeds the individual Phase 1 directions.

Indiana Bat (*Myotis sodalis*)

Image Source: https://www.usgs.gov/media/images/indiana-bat-myotis-sodalis

Survey Techniques

Habitat Survey for Indiana Bat (Phase 1 Survey)

Please note: this methodology is pending updates once the bat programmatic is completed.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

Throughout the *M. sodalis* range, the following should be considered suitable summer habitat (USDOI, 2018b[1]):

- Forested/wooded habitats characterized by the following:
    - Live trees and/or snags ≥5 inches (in) [12.7 centimeter (cm)] diameter at breast height (dbh) that have exfoliating bark, cracks, crevices, and/or hollows[2] (See: **Images 1. – 3.**)
        - Individual trees are only considered suitable habitat when they exhibit these characteristics ***and*** are located within 1,000 feet (ft) [305 meters (m)] of other suitable forested/wooded habitat.
        - Wooded fencerows, riparian forests, and other wooded corridors containing the above characteristics are also suitable.

Image 1. Suitable forested habitat
Photo By: Hannah Held, GDOT, Senior Ecologist

[1] The USFWS *Range-wide Indiana Bat Survey Guidelines* is updated annually. If changes occur to the Phase 1 survey portion, this document will be updated as soon as possible; however, if you believe this document to be out-of-date in comparison with the latest USFWS protocol, please default to the USFWS protocol and notify your GDOT Project Ecologist.

[2] While trees <5 in (<12.7 cm) dbh that have exfoliating bark, cracks, crevices, and/or hollows may have some potential to be male *M. sodalis* summer roosting habitat, early-successional, even-aged stands of trees <5 in dbh are **not** considered suitable roosting habitat.

Image 2. Suitable roost trees with exfoliating bark
Photo By: Hannah Held, GDOT, Senior Ecologist

Image 3. *M. sodalis* roosting in 20cm pine snag under exfoliating bark
Source: https://www.researchgate.net/figure

- Previously defined suitable forested habitats that are adjacent to and/or interspersed with wetlands, open waters, streams, agricultural fields, and pastures are more ideal habitat for *M. sodalis*, as foraging occurs in these areas.
    - These types of areas must be connected to the suitable roosting habitat via forested corridors to be considered foraging habitat, as *M. sodalis* are reluctant to cross open areas to get to foraging habitat (USFWS, 2008).
- See **Image 4.** for examples of forested areas not considered suitable habitat due to small dbh, thick mid-stories, and/or lack of species with exfoliating bark.
- It is important to note that winter habitat assessments should consider how forested habitats will appear when trees are fully leaves in the spring and summer (e.g. what may initially appear as marginally suitable habitat in the winter, could actually be too thick of a mid-story once fully leaved).
- Bridges and culverts
    - When encountered, cracks/crevices/rough surfaces in these structures shall be visually assessed for signs of bats and/or bat usage (e.g. individuals, urine staining, guano—See: **Images 5. – 7.**).
    - Use of a spotlight or other bright light source is required for these assessments.
    - When inspecting a bridge or culvert, the "Georgia Bats in Bridge Datasheet" shall be filled out for each structure, and data entered into the GADNR database, either through the link provided on the datasheet or using the bats and bridges application.

The "*GDOT Indiana Bat & Northern Long-eared Bat Habitat Assessment Datasheet*" included in this methodology shall be completed for all Phase 1 surveys and included in the ecology reports. One form should be completed for each distinct forest type.

Unlike most other species, the identification of suitable habitat does not automatically prompt a Phase 2 survey. If habitat is found within the Project survey area, the GDOT Project Ecologist shall be informed. He/she will then contact USFWS and GADNR to determine whether a Phase 2 survey is warranted.

Image 4. Examples of unsuitable forested habitat
Photos By: Hannah Held, GDOT, Senior Ecologist

Image 5. Bats roosting in bridges using cracks in support beams & bridge joints
Source: https://www.environment.fhwa.dot.gov/esawebtool/Site/ibatNLEBBA.aspx#fiveseven

Image 6. Urine staining and guano on support beam
Photo By: Anne Sexton, GDOT, Ecologist

Image 7. Guano pile below bridge deck
Photo By: Anne Sexton, GDOT, Ecologist

Northern Long-eared Bat (*Myotis septentrionalis*)

Image Source: https://www.fws.gov/midwest/endangered/mammals/nleb/nlebfactsheet.html

Habitat Survey for Northern Long-eared Bat (Phase 1 Survey)

Please note: this methodology is pending updates once the bat programmatic is completed.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

Throughout the *M. septentrionalis* range, the following should be considered suitable summer habitat (USDOI, 2018b[1]):

- Forested/wooded habitats characterized by the following:
    - Live trees and/or snags ≥3 in dbh that have exfoliating bark, cracks, crevices, and/or hollows (See: **Images 1. – 3.** & **Image 8.**)
        - Individual trees are only considered suitable habitat when they exhibit these characteristics ***and*** are located within 1,000 ft (305 m) of other suitable forested/wooded habitat.
        - Wooded fencerows, riparian forests, and other wooded corridors containing the above characteristics are also suitable.
        - It is important to note that winter habitat assessments should consider how forested habitats will appear when trees are fully leaved in the spring and summer (e.g. what may initially appear as marginally suitable habitat in the winter, could actually be too thick of a mid-story once fully leaved).
    - Previously defined suitable forested habitats that contain hillsides and ridges are more ideal habitat for *M. septentrionalis*, as foraging primarily occurs within the forested canopies of these areas (Patriquin and Barclay, 2003; Owen et al., 2003).
- Human-made structures, such as buildings, barns, bridges, culverts, and bat houses (See: **Images 5.**, **9.**, & **10.**)
    - When encountered, cracks/crevices/rough surfaces in these structures shall be visually assessed for signs of bats and/or bat usage (e.g. individuals, urine staining, guano [See: **Images 6.** & **7.**]).
        - Use of a spotlight or other bright light source is required for these assessments.
        - If inspecting a bridge or culvert, the "Georgia Bats in Bridge Datasheet" shall be filled out for each structure, and data entered into the GADNR database, either through the link provided on the datasheet or using the bats and bridges application.

The "*GDOT Indiana Bat & Northern Long-eared Bat Habitat Assessment Datasheet*" included in this methodology shall be completed for all Phase 1 surveys and included in the ecology reports. One form should be completed for each distinct forest type.

Unlike most other species, the identification of suitable habitat does not automatically prompt a Phase 2 survey. If habitat is found within the Project survey area, the GDOT Project Ecologist shall be informed. He/she will then contact USFWS and GADNR to determine whether a Phase 2 survey is warranted.

Image 8. *M. septentrionalis* roosting in snag under exfoliating bark
Source:
https://fw.ky.gov/Wildlife/Pages/Northern-Long-eared-Bat.aspx

Image 9. Abandoned shed with potential to serve as a summer roost site
Photo By: Gray Vickery, GDOT, Ecologist

Image 10. Abandoned house with potential to serve as a summer roost site
Photo By: Sara Kuhn, GDOT, Ecologist

GDOT Indiana Bat & Northern Long-eared Bat Habitat Assessment Datasheet

General Information

Surveyor(s):_____

Date: _____ **Field survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Approx. survey area centroid (Lat/Long)**:** _____

Species Information

Target Species (Circle all that apply)**:** Indiana bat Northern Long-eared bat

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Desktop Review Data

Total survey area acreage: _____ **Total forested ac. within survey area:** _____

Landscape w/in 5mi Radius
Flight corridors to other forested areas and/or foraging areas? If yes, please describe:
Describe adjacent properties (e.g. forested, grassland, commercial, residential, water resources, etc.)**:**

Field Assessment Data

Does the forested area(s) contain live trees and/or snags that could serve as suitable roosting habitat for Indiana bat (≥5in dbh)? (Circle one) **YES** **NO** **N/A**

Does the forested area(s) contain/is it adjacent to or connected via forested corridor(s) to aquatic resources and/or pastureland/fields that could serve as foraging habitat for Indiana bat? (Circle one) **YES** **NO** **N/A**

Does the forested area(s) contain live trees and/or snags that could serve as suitable roosting habitat northern long-eared bat (≥3in dbh)? (Circle one) **YES** **NO**

Does the forested area(s) contain hillslopes and/or ridges that could serve as suitable foraging habitat for northern long-eared bat? (Circle one) **YES** **NO**

Does the survey area contain any human-made structures that could serve as suitable roosting habitat for northern long-eared bat? (Circle one) **YES** **NO**

Does the survey area contain any individual live trees that could serve as suitable roosting habitat for either Indiana bat or northern long-eared bat that are also within 1,000ft of suitable forested habitat? (Circle one) **YES** **NO**

Indiana Bat and Northern Long-eared Bat Species Survey (Phase 2 Survey)

Only ecologists prequalified in Area Class 1.06(h) shall conduct this type of survey effort.

Phase 2 surveys shall be conducted in accordance with the U.S. Fish and Wildlife Service's *Range-wide Indiana Bat Survey Guidelines*, which is updated annually and available here: https://www.fws.gov/midwest/endangered/mammals/inba/inbasummersurveyguidance.html

Habitat Survey Methodology for Round-tailed Muskrat (*Neofiber alleni*)

Source: https://www.mindenpictures.com/search/preview/round-tailed-muskrat-neofiber-alleni-portrait-florida/0_00413968.html

Survey Techniques

Habitat Survey for Round-tailed Muskrat (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

Round-tailed muskrat (*Neofiber alleni*) typically inhabit shallow, emergent wetlands occurring within the following broad terrestrial habitat types (Schooley et al., 2005):

- Dry prairie (See: **Image 1.**)
- Pine flatwoods (See: **Image 2.**) including long leaf pine (*Pinus palustris*) and slash pine (*Pinus elliotii*)
- Pine plantations
- Oak (*Quercus* spp.) scrub (See: **Image 3.**)

Image 1. Typical dry prairie habitat
Source: https://fineartamerica.com/featured/okefenokee-prairie-myra-glisson.html

Image 2. Typical pine flatwoods habitat
Source: http://volusianaturalist.com/image-gallery-okefenokee-swamp/

Image 3. Typical oak scrub habitat
Source: http://www.bio.miami.edu/pze/Florida%20scrub.html

The following microhabitat characteristics within the previously mentioned larger terrestrial habitats should be considered when assessing the suitability of possible *N. alleni* habitat:

- *N. alleni* are associated with a variety of shallow, emergent wetlands
  - Freshwater and saltwater marshes
  - Muck fields
  - Bogs
  - Pocosins
  - Carolina bays
  - Wet prairies (See: **Image 4.**)

Image 4. Typical wet prairie system
Source: http://volusianaturalist.com/image-gallery-okefenokee-swamp/

- Dominant cover by emergent sedges and presence of floating vegetation mats near open water should be considered suitable habitat (Bergstrom et al., 2000).
- *N. alleni* is most commonly found in areas with water 6 – 18 inches deep with a sandy, peaty or soft substrate deep enough to allow burrowing to water during dry periods (Birkenholz, 1972).

Despite species presence/absence (Phase 2) surveys not being required for *N. alleni*, surveyors should also look for and document possible indicators of current/recent presence of the species when conducting Phase 1 surveys; specifically, apparent *N. alleni* nest houses and feeding platforms. Signs of suspected current or recent presence should be photographed and reported to GADNR.

- *N. alleni* construct spherical to dome-shaped nest houses utilizing sedges (*Carex* spp. and *Eleocharis* spp.), cattails (*Typha* spp.), saw grass (*Cladium* spp.), as well as maidencane (*Panicum hemitomon*) (Harper, 1920; Edwards et al., 2013).
    - Easier to identify during the winter months due to general reduced density of vegetation (Ozier, 1999).
- Nest houses are built atop floating mats of dense aquatic vegetation, such as *Sphagnum* or peat or are attached to the bases of shrubs or small cypress (*Taxodium* spp.) trees (Harper, 1920; Edwards et al., 2013 [See: **Image 5.**]).
    - Easier to identify during the winter months due to general reduced density of vegetation (Ozier, 1999)

Image 5. Round-tailed muskrat nest house
Source: http://www.mammalwatching.com/places/georgia/

- *N. alleni* may construct several feeding platforms in the vicinity of nest houses, consisting of a pad of denuded vegetation, usually 4 – 6 inches in size (Birkenholz, 1962).
- Nesting habitat often observed at the ecotone between mixed emergent marsh and dense chain-fern (*Woodwardia* spp.) marsh (Ozier, 1999).

Habitat Survey Methodology for Appalachian Cottontail (*Sylvilagus obscurus*)

Source: https://www.ncwildlife.org/Portals/0/Learning/documents/Profiles/Mammals/Appalachian_Cottontail_WildlifeProfile.pdf

Survey Techniques

Habitat Survey for Appalachian Cottontail (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

In Georgia, *S. obscurus* have typically been documented at elevations greater than 3,000 feet within the Appalachian Mountains (Chapman et al., 1992; Ozier, 2009), although records are very limited within the state. Individuals have been found as low in elevation as 1,000 feet in other parts of the range. *S. obscurus* typically inhabit the following broad terrestrial habitat types:

- Boreal coniferous forests (See: **Image 1.**)
- Mixed pine-oak woodlands (See: **Image 2.**)
- Successional (6- to 9-year-old) clear-cuts (Boyce & Barry, 2007) (See: **Image 3.**)
- Heath balds (Chapman, 1992) (See: **Image 4.**)

Image 1. Typical boreal coniferous forest habitat
Source:
https://en.wikipedia.org/wiki/Southern_Appalachian_spruce%E2%80%93fir_forest#/media/File:Clingmans-dome-spruce-fir-tn1.jpg

Image 2. Typical mixed pine-oak woodlands
Source: https://www.naturalcommunitiesofgeorgia.com/pine-oak-woodlands.html

Image 3. Typical successional clear-cut habitat
Source: https://www.srs.fs.usda.gov/compass/2014/07/03/young-forests-can-benefit-wildlife/

Image 4. Typical heath bald
Source: https://www.flickr.com/photos/94082222@N00/3923214546/in/photostream/

The following microhabitat characteristics should be considered when assessing the suitability of possible *S. obscurus* habitat:

- *S. obsurus* is associated with areas of dense cover containing shrubby, ericaceous vegetation including (Bunch et al., 2005 [See: **Image 5.**]):
    - Mountain laurel (*Kalmia latifolia*)
    - Blueberries (*Vaccinium* spp.)
    - Blackberries (*Rubus* spp.)
    - Greenbriar (*Smilax* spp.)
    - Cane (*Arundinaria gigantea*)
- Overstory species growing singly or in groups,
    - Common associates within Georgia include hemlock (*Tsuga* spp.) and pines (*Pinus* spp.).
- *S. obscurus* are often associated with disturbed areas or regenerating clear-cuts that are fire-maintained or denuded from wind throw.
- Surrounding forested ecotones typically consist of (Chapman, 1992):
    - Birch (*Betula* spp.)
    - Maple (*Acer* spp.)
    - Aspen (*Populus* spp.)
    - Hollies (*Ilex* spp.)

Image 5. Typical oak forest with ericaceous understory
Source: https://www.researchgate.net/figure/An-oak-forest-with-a-dense-ericaceous-heath-understory-of-blueberry-huckleberry-and_fig14_265728451

Habitat Survey Methodology for West Indian Manatee (*Trichechus manatus*)

Photo By: GADNR

Survey Techniques

Habitat Survey for West Indian Manatee (Phase 1 Survey)

NOAA Fisheries, USFWS, and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessment surveys (Phase 1 survey) should be conducted via pedestrian surveys, can be conducted year round, and shall consider the following to be suitable habitat (George, 2009 & USDOI, 2019).

- *T. manatus* can be found in all tidal fresh, brackish, and salt waters in Georgia, including:
    - Nearshore ocean waters
    - Tidal creeks (See: **Image 1.**)
    - Estuaries
    - Tidal portions of the lower St. Mary's, Satilla, Altamaha, Ogeechee, and Savannah Rivers (See: **Image 2**.)

Image 1. Tidal creek, Jekyll Island, GA
Photo By: Scott Long [CC BY 3.0 (https://creativecommons.org/licenses/by/3.0)]

Image 2. Lower Altamaha River, Glynn County, GA.
Photo By: GADNR

PLANTS

Habitat & Species Survey Methodology for Protected Plant Species

Photos By: GDOT Ecology

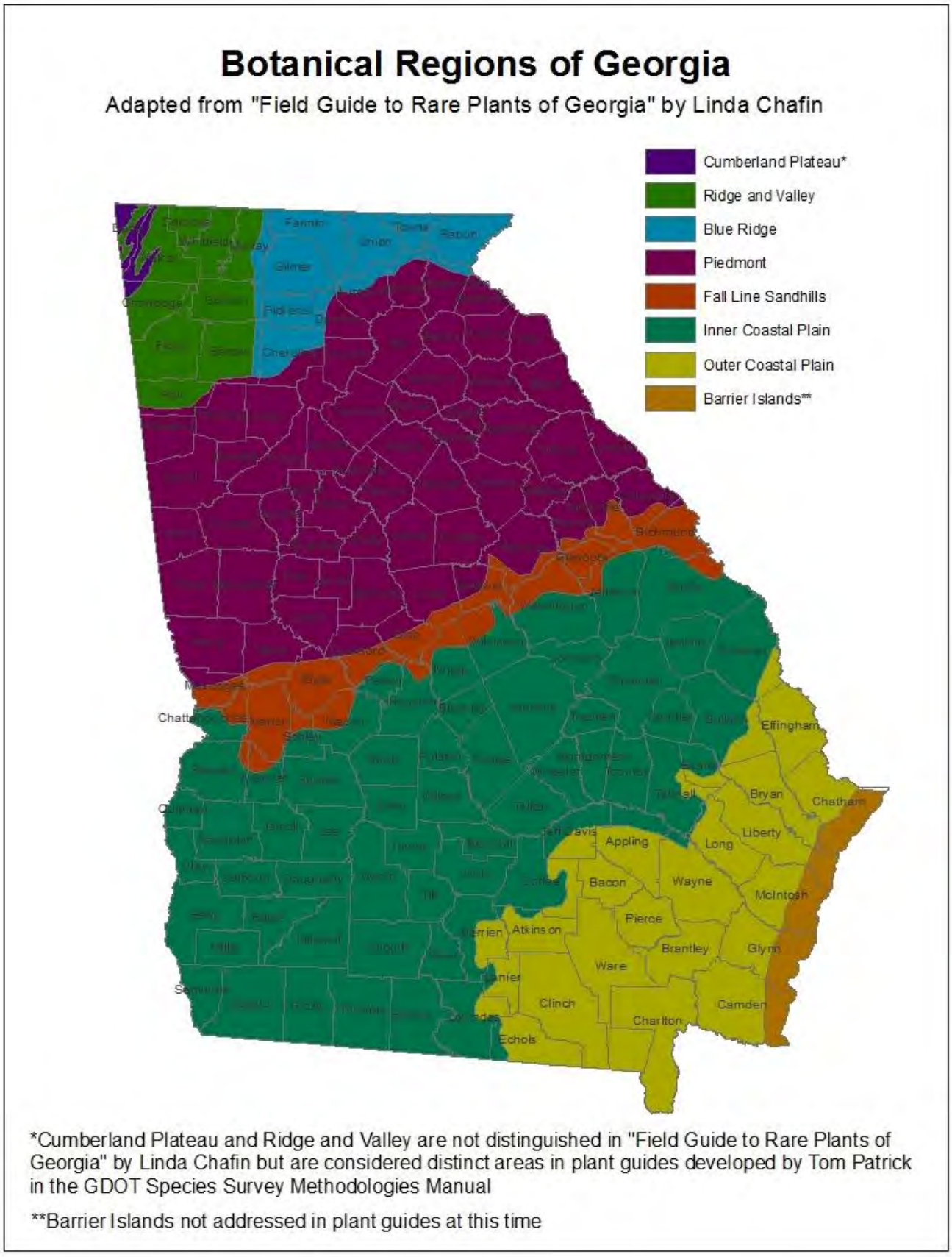
Survey Techniques

Habitat Survey for Protected Plant Species (Phase 1 Survey)

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

The Project Ecologist shall reference the appropriate guide for the botanical region (See: **Inserts 1. – 8.**) where the proposed Project occurs in order to determine suitable habitat characteristics for all species previously identified as potentially occurring in the Project area (See: “Standard Operating Procedures” for Early Coordination details). For Projects that occur in counties containing multiple regions, please reference all relevant guides (i.e. not just the guide for the Project location). For a glossary of habitat terms used in the physiographic region guides, see **Insert 9**.

Insert 1. – Botanical Regions of Georgia Map



Insert 2. Blue Ridge – Protected Plant Habitats Guide

The following is a guide to aid in determining suitable habitat characteristics for state and/or federally protected plants that could occur along highways, or within project areas for new highways, within the Blue Ridge region of Georgia (Patrick, 2019). Of the plants that can be found in this guide, the following species are federally listed, while the remaining are state listed – *Gymnoderma lineare*, *Helonias bullata*, *Isotria medeoloides*, *Platanthera integrilabia*, *Sarracenia oreophila*, *Torreya taxifolia* (introduced), *Trillium persistens*, and *Xyris tennesseensis*.

The Blue Ridge region contains many highly significant natural areas. These areas include boulder fields at high elevations (above 4,000 ft.), high elevation cliffs such as on Rabun Bald, table mountain pine woodlands, and the rocky cliffs of Glade Mountain. Among the natural areas near existing roadsides are serpentine woodlands at Popcorn Overlook, mountain bog safeguarding sites, and ROWs with *Gentianopsis crinita* in the vicinity of Brasstown Bald.

Refer to "The Natural Communities of Georgia by Edwards, Ambrose and Kirkman (2013) for more detailed discussions of the geology and vegetation of the Blue Ridge region. The habitats that may contain protected species are provided below as a rapid means of highlighting what to look for in the Blue Ridge region. Note that some plants occur in more than one habitat. Linda Chafin's "Field Guide to the Rare Plants of Georgia" (2007) is a recommended tool to pair with this quick guide, as it contains maps, habitat illustrations, and identification characteristics for the state's rare plants.

Wetland habitats, as determined by soils and vegetation, plus at least a seasonally wet hydrology or heavy rainfall ponding, seepage or flooding. For seepy or seasonally moist outcrops with little soil, see next half of couplet.

> **Flatwoods and low woods,** areas with perched water tables over amphibolite, gneiss, serpentine or other mafic bedrock, sometimes along small streams; cowbane (*Oxypolis rigidior*) and tall coneflower (*Rudbeckia laciniata*) common associates – [*Pedicularis lanceolata*]
>
> **Sphagnum (peat) bogs,** often with pockets or channels of standing water – [*Helonias bullata*, *Kalmia carolina*, *Platanthera integrilabia*, *Sanguisorba canadensis*, *Sarracenia purpurea* var. *montana*, *Chelone cuthbertii*]
>
> **Fens,** seepages over serpentine or mafic bedrock – [*Sanguisorba canadensis*, *Sarracenia oreophila*, *Xyris tennesseensis*]
>
> **Spring runs,** over limestone or shale – [*Xyris tennesseensis*]
>
> **Moist, forested streamsides,** especially in small, sunny gaps, typically occurring with *Rhododendron* species and mountain laurel (*Kalmia latifolia*) – [*Shortia galacifolia*]; often in bouldery areas with open understory – [*Cymophyllus fraserianus*, *Platanthera integrilabia*]
>
> **Headwaters of small streams on rocks with mosses and liverworts,** in flowing, clear, shallow water forming mats – [*Megaceros aenigmaticus*]

Steepheads and ravines with mountain laurel, – [*Torreya taxifolia, Trillium persistens*] *Torreya taxifolia* has been introduced to Vogel State Park, but because of its status as a federally listed species, impacts to introduced populations shall be assessed. This species is not currently expected to occur in this region outside of Vogel State Park.

Upland, non-wetland habitats, as determined by soils and vegetation, but including temporary shallow seeps and pools on rock outcrops.

Hardwood-dominated, floristically rich, mesic forests and cove hardwoods, – [*Coreopsis latifolia, Cypripedium parviflorum, Hydrastis canadensis, Silene ovata*], often within boulder fields or rocky areas within these habitats – [*Streptopus lanceolatus* var. *lanceolatus, Trientalis borealis*]

Pine-dominated, submesic forests and pine plantations, – [*Cypripedium acaule*]

Old fields, with scattered hawthorns and other encroaching woody vegetation, stony with mafic bedrock – [*Berberis canadensis*]

Roadside backslopes, herb-dominated ROWs and old fields over serpentine bedrock, – [*Gentianopsis crinita*]

Roadsides; thin soils around sandstone outcrops; light gaps within mixed oak-hickory forests; bouldery edges of rivers and streams, – [*Lysimachia fraseri*]

Mesic, mixed pine-hardwood forests between 30 and 60 years old with open understory, usually adjacent to old logging roads, trails, homesites and often showing evidence of recent clearing or thinning; Virginia pine (*Pinus virginiana*) and/or white pine (*Pinus strobus*) a component; Indian cucumber-root (*Medeola virginiana*), hemlock (*Tsuga canadensis*), and northern red oak (*Quercus rubra*) often present. – [*Isotria medeoloides*]

Dry to submesic mixed pine-oak forests with mountain laurel (*Kalmia latifolia*) understory, often with rich mix of pines, including Table Mountain (*Pinus pungens*), Virginia, white, and shortleaf (*Pinus echinata*) and chestnut oak (*Quercus prinus*) – [*Fothergilla major, Monotropsis odorata, Xerophyllum asphodeloides*]

Rocky forests near ridgelines, dry slopes, and cliffs, often with white oak (*Quercus alba*) or northern red oak (*Quercus rubra*) – [*Convallaria pseudomajalis*]; often with Table Mountain and Virginia pines – [*Tsuga caroliniana*]

Thickets of widely spaced, naturally regenerated Virginia pine in formerly submesic chestnut oak forests, often with heath understory; plants at the base of pines, rarely oaks – [*Monotropsis odorata*]

Mesic slopes, often with mountain laurel, rosebay rhododendron (*Rhododendron maximum*), Carolina rhododendron (*Rhododendron carolinianum*), dwarf rhododendron (*Rhododendron minus*), and lowbush blueberry (*Vaccinium angustifolium*) – [*Trillium persistens*]; especially in small, sunny gaps throughout these habitats – [*Shortia galacifolia*]

Dry to submesic hardwood forests, especially in light gaps and forest edges, cliff bases, – [*Calamagrostis porteri*]

High elevation granite outcrops, domes, ledges, summits, and cliffs, – [*Gymnoderma lineare, Leiophyllum buxifolium, Packera millefolium, Solidago simulans*], and seepy ledges within these habitats – [*Carex biltmoreana, Carex misera, Solidago simulans*]

Mountaintop balds and high-elevation rocky clearings, – [*Sibbaldiopsis tridentata, Streptopus lanceolatus* var. *lanceolatus*]

Moist, rocky cliff faces at high elevations, – [*Cetradonia* (*Gymnoderma*) *lineare*] This species is known from one population in the Chattahoochee National Forest in Rabun County and currently, would not be expected to occur outside of this area.

Compiled January 2019 by:
Wildlife Conservation Section
Wildlife Resources Division
Georgia Department of Natural Resources

Edited May 2019 by:
U.S. Fish & Wildlife Service
Georgia Department of Transportation

Insert 3. Ridge & Valley – Protected Plant Habitats Guide

The following is a guide to aid in determining suitable habitat characteristics for state and/or federally protected plants that could occur along highways, or within project areas for new highways, within the Ridge and Valley region of Georgia (Patrick, 2018). Of the plants that can be found in this guide, the following species are federally listed, while the remaining are state listed – *Arabis georgiana, Clematis socialis, Helianthus verticillatus, Marshallia mohrii, Platanthera integrilabia, Sagittaria secundifolia*, *Scutellaria montana*, *Spirea virginia,* and *Xyris tennesseensis.*

The Ridge and Valley Province contains highly significant natural areas – Coosa Prairies, Cassville Mountain Sagponds, Chickamauga Battlefield Limestone Glades, Little Dry Creek WMA (calcareous flatwoods with *Clematis socialis*), Turner Creek Limestone Glade (*Silene regia* in powerline ROW), Drummond Swamp, Mostellar Springs, Blacks Bluff Preserve, and Resaca Battlefield Historic Site (*Scutellaria montana* monitoring sites), among many others.

Refer to "The Natural Communities of Georgia" by Edwards, Ambrose and Kirkman (2013) for more detailed discussions of the geology and vegetation of the Ridge and Valley region. The habitats that may contain protected species are provided below as a rapid means of highlighting what to look for in the Ridge and Valley Province. Note that some plants occur in more than one habitat. Linda Chafin's "Field Guide to the Rare Plants of Georgia" (2007) is a recommended tool to pair with this quick guide, as it contains maps, habitat illustrations, and identification characteristics for the state's rare plants.

Wetland Habitats, as determined by soils and vegetation, plus at least a seasonally wet hydrology or heavy rainfall ponding, seepage or flooding. For seepy or seasonally moist outcrops with little soil, see next major couplet.

> **Streams,** over sandstone – [*Sagittaria secundifolia, Spirea virginiana*]
>
> **Spring runs,** over limestone or shale – [*Xyris tennesseensis*]
>
> **Seepages,** along stream sides or in bogs – [*Platanthera integrilabia*]
>
> **Calcareous flatwoods and low woods,** areas with perched water tables over sedimentary bedrock, forested with open understory – [*Carya myristiciformis, Clematis socialis, Lilium michiganense, Prenanthes barbata, Trillium georgianum, Trillium pusillum*]
>
> **Swamps,** with pockets or channels of standing water and openings in canopy – [*Alnus maritima* ssp. *georgiensis*]; with maple-blackgum dominated canopy – [*Platanthera integrilabia, Trillium pusillum*]
>
> **Low terraces and floodplains,** along streams subject to occasional high-water flooding or with high water tables, over mafic bedrock – [*Aureolaria patula, Jamesianthus alabamensis, Thalictrum debile*]
>
> **Wet prairies and seasonally moist ROWs,** areas over dolomite or shale, dominated by herbs, sometimes with encroaching vegetation – [*Asclepias purpurascens, Clematis fremontii, Helianthus verticillatus, Marshallia mohrii, Rudbeckia heliopsidis, Spiranthes magnicamporum*]

Upland, Non-wetland habitats, as determined by soils and vegetation, but including temporary shallow seeps and pools on rock outcrops.

Hardwood-dominated, floristically rich forests, often over limestone or mafic rock – [*Crataegus triflora, Cypripedium parviflorum, Hydrastis canadensis, Jeffersonia diphylla, Pachysandra procumbens, Scutellaria montana, Veratrum woodii*]

Limestone exposures,

Ledges, cliffs, terraces, – [*Arabis georgiana, Jeffersonia diphylla, Neviusia alabamensis, Silene regia, Viburnum bracteatum*]

Cedar glades, areas with limestone pavement, often with eastern redcedar, seasonally wet, moist or submesic, including adjacent hardwood forests – [*Leavenworthia exigua, spiranthes magnicamporum, Thaspium pinnatifidum*]

Pine-dominated, submesic forests and pine plantations, – [*Cypripedium acaule*]

Old fields, with scattered hawthorns and other encroaching woody vegetation, stony with mafic bedrock – [*Berberis canadensis, Symphyotrichum georgianum*]

Roadsides; thin soils around sandstone outcrops; light gaps within mixed oak-hickory forests; bouldery edges of rivers and streams, – [*Lysimachia fraseri*]

Herb-dominated ROWs, submesic prairies, pine-oak savannas, – [*Sabatia capitata, Symphyotrichum georgianum*]

Wooded slopes adjacent to sagponds, – [*Fothergilla major*]

Compiled November 2018 by:
Wildlife Conservation Section
Wildlife Resources Division
Georgia Department of Natural Resources

Edited May 2019 by:
U.S. Fish & Wildlife Service
Georgia Department of Transportation

Insert 4. Cumberland Plateau – Protected Plant Habitats Guide

The following is a guide to aid in determining suitable habitat characteristics for state and/or federally protected plants that could occur along highways, or within project areas for new highways, within the Cumberland Plateau region of Georgia (Patrick, 2019). Of the plants that can be found in this guide, the following species are federally listed, while the remaining are state listed – *Clematis morefieldii*, *Platanthera integrilabia*, *Sagittaria secundifolia*, *Scutellaria montana*, and *Spiraea virginiana.*

The Cumberland Plateau region contains highly significant natural areas – Pigeon Mountain, with its rich limestone pockets and terraces with limestone exposures; specialized geomorphic features known as gulfs with sandstone ledges; large streams with bouldery gravel bars; and wet meadows and seeps.

Refer to "The Natural Communities of Georgia" by Edwards, Ambrose and Kirkman (2013) for more detailed discussions of the geology and vegetation of the Cumberland Plateau in Georgia. The habitats that may contain protected species are provided as a rapid means of highlighting what to look for on the Cumberland Plateau, including the escarpment downhill to the Ridge and Valley Province. Note that some plants occur in more than one habitat. Linda Chafin's "Field Guide to the Rare Plants of Georgia" (2007) is a recommended tool to pair with this quick guide, as it contains maps, habitat illustrations, and identification characteristics for the state's rare plants. It should be noted, however, that Chafin's guide does not recognize the Cumberland Plateau as a distinct region, but rather, includes it within the Ridge and Valley region.

Wetland habitats, as determined by soils and vegetation, plus at least a seasonally wet hydrology or heavy rainfall pooling, seepage or flooding. For seepy or seasonally moist outcrops with little soil, see next half of couplet.

> **Low terraces and floodplains,** near streams and underlain by limestone or other sedimentary bedrock – [*Hydrastis canadensis, Jeffersonia diphylla, Rudbeckia heliopsidis*]
>
> **Wet meadows and sphagnous (peaty) seepages,** commonly along ROWs atop the plateau, often obscured by lack of prescribed fire and woody plant competition for light and moisture – [*Lilium philadelphicum*, *Platanthera integrilabia, Sabatia capitata*]
>
> **Bouldery gravel bars subjected to periodic eventful flooding along major streams in gulfs on the escarpment,** often in company with shrubby dogwoods (*Cornus* spp.) and *Viburnum* spp. – [*Spiraea virginiana*]
>
> **Shallow runs and riffles of the Little River watershed over sedimentary rock,** the plants anchored in crevices underwater, doing best in stretches with little canopy shade – [*Sagittaria secundifolia*]

Upland, non-wetland habitats, as determined by soils and vegetation, but including temporary shallow seeps and pools on rock outcrops.

> **Partially exposed limestone ledges on the escarpment,** submesic to mesic, often with other calciphiles, such as American smoketree (*Cotinus obovatus*), blue ash (*Fraxinus quadrangulata*), Eastern redcedar (*Juniperus virginiana*), and slippery elm (*Ulmus rubra*) – [*Clematis morefieldii*, *Desmodium ochroleucum, Jeffersonia diphylla, Neviusia alabamensis*]

Roadside backslopes, herb-dominated ROWs, submesic meadows, well-managed pine-oak savannas, – [*Sabatia capitata, Symphyotrichum georgianum*]

Pine-dominated, submesic forests and pine plantations, – [*Cypripedium acaule*]

Submesic, upland pine-hickory-oak forests and woodlands, often within transition zones between flatwoods and uplands– [*Nestronia umbellula*]

Roadsides; thin soils around sandstone outcrops; light gaps within mixed oak-hickory forests; bouldery edges of rivers and streams, – [*Lysimachia fraseri*]

Chestnut oak (*Quercus prinus*) forests with mountain laurel (*Kalmia latifolia*) understory, often with rich mix of pines, including Virginia (*Pinus virginiana*), white (*Pinus strobus*), and shortleaf (*Pinus echinata*) – [*Fothergilla major*, *Monotropsis odorata*]

Thickets of widely spaced, naturally regenerated Virginia pine in formerly submesic chestnut oak forests, – [*Monotropsis odorata*]

Mixed mesophytic forests, often with yellowwood (*Cladrastis kentukea*), white basswood (*Tilia heterophylla*), and Ohio buckeye (*Aesculus glabra*) – [*Cypripedium parviflorum*, *Veratrum woodii*]

Mature mixed pine-oak-hickory forests with rich herbaceous layer, likely on upper slopes just beneath the sandstone caprock – [*Crataegus triflora, Scutellaria montana, Veratrum woodii*]

Compiled January 2019 by:
Wildlife Conservation Section
Wildlife Resources Division
Georgia Department of Natural Resources

Edited May 2019 by:
U.S. Fish & Wildlife Service
Georgia Department of Transportation

Insert 5. Piedmont – Protected Plant Habitats Guide

The following is a guide to aid in determining suitable habitat characteristics for state and/or federally protected plants that could occur along highways, or within project areas for new highways, within the Piedmont region of Georgia (Patrick, 2019). Of the plants that can be found in this guide, the following species are federally listed, while the remaining are state listed – *Amphianthus pusillus*, *Arabis georgiana*, *Echinacea laevigata*, *Helonias bullata*, *Isoetes melanospora*, *Isoetes tegetiformans*, *Isotria medeoloides*, *Platanthera integrilabia*, *Ptilimnium nodosum*, *Rhus michauxii*, *Schwalbea americana*, *Silene polypetala*, *Torreya taxifolia* (introduced), *Trillium persistens*, and *Trillium reliquum.*

Adjacent to the Blue Ridge Province are the Piedmont Foothills of the Piedmont Plateau. Some of the important habitats and sites in the Piedmont Foothills are thought of as within the Blue Ridge region, however, geology dictates that they are included within the Piedmont. Examples of Piedmont Foothills sites include the Blue Ridge Escarpment, Tallulah Gorge, Currahee Mountain, Lee Mountain, Cedar Creek, Davidson Creek, Toccoa Glades, and Panther Creek. *Trillium persistens*, *Platanthera integrilabia*, and *Echinacea laevigata* are conspicuous federally listed plants found in the Piedmont Foothills. The region contains many highly significant natural areas – granite rock outcrops, river shoals, rich hardwood ravines, ultramafic woodlands, and upland perched seepage swamps—to name just a few.

Refer to "The Natural Communities of Georgia" by Edwards, Ambrose and Kirkman (2013) for more detailed discussions of the geology and vegetation of the Piedmont Plateau. The habitats that may contain protected species in the Piedmont are provided as a rapid means of highlighting what to look for within the Piedmont Plateau. Note that some plants occur in more than one habitat. Linda Chafin's "Field Guide to the Rare Plants of Georgia" (2007) is a recommended tool to pair with this quick guide, as it contains maps, habitat illustrations, and identification characteristics for the state's rare plants.

Wetland habitats, as determined by soils and vegetation, plus at least a seasonally wet hydrology or heavy rainfall ponding, seepage or flooding.

> **Hardwood forest low terraces, streamsides, and floodplains,** – [*Jamesianthus alabamensis, Macbridea caroliniana, Scutellaria ocmulgee*, *Stewartia malacodendron, Waldsteinia* (*Geum*) *lobata*]
>
> **Seepage bogs and seasonally moist ROWs,** – usually associated with *Sphagnum* spp., stiff cowbane (*Oxypolis rigidior*), kidney-leaf grass of Parnassus (*Parnassia asarifolia*), sometimes in wooded seeps with sweetbay magnolia (*Magnolia virginiana*), swamp tupelo (*Nyssa biflora*) – [*Platanthera integrilabia*]; often with red maple (*Acer rubrum*), purple pitcherplant (*Sarracenia purpurea*), mountain laurel (*Kalmia latifolia*), rosebay rhododendron (*Rhododendron maximum*), and tag alder (*Alnus serrulata*) – [*Helonias bullata*]
>
> **Seasonally moist ROWs, edges of disturbed wetlands (beaver ponds),** – [*Asclepias purpurascens*]
>
> **Shrub bogs,** – [*Fothergilla gardenii, Kalmia carolina*]
>
> **Headwaters of small streams on rocks with mosses and liverworts,** in flowing, clear, shallow water forming mats – [*Megaceros aenigmaticus*]

Shoals of major streams near Fall Line, – [*Hymenocallis coronaria*]

Upland Seepage Swamps, seasonally wet, perched wetlands over gabbro – [*Quercus oglethorpensis*]

Upland, non-wetland habitats,

Heath Bluffs, evergreen shrub-dominated slopes with mountain laurel, hillside blueberry (*Vaccinium pallidum*), Dwarf rhododendron (*Rhododendron minus*), sometimes a few scattered montane longleaf pine (*Pinus palustris*), blackjack oak (*Quercus marilandica*), and chestnut oak (*Quercus prinus*) – [*Xerophyllum asphodeloides*]

Mesic hardwood ravines, forested habitats with a rich, ephemeral, spring flora over metamorphic amphibolite or mica schist – [*Cypripedium parviflorum, Hydrastis canadensis, Schisandra glabra, Silene polypetala, Silene ovata, Torreya taxifolia, Trillium reliquum, Veratrum woodii*]

Mesic hardwood ravines – Chattahoochee and Flint River Watersheds, rich wildflower sites – [*Croomia pauciflora, Pachysandra procumbens, Rhododendron prunifolium, Trillium reliquum*]

Mixed oak-hickory-pine forests, within acidic soils along slopes and stream terraces – [*Isotria medeoloides*]

Old fields, Rights-of-Way, pine-oak woodlands, generally over mafic, well-drained soils – [*Acmispon helleri, Berberis canadensis, Echinacea laevigata, Marshallia ramosa, Rhus michauxii, Symphyotrichum georgianum*]

Shallow, rocky soils with little-to-no overstory, over magnesium-rich, ultramafic bedrock; often within utility rights-of-way – [*Paronychia virginica, Symphyotrichum georgianum*]

Pine-dominated, submesic forests and pine plantations, – [*Cypripedium acaule, Schwalbea americana*]

Submesic, upland pine-hickory-oak forests and woodlands, – [*Nestronia umbellula*]

Granite or Granitic Outcrops, there are several types of granite outcrops, thus the term "granitic" may be more accurate as the bedrock can range from porphyritic granite (large chunks of feldspar evident, as at Heggies Rock) to Lithonia gneiss (banded patterns) – [*Allium speculae, Amphianthus pusillus, Cuscuta harperi, Draba aprica, Eriocaulon koernickianum, Isoetes melanospora, Isoetes tegetiformans, Nestronia umbellula, Ptilimnium nodosum*, and *Sedum pusillum*].

Rocky bluffs along major streams, bedrock of limestone, shale or granitic gneiss; open understory, sparse canopy, often near eastern redcedar (*Juniperus virginiana*) – [*Arabis georgiana, Sedum nevii*]

Ultramafic barrens and woodlands, especially in mowed ROWs, largest ultramafic barrens occur in the Burks Mountain complex, Columbia County – [*Elliottia racemosa, Pediomelum piedmontanum*]

Moist cove forests of the Blue Ridge Escarpment, Savannah River watershed, especially near the Brevard Fault, sometimes referred to as “marble coves”, nutrient rich, calcareous or mafic bedrock – [*Carex radfordii*]

Steep gorge slopes over quartzite, present from the Tallulah Gorge downstream on the Tugaloo from the main falls to Panther Creek – [*Trillium persistens*]

Chestnut oak forests with mountain laurel understory, – [*Fothergilla major*]

Virginia pine (*Pinus virginiana*) thickets, – [*Monotropsis odorata*]

Roadsides; thin soils around sandstone outcrops; light gaps within mixed oak-hickory forests; bouldery edges of rivers and streams, – [*Lysimachia fraseri*]

Compiled February 2019 by:
Wildlife Conservation Section
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U.S. Fish & Wildlife Service
Georgia Department of Transportation

Insert 6. Fall Line Sandhills – Protected Plant Habitats Guide

The following is a guide to aid in determining suitable habitat characteristics for state and/or federally protected plants that could occur along highways, or within project areas for new highways, within the Fall Line Sandhills region of Georgia (Patrick, 2019). Of the plants that can be found in this guide, the following species are federally listed, while the remaining are state listed – *Amphianthus pusillus*, *Isoetes tegetiformans*, *Lindera melissifolia*, *Silene polypetala* (formerly *Silene catesbaei*), and *Trillium reliquum.*

The Fall Line Sandhills region contains highly significant natural areas - Black Creek Seepage Bog in the Fall Line Sandhills WMA, Parkers Millpond Tract (owned by The Nature Conservancy), other seepage bogs and seasonal ponds, rich hardwood ravines, and intact longleaf pine uplands - some of which are located on Ft. Benning and Ft. Gordon.

Refer to "The Natural Communities of Georgia by Edwards, Ambrose and Kirkman (2013) for more detailed discussions of the geology and vegetation of the Fall Line Sandhills. The habitats that may contain protected species are provided below as a rapid means of highlighting what to look for in the Fall Line Sandhills region. Note that some plants occur in more than one habitat. Linda Chafin's "Field Guide to the Rare Plants of Georgia" (2007) is a recommended tool to pair with this quick guide, as it contains maps, habitat illustrations, and identification characteristics for the state's rare plants.

Wetland habitats, as determined by soils and vegetation, plus at least a seasonally wet hydrology or heavy rainfall ponding, seepage or flooding.

Sphagnum bogs, swamps, and wet terraces, typically along streams – [*Chamaecyparis thyoides, Kalmia carolina, Sarracenia rubra*]

Atlantic white cedar swamps, – [*Fothergilla gardenii, Kalmia carolina, Macbridea caroliniana, Pinguicula primuliflora, Sarracenia rubra*]

Hardwood forest terraces, slopes, and bluffs, – [*Scutellaria ocmulgee, Silene polypetala, Waldsteinia (Geum) lobata*]

Millponds and peat islands in permanent ponds, – [*Myriophyllum laxum, Sarracenia psittacina, Sarracenia rubra*]

Seasonal ponds and ecotones, – [*Fothergilla gardenii, Lindera melissifolia*]

Seepage bogs, shrub bogs, and seasonally moist ROWs, – [*Fothergilla gardenii, Macbridea caroliniana, Pinguicula primuliflora, Sarracenia rubra*]

Spring runs and clearwater creeks, – [*Myriophyllum laxum, Pinguicula primuliflora*]

Upland, non-wetland habitats,

Granite or Granitic Outcrops, there are several types of granite outcrops, thus the term "granitic" may be more accurate as the bedrock can range from porphyritic granite (large chunks of feldspar evident, as at Heggies Rock) to Lithonia gneiss (banded patterns) – [*Amphianthus pusillus*, *Isoetes tegetiformans*].

Dry, open, sandy ROWs, – [*Pityopsis pinifolia, Stylisma pickeringii* var. *pickeringii*]

Mesic hardwood ravines, forested habitats with a rich, ephemeral, spring flora with nutrient rich soils – [*Croomia pauciflora, Silene ovata, Silene polypetala, Trillium reliquum*]

Mixed oak-hickory-pine forests, – [*Brickellia cordifolia, Nestronia umbellula*]

Old fields, – [*Pityopsis pinifolia, Stylisma pickeringii* var. *pickeringii*]

Scrub oak-longleaf pine (*Pinus palustris*) woodlands, – [*Pityopsis pinifolia, Stylisma pickeringii* var. *pickeringii*]

Submesic, upland longleaf pine-hickory-oak forests and woodlands, – [*Brickellia cordifolia, Nestronia umbellula*]

Xeric sandhills or "balds", these are inland dune-like habitats over deep, white Kershaw sands with scattered scrub, oaks, and pines. In Fall Line Sandhills, known only from Ft. Gordon. – [*Ceratiola ericoides*]

Compiled January 2019 by:
Wildlife Conservation Section
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Georgia Department of Transportation

Insert 7. Inner Coastal Plain – Protected Plant Habitats Guide

The following is a guide to aid in determining suitable habitat characteristics for state and/or federally protected plants that could occur along highways, or within project areas for new highways, within the Inner Coastal Plain region of Georgia (Patrick, 2019). Of the plants that can be found in this guide, the following species are federally listed, while the remaining are state listed – *Arabis georgiana, Lindera melissifolia, Oxypolis canbyi, Ptilimnium nodosum, Schwalbea americana, Silene polypetala, Thalictrum cooleyi, Torreya taxifolia*, and *Trillium reliquum.*

The Inner Coastal Plain is complex and hard to define without geologic details. The Inner Coastal Pain is separated from Outer Coastal Plain by characteristics including elevation, topography, and geologic age. The Outer Coastal Plain is lower in elevation, flatter and more recently exposed terraces representing exposure recent exposure from receding sea levels. As used here, the Inner Coastal Plain is below the Fall Line Sandhills and contains several highly distinguishable subregions (ecoregional subdivisions) including: the Fort Valley Plateau with Black Belt prairies; the Tifton Uplands, which contain hardened sandstone outcrops known as Altamaha Grit exposures; the Dougherty Plain, characterized by its numerous limesink ponds and other features of karst topography; the inland aeolian sand dunes along the Ohoopee and Canoochee rivers; and the Vidalia Uplands, adjoining the Outer Coastal Plain with elevations from 150 to 500 ft. The Vidalia Uplands also contain Altamaha Grit outcrops, steeps bluffs along major rivers, and several Carolina bays.

Refer to "The Natural Communities of Georgia" by Edwards, Ambrose and Kirkman (2013) for more detailed discussions of the geology and vegetation of the Coastal Plain. The habitats that may contain protected species are provided as a rapid means of highlighting what to look for on the Inner Coastal Plain. Note that some plants occur in more than one habitat. Linda Chafin's "Field Guide to the Rare Plants of Georgia" (2007) is a recommended tool to pair with this quick guide, as it contains maps, habitat illustrations, and identification characteristics for the state's rare plants. This region is by far the most floristically diverse in Georgia.

Wetland habitats, as determined by soils and vegetation, plus at least a seasonally wet hydrology or heavy rainfall ponding, seepage or flooding.

Openings in swampy flatwoods and swampy ROWs, often associated with small streams – [*Rudbeckia auriculata, Salix floridana, Sarracenia leucophylla*]

Calcareous swamps and oak flatwoods where soil is typically saturated for long periods, – [*Arnoglossum diversifolium (Cacalia diversifolia), Sideroxylon thornei*]

Boggy openings in maintained ROWs, openings in calcareous swamps and in shallow water of wet thickets, – [*Lythrum curtissii*]

Seasonal ponds, upland depression ponds and ecotones; ponded areas of ROWs, open canopy to full shade; highly variable water levels; this category includes Carolina bays and seasonal cypress (*Taxodium* spp.) ponds – [*Fimbristylis perpusilla, Fothergilla gardenii, Leitneria floridana, Lindera melissifolia, Litsea aestivalis, Oxypolis canbyi, Ptilimnium nodosum (Harperella nodosa), Sideroxylon thornei*]

Seasonal limesink ponds with open canopy and graminoid cover, little or no woody competition due to persistent shallow water table and dense, diverse herbaceous cover; absence of competitive maidencane (*Panicum hemitomon/Hymenachne hemitomon)* – [*Dichanthelium hirstii*]

Seepage bogs, shrub bogs and seasonally moist ROWs, – [*Balduina atropurpurea, Fothergilla gardenii, Macranthera flammea, Pinguicula primuliflora, Rhynchospora solitaria, Sarracenia flava, Sarracenia leucophylla, Sarracenia minor* var. *minor, Sarracenia psittacina, Sarracenia purpurea* var. *venosa, Sarracenia rosea, Sarracenia rubra*]

Seasonally wet, mixed pine-hardwoods, adjacent mesic savannas, and adjacent ROW backslopes, – [*Thalictrum cooleyi*]

Hardwood depressions on exposed mineral soil, especially on the Dougherty Plain; live oak (*Quercus virginiana*) canopy dominant – [*Evolvulus sericeus*]

Altamaha Grit outcrop seepages, – [*Evolvulus sericeus*]

Seepages and adjacent upper slopes with high water table, loamy soils with high calcium, shell fragments and crayfish chimneys in habitat over limestone bedrock – [*Cypripedium kentuckiense*]

Shrub bogs, – [*Fothergilla gardenii*]

Blackwater streambanks and floodplains, – [*Coreopsis integrifolia, Macbridea caroliniana*]

Spring runs, clearwater creeks, Atlantic white cedar (*Chamaecyparis thyoides*) swamps, – [*Myriophyllum laxum, Pinguicula primuliflora*]

Streamhead bogs and bayheads, in peaty soils often with sweetbay magnolia (*Magnolia virginiana*), pond pine (*Pinus serotina*), swamp titi (*Cyrilla racemiflora*), and black titi (*Cliftonia monophylla*) – [*Macranthera flammea, Morella inodora*]

Hardwood forest low terraces, streamsides, and floodplains, – [*Scutellaria ocmulgee, Sideroxylon thornei, Stewartia malacodendron, Waldsteinia (Geum) lobata*]

Sand-bottomed ponds and lakes, usually tannin-stained water – [*Najas filifolia*]

Upland, non-wetland habitats,

Hardwood low terraces, – [*Waldsteinia (Geum) lobata*]

Low terraces along major streams in relict longleaf pine (*Pinus palustris*)-wiregrass (*Aristida stricta*) habitat, can also be persistent in planted slash pine (*Pinus elliottii*) with little site prep – [*Amorpha georgiana*]

Dry, open, sandy backslopes along ROWs, – [*Stylisma pickeringii*]

Submesic, open, sandy backslopes along ROWs, often surrounding Altamaha Grit outcrops and relict longleaf pine-wiregrass woodlands – [*Elliottia racemosa, Marshallia ramosa, Penstemon dissectus*]

Sunny openings around Altamaha Grit outcrops and flint kaolin, – [*Amorpha georgiana*]

Altamaha Grit outcrops, epiphytic on rayless goldenrod (*Bigelowia nuttallii*), orange-grass (*Hypericum gentianoides*), and smallhead blazing-star (*Liatrus microcephala*), – [*Cuscuta harperi*]

Mesic hardwood ravines, forested habitats with a rich, ephemeral, spring flora over limestone bedrock with nutrient rich soils; beech (*Fagus* spp.), Shumard oak (*Quercus shumardii*), southern magnolia (*Magnolia grandiflora*), and basswood (*Tilia* spp.) often indicators – [*Carex baltzellii, Crataegus triflora, Croomia pauciflora, Rhododendron prunifolium, Schisandra glabra, Silene ovata, Silene polypetala, Stewartia malacodendron, Trillium reliquum, Veratrum woodii*]

Mixed oak-hickory-pine forests, – [*Brickellia cordifolia, Nestronia umbellula*]

Limestone glades, openings, thin soils with exposed limestone and/or boulders – [*Desmodium ochroleucum, Sageretia minutiflora, Silene regia, Symphyotrichum georgianum*]

Old fields, – [*Pityopsis pinifolia, Stylisma pickeringii* var. *pickeringii*]

Scrub oak-longleaf pine woodlands, – [*Elliottia racemosa, Stylisma pickeringii*]

Submesic, sandy, upland longleaf pine-hickory-oak forests and woodlands, – [*Astragalus michauxii, Brickellia cordifolia, Carex dasycarpa, Elliottia racemosa, Matelea pubiflora, Nestronia umbellula, Sideroxylon macrocarpum*]

Xeric sandhills or "balds", these are inland dune-like habitats over deep, white Kershaw sands with scattered scrub, oaks, pines; often also with woody goldenrod – [*Clinopodium ashei, Ceratiola ericoides, Matelea pubiflora*]

Subxeric inland fossil dunes, aeolian dunes dominated by Darlington oak (*Quercus hemisphaerica*) and sandy openings, such as in Albany along the Flint River – [*Stylisma pickeringii*]

Limestone cliffs, ledges, caves, outcrops, often with trailing partridgeberry (*Mitchella repens*) vines; well-shaded – [*Asplenium heteroresiliens*]

Steepheads and ravines with mountain laurel (*Kalmia latifolia*), steepheads are narrow, steep ravines formed by springs that undercut from below, headward, away from the mouth of the stream – [*Illicium floridanum, Torreya taxifolia*]

Well-managed longleaf pine-wiregrass woodlands with open understory and diverse ground vegetation, most likely observed after early growing season burns – [*Habenaria quinqueseta, Pteroglossaspis ecristata, Schwalbea americana*]

Open, mesic hardwood bluffs, ROW backslopes, and margins of sand ridges, – [*Matelea alabamensis*]

Sandy, eroding riverbanks, – [*Arabis georgiana*]

Epiphytic on southern magnolia (*Magnolia grandiflora*) and live oak, – especially on lower bluff slopes along major streams, blackwater river swamps and mesic hardwood hammocks; usually mixed with resurrection ferns (*Pleopeltis polypodioides*) – [*Epidendrum magnoliae*]

Altamaha Grit crevices, with high humidity – [*Epidendrum magnoliae*]

Flat-topped or gradually sloping boulders of Altamaha Grit, amidst other herbs in a mesic, high humidity setting – [*Habenaria quinqueseta*]

Compiled March 2019 by:
Wildlife Conservation Section
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Georgia Department of Transportation

Insert 8. Outer Coastal Plain – Protected Plant Habitats Guide

The following is a guide to aid in determining suitable habitat characteristics for state and/or federally protected plants that could occur along highways, or within project areas for new highways, within the Outer Coastal Plain region of Georgia. Of the plants that can be found in this guide, the following species are federally listed – *Baptisia arachnifera, Echinacea laevigata,* and *Lindera melissifolia*.

Like the Inner Coastal Plain, the Outer Coastal Plain is complex and hard to define without geologic details. The Outer Coastal Plain is separated from the Inner Coastal Plain by characteristics including elevation, topography, and geologic age. The Outer Coastal Plain is lower in elevation with wetter soils, flatter and more contains terraces with more recent exposure from receding sea levels. As used here, the Outer Coastal Plain is south and east of the Inner Coastal Plain and just inland from the Barrier Islands. This region contains several distinguishable subregions including: the Okefenokee Plains comprised of pine stands interspersed with numerous swamps and bays; the Sea Island Flatwoods were formed in the Pleistocene and are characterized by vast areas with poorly drained soils dominated by pine flatwoods habitats with embedded dryer areas; the Okefenokee Swamp is a large and unique fire-maintained feature with a mixture of forested swamp and freshwater marsh with some pine-dominated uplands; the Bacon Terraces include relatively flat terraces dissected by much of the upper Satilla River basin; large coastal rivers including the Savannah, Ogeechee, and Altamaha are significant features in the region with large floodplains and terraces; these rivers as well as the Satilla and St. Marys have associated aeolian river dunes with deep sands.

Refer to "The Natural Communities of Georgia" by Edwards, Ambrose and Kirkman (2013) for more detailed discussions of the geology and vegetation of the Coastal Plain. The habitats that may contain protected species are provided as a rapid means of highlighting what to look for on the Outer Coastal Plain. Note that some plants occur in more than one habitat. Linda Chafin's "Field Guide to the Rare Plants of Georgia" (2007) is a recommended tool to pair with this quick guide, as it contains maps, illustrations, and identification characteristics for the state's rare plants.

Wetland habitats, as determined by soils and vegetation, plus at least a seasonally wet hydrology or heavy rainfall ponding, seepage or flooding.

> **Freshwater or brackish swamps and marshes,** sometimes with Sawgrass (*Cladium mariscus ssp. jamaicense*) and Cabbage Palm (*Sabal palmetto*) – [*Leitneria floridana, Evolvulus sericeus*]
>
> **Calcareous swamps and oak flatwoods where soil is typically saturated for long periods,** – [*Sideroxylon thornei*]
>
> **Seasonal ponds, upland depression ponds and ecotones; ponded areas of ROWs,** open canopy to full shade; highly variable water levels; this category includes Carolina bays and seasonal cypress (*Taxodium* spp.) ponds – [*Fothergilla gardenii, Leitneria floridana, Lindera melissifolia, Litsea aestivalis, Sideroxylon thornei*]
>
> **Seepage bogs, shrub bogs, and seasonally moist ROWs,** – [*Balduina atropurpurea, Fothergilla gardenii, Hartwrightia floridana, Macbridea caroliniana, Sarracenia flava, Sarracenia minor* var. *minor, Sarracenia psittacina*]

Open, wet, pine flatwoods and savannas, often with peaty soils – [*Hartwrightia floridana, Macbridea caroliniana, Sarracenia minor var. minor*]

Sphagnum bogs and wet, spring-run terraces, – [*Chamaecyparis thyoides*]

Blackwater streambanks and floodplains, often in openings or disturbed wet sites in ROWs or roadsides – [*Coreopsis integrifolia, Macbridea caroliniana*]

Spring runs, shallow, clear or blackwater streams, and sloughs, also in altered shallow wetlands including beaver ponds, drainage ditches and canals – [*Myriophyllum laxum*]

Streamhead bogs and bayheads, in peaty soils often with sweetbay magnolia (*Magnolia virginiana*), pond pine (*Pinus serotina*), swamp titi (*Cyrilla racemiflora*), and black titi (*Cliftonia monophylla*) – [*Morella inodora*]

Hardwood forest low terraces, streamsides, and floodplains, sometimes with calcareous soils – [*Sideroxylon thornei, Stewartia malacodendron*]

Okefenokee Swamp, usually growing on floating peat (*Sphagnum* spp.) mats – [*Sarracenia minor* var. *okeefenokeensis, Sarracenia psittacina*]

Upland, non-wetland habitats,

Coastal maritime forests over shell mounds, typically on barrier islands, sometimes bordering salt marshes – [*Forestiera godfreyi, Forestiera segregata, Sageretia minutiflora, Sapindus marginatus*]

Low terraces along major streams in relict longleaf pine (*Pinus palustris*)-wiregrass (*Aristida stricta*) habitat, can also be persistent in planted slash pine (*Pinus elliottii*) with little site prep – [*Amorpha georgiana*]

Well-drained, sandy-loamy soils in mixed pine-hardwood forests on river bluffs and stream terraces, levees and swales in floodplains, - [*Carex dasycarpa*]

Submesic, open, sandy backslopes along ROWs, sometimes surrounding Altamaha Grit outcrops and/or among relict longleaf pine-wiregrass woodlands – [*Elliottia racemosa, Penstemon dissectus*]

Open, dry pine flatwoods, often with Southern Wiregrass (*Aristida beyrichiana*) **–** [*Baptisia arachnifera, Pteroglossaspis ecristata*]

Sunny openings associated with Altamaha Grit outcrops, rare in this area but potentially at the far western edge of the Outer Coastal Plain**,** – [*Amorpha georgiana, Penstamon dissectus*]

Mesic hardwood ravines, forested habitats with a rich, ephemeral, spring flora over limestone bedrock with nutrient rich soils; beech (*Fagus* spp.), Shumard oak (*Quercus shumardii*), southern magnolia (*Magnolia grandiflora*), and basswood (*Tilia* spp.) often indicators – [*Stewartia malacodendron*]

Open, grassy ROWs, possibly over calcium-rich soils – [*Echinacea laevigata*]

Dry, sandy, upland longleaf pine-scrub oak forests and woodlands, – [*Astragalus michauxii, Carex dasycarpa, Elliottia racemosa, Matelea pubiflora, Sideroxylon macrocarpum*]

Xeric sandhills or "balds", these are inland dune-like habitats over deep, white Kershaw sands with scattered scrub, oaks, pines; often also with woody goldenrod – [*Ceratiola ericoides*, *Matelea pubiflora*]

Xeric river dunes with deep, well-drained soils, – [*Dicerandra radfordiana*]

Calcareous (shell or limestone) bluffs and outcrops, tabby ruins, often with trailing partridgeberry (*Mitchella repens*) vines; well-shaded – [*Asplenium heteroresiliens*]

Well-managed longleaf pine-wiregrass woodlands with open understory and diverse ground vegetation, most likely observed after early growing season burns – [*Habenaria quinqueseta*, *Pteroglossaspis ecristata*]

Open, mesic hardwood bluffs, ROW backslopes, and margins of sand ridges, – [*Matelea alabamensis*]

Epiphytic on southern magnolia (*Magnolia grandiflora*), live oak (*Quercus virginiana*), and tupelos (*Nyssa spp.*), – especially on lower bluff slopes along major streams, blackwater river swamps, and mesic hardwood hammocks; usually occurring with resurrection fern (*Pleopeltis polypodioides*) – [*Epidendrum magnoliae*]

Compiled December 2019 by:
Wildlife Conservation Section
Wildlife Resources Division
Georgia Department of Natural Resources

Insert 9. – Plant Habitat Terminology Glossary

Aeolian (dunes) – arising from erosion, transportation, and deposition of sediment by wind

Bald – lacking a natural or usual vegetative covering

Bluff – a high, steep bank (aka cliff)

Calcareous – consisting of, or containing calcium; growing on limestone or in soil impregnated with lime

Caprock – a relatively impermeable layer of rock that forms a barrier or seal above the fluids migrating in layers below

Cove (forest) – mixed deciduous forests over rich, fertile, damp soils within bowl-shaped mountain valleys

Escarpment – a long, steep slope, especially one at the edge of a plateau or separating areas of land at different heights

Fen – a wetland with alkaline, neutral, or slightly acidic peaty soil; a low, marshy or frequently flooded area of land

Gabbro – a dark, granular, igneous rock primarily composed of labradorite and augite

Graminoid – herbaceous plant with grass-like morphology

Gulf – a deep ravine, chasm, or abyss

Heath – a rather level, open, uncultivated land, usually with coarse, poorly drained soil, and a surface rich in peat or peaty humus

Mafic (bedrock) – igneous rock that is rich in calcium, magnesium, and iron

Mesic – adequate soil moisture retention year round; water is removed somewhat slowly in relation to supply

Mesophytic – adapted to growing in a moderately moist environment

Sagpond – body of water collected in the lowest parts of a depression formed between two sides of an active fault zone

Sedimentary (bedrock) – that which has formed through the deposition and solidification of sediment, especially sediment transported by water

Serpentine (bedrock) – a type of ultramafic bedrock that is characteristically steep and vulnerable to erosion; soils generally regarded as poor, rocky, and often reddish-brown or gray due to lack of organic content

Steephead – steepheads are narrow, steep ravines formed by springs that undercut from below, headward, away from the mouth of the stream

Submesic – water is readily removed in relation to supply; water available for moderately short periods following precipitation

Subxeric – water is removed rapidly in relation to supply; soil is moist for short periods immediately following precipitation; seasonally moist, periodically dry

Xeric – water is rapidly removed in relation to supply; soil is moist for very brief periods immediately following precipitation; dry and drought resistant, little moisture retention, excessively drained

General Protected Plant Species Survey (Phase 2 Survey)

A scientific collector's permit will not be required since plants will not be collected during this type of survey effort.

Species surveys shall be conducted during the appropriate season(s) noted in **Table 1.** Any surveys conducted outside of the advised season may be considered invalid[1]. Approval from the relevant Agency(ies) and GDOT Project Ecologist must be given to perform surveys outside of the designated season. Species surveys shall consider the following (Cypher, 2002). **For greenfly orchid (*Epidendrum magnoliae*) or sweet pinesap (*Monotropsis odorata*) surveys, please skip to the species-specific Phase 2 surveys for these species.**

- It is strongly recommended that prior to conducting the Phase 2 survey, at least one surveyor who will be present during the Phase 2 survey visit a known reference population (if available) of the species.
    - Reference population observations are especially important for those species that require observation within a specific window that is of short duration (e.g. *Trillium* species). Reference sites should be chosen as near to the same latitude as the proposed Project if possible.
    - Reference populations can be found in **Table 2.**
    - If a reference site visit occurs, GADNR's Survey 123 Plant Reference Visit Acknowledgement Form must be completed. Access guidance for the form can be found in **Appendix C.**
- Surveys are best conducted with at least 2 people.
    - It is preferred that at least one of the surveyors have experience identifying the target species and has seen the species growing in natural habitat.
- Parallel transect lines shall be walked in a zig-zag pattern[2] across the entirety of the previously identified suitable habitat.
    - Transects lines can be arranged in a manner that factors in topography, water bodies, or other features.
- The majority of species can be captured by spacing transects 5-10 meters (16-33 feet) apart. Any variation from this spacing will be noted in species-specific guidance (See: **Table 1.**).
    - Spacing of transect lines should consider how the surrounding habitat could affect visual detection (i.e. closer transects in habitats with thick ground cover and/or understory; closer transects for small and/or nondescript species).
    - Visual detection areas shall overlap in order for surveys to increase species detectability chances (See: **Figure 1.**).

[1] Some survey seasons in this table differ from those listed in the GADNR species profiles—surveyors shall default to this table in all cases.

[2] Except in situations where a zig-zag pattern would not serve as the best suited method to adequately cover the habitat type (e.g. stream beds/banks/seeps, limestone crevices, rock outcrops, ponds, etc.), in which case, transects may be modified as best suited to adequately cover the habitat.

- If the surveyors are uncertain about a species' identification and it is presumed to be a protected species, photographs shall be taken as described in **Insert 10.** for expert verification
    - GPS data described above should still be collected in order to prevent the need for a second Phase 2 survey should the expert verify the occurrence of the protected species.

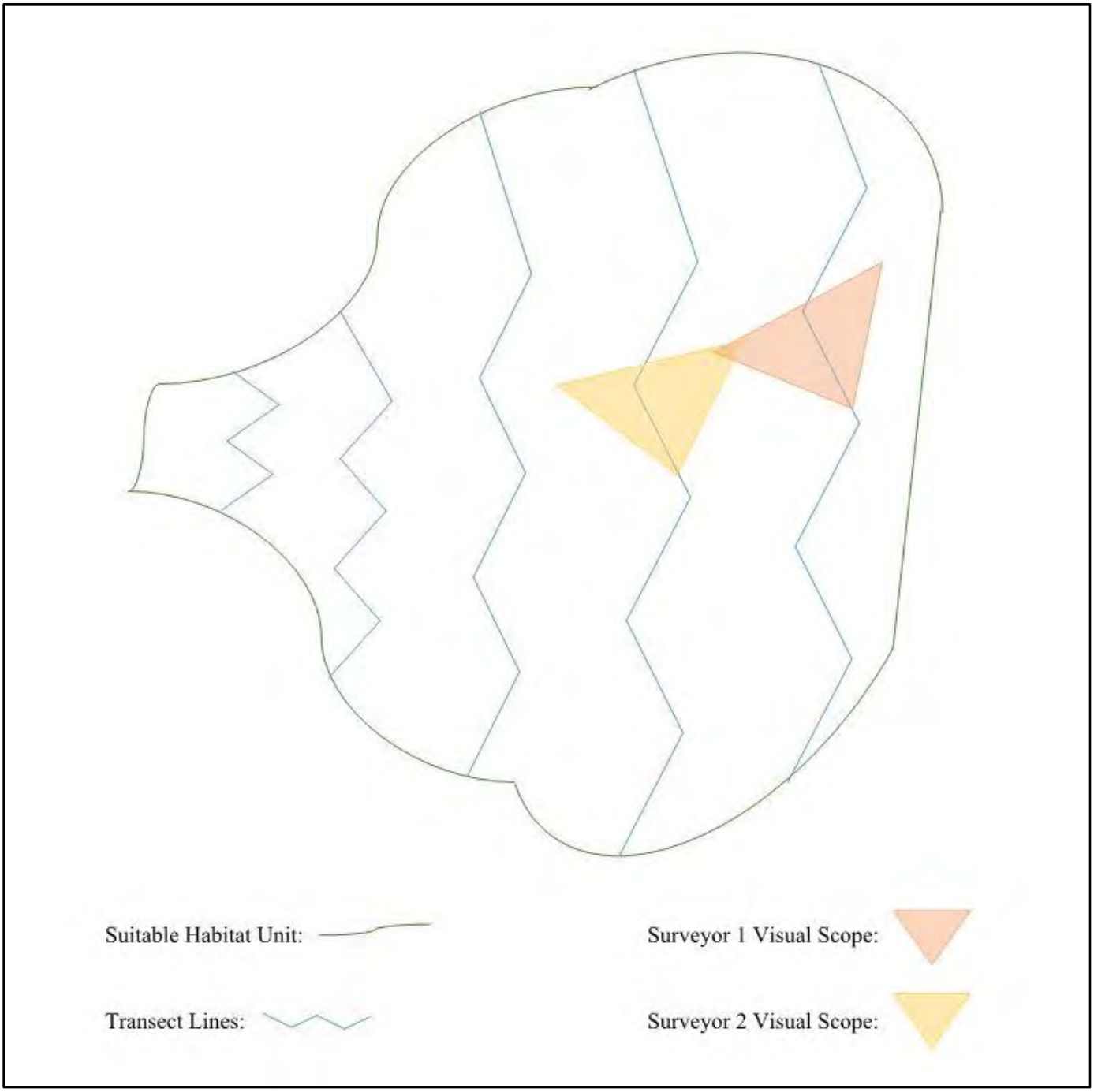

Figure 1. Example Phase 2 Technique Layout

Table 1. Protected Plant Species Phase 2 Survey Seasons

Key	
	Fruiting
	Evergreen
	Flowering
	Other ID Factors
* Phase 2 transects shall be no more than 3m apart	
** Phase 2 transects can be up to 15m apart	
^ Species has unique Phase 2 methodology	

		Spring			Summer			Autumn			Winter		
Common Name	**Scientific Name**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
Carolina Trefoil *	*Acmispon helleri*						Late						
Flatrock Onion	*Allium speculae*			Mid		Mid							
Georgia Alder	*Alnus maritima ssp. georgiensis*												
Georgia Indigo Bush	*Amorpha georgiana*		Mid	Early									
Pool Sprite	*Amphianthus pusillus*												
Georgia Rockcress	*Arabis georgiana*					Early							
Variable-leaf Indian-plantain	*Arnoglossum diversifolium*												
Purple Milkweed	*Asclepias purpurascens*			Late									
Marl Spleenwort *	*Asplenium heteroresiliens*												
Sandhill Milk-vetch	*Astragalus michauxii*												
Spreading Yellow Foxglove	*Aureolaria patula*												
Purple Honeycomb Head	*Balduina atropurpurea*												
Hairy Rattleweed	*Baptisia arachnifera*				Late								

		Spring			Summer			Autumn			Winter		
Common Name	**Scientific Name**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
American Barberry	*Berberis canadensis*												
Heartleaf Brickellia	*Brickellia cordifolia*						Late						
Porter's Reed-grass	*Calamagrostis porteri*												
Ohoopee Wild Basil	*Clinopodium ashei*												
Baltzell's Sedge *	*Carex baltzellii*												
Granite Dome Sedge *	*Carex biltmoreana*												
Velvet Sedge *	*Carex dasycarpa*												
Wretched Sedge *	*Carex misera*												
Radford's Sedge *	*Carex radfordii*		Late		Mid								
Nutmeg Hickory	*Carya myristiciformis*												
Sandhill Rosemary	*Ceratiola ericoides*												
Atlantic White-cedar	*Chamaecyparis thyoides*												
Cuthbert's Turtlehead	*Chelone cuthbertii*					Late							
Fremont's Leatherflower	*Clematis fremontii*												
Alabama Leatherflower	*Clematis socialis*		Late										
American Lily-of-the-Valley	*Convallaria pseudomajalis*												
Floodplain Tickseed	*Coreopsis integrifolia*												
Broadleaf Tickseed	*Coreopsis latifolia*												
Three-flowered Hawthorn	*Crataegus triflora*												
Croomia	*Croomia pauciflora*												
Harper's Dodder *	*Cuscuta harperi*				Late								
Fraser's Sedge	*Cymophyllus fraserianus*		Late										
Pink Ladyslipper	*Cypripedium acaule*												
Kentucky Ladyslipper	*Cypripedium kentuckiense*		Mid	Early									

		Spring			Summer			Autumn			Winter		
Common Name	**Scientific Name**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
American Yellow Ladyslipper	*Cypripedium parviflorum*												
Cream-flowered Tick-trefoil *	*Desmodium ochroleucum*												
Radford's Mint	*Dicerandra radfordiana*							Late	Late				
Hirst's Witch Grass *	*Dichanthelium hirstii*						Late						
Sun-loving Draba	*Draba aprica*												
Smooth Purple Coneflower	*Echinacea laevigata*			Mid									
Georgia Plume	*Elliottia racemosa*												
Greenfly Orchid ^	*Epidendrum magnoliae*												
Dwarf Hatpins	*Eriocaulon koernickianum*			Late									
Silky Morning-glory *	*Evolvulus sericeus*												
Harper's Fimbry *	*Fimbristylis perpusilla*												
Godfrey's Wild Privet	*Forestiera godfreyi*											Late	
Florida Wild Privet	*Forestiera segregata*												
Dwarf Witch-alder	*Fothergilla gardenii*												
Mountain Witch-alder	*Fothergilla major*												
Fringed Gentian	*Gentianopsis crinita*							Late		Early			
Rock Gnome Lichen	*Gymnoderma lineare*												
Michaux's Spider Orchid	*Habenaria quinqueseta*												
Hartwrightia	*Hartwrightia floridana*												
Whorled Sunflower	*Helianthus verticillatus*						Late						
Swamp Pink	*Helonias bullata*				Early								
Goldenseal	*Hydrastis canadensis*	Late											
Shoals Spiderlily	*Hymenocallis coronaria*			Late									

		Spring			Summer			Autumn			Winter		
Common Name	**Scientific Name**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
Florida Anise	*Illicium floridanum*	Mid											
Black-spored Quillwort	*Isoetes melanospora*												
Mat-forming Quillwort	*Isoetes tegetiformans*												
Small Whorled Pogonia	*Isotria medeoloides*												
Alabama Warbonnet	*Jamesianthus alabamensis*												
Twinleaf	*Jeffersonia diphylla*	Late											
Carolina Bog Laurel	*Kalmia carolina*												
Gladecress *	*Leavenworthia exigua*												
Sand-myrtle	*Leiophyllum buxifolium*												
Corkwood	*Leitneria floridana*												
Michigan Lily	*Lilium michiganense*				Mid								
Wood Lily	*Lilium philadelphicum*		Late		Early								
Pond Spicebush	*Lindera melissifolia*	Mid											Late
Pond Spice	*Litsea aestivalis*												
Fraser's Loosestrife	*Lysimachia fraseri*				Mid								
Curtiss' Loosestrife	*Lythrum curtissii*							Early					
Carolina Bogmint	*Macbridea caroliniana*					Mid		Early					
Hummingbird Flower	*Macranthera flammea*												
Coosa Barbara Buttons	*Marshallia mohrii*			Mid	Early								
Pineland Barbara Buttons	*Marshallia ramosa*			Mid									
Alabama Milkvine	*Matelea alabamensis*												
Trailing Milkvine	*Matelea pubiflora*												
Bighorn Hornwort *	*Megaceros aenigmaticus*												
Sweet Pinesap *^	*Monotropsis odorata*												
Odorless Bayberry	*Morella inodora*												

		Spring			Summer			Autumn			Winter		
Common Name	**Scientific Name**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
Lax Water-milfoil	*Myriophyllum laxum*												
Narrowleaf Naiad	*Najas filifolia*												
Indian Olive	*Nestronia umbellula*		Late										
Alabama Snow-wreath	*Neviusia alabamensis*	Late											
Canby Dropwort *	*Oxypolis canbyi*												
Allegheny-spurge *	*Pachysandra procumbens*	Late											
Blue Ridge Golden Ragwort	*Packera millefolium*			Late									
Yellow Nailwort	*Paronychia virginica*						Mid		Early				
Swamp Lousewort	*Pedicularis lanceolata*												
Dixie Mountain Breadroot	*Pediomelum piedmontanum*			Late									
Cutleaf Beardtongue	*Penstemon dissectus*		Late										
Clearwater Butterwort	*Pinguicula primuliflora*												
Sandhill Golden-aster	*Pityopsis pinifolia*												
Monkeyface Orchid *	*Platanthera integrilabia*					Mid							
Barbed Rattlesnake Root	*Prenanthes barbata*												
Crestless Plume Orchid *	*Pteroglossaspis ecristata*												
Harperella	*Ptilimnium nodosum*			Late									
Oglethorpe Oak **	*Quercus oglethorpensis*												
Plumleaf Azalea	*Rhododendron prunifolium*												
Dwarf Sumac	*Rhus michauxii*												
Solitary Beakrush	*Rhynchospora solitaria*												
Swamp Black-eyed Susan	*Rudbeckia auriculata*												
Little River Black-eyed Susan	*Rudbeckia heliopsidis*												

		Spring			Summer			Autumn			Winter		
Common Name	**Scientific Name**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
Cumberland Rose Gentian	*Sabatia capitata*												
Climbing Buckthorn	*Sageretia minutiflora*												
Kral's Water-plantain *	*Sagittaria secundifolia*												
Florida Willow	*Salix floridana*												
Canada Burnet	*Sanguisorba canadensis*												
Soapberry	*Sapindus marginatus*												
Yellow Flytrap	*Sarracenia flava*								Early				
Whitetop Pitcherplant	*Sarracenia leucophylla*								Early				
Hooded Pitcherplant	*Sarracenia minor var. minor*								Early				
Okenfenokee Giant Pitcherplant	*Sarracenia minor var. okefenokeensis*								Early				
Green Pitcherplant	*Sarracenia oreophila*												
Parrot Pitcherplant	*Sarracenia psittacina*												
Mountain Purple Pitcherplant *	*Sarracenia purpurea var. montana*								Early				
Southern Purple Pitcherplant *	*Sarracenia purpurea var. venosa*								Early				
Rose Pitcherplant	*Sarracenia rosea*												
Gulf Sweet Pitcherplant	*Sarracenia rubra ssp. gulfensis*								Early				
Sweet Pitcherplant	*Sarracenia rubra*								Early				
Bay Star-vine	*Schisandra glabra*												
Chaffseed	*Schwalbea americana*												
Large-flowered Skullcap	*Scutellaria montana*			Mid	Early								
Ocmulgee Skullcap	*Scutellaria ocmulgee*				Late								
Nevius Stonecrop	*Sedum nevii*												
Granite Stonecrop	*Sedum pusillum*												

		Spring			Summer			Autumn			Winter		
Common Name	**Scientific Name**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
Oconee Bells	*Shortia galacifolia*	Mid	Mid										
Mountain/Three-toothed Cinquefoil	*Sibbaldiopsis tridentata*												
Ohoopee Bumelia	*Sideroxylon macrocarpum*												
Swamp Buckthorn	*Sideroxylon thornei*								Early				
Ovate Catchfly	*Silene ovata*						Late			Early			
Fringed Campion	*Silene polypetala*	Mid											
Royal Catchfly	*Silene regia*			Late		Early							
Cliffside Goldenrod	*Solidago simulans*												
Virginia Spirea	*Spiraea virginiana*			Late									
Great Plains Ladies-tresses	*Spiranthes magnicamporum*								Mid				
Silky Camellia	*Stewartia malacodendron*												
Rosy Twisted Stalk	*Streptopus lanceolatus var. lanceolatus*			Mid									
Pickering's Morning-glory	*Stylisma pickeringii var. pickeringii*			Late									
Georgia Aster	*Symphyotrichum georgianum*							Late		Mid			
Cooley Meadowrue	*Thalictrum cooleyi*			Mid		Early							
Trailing Meadowrue *	*Thalictrum debile*	Mid											
Glade Meadowparsnip	*Thaspium pinnatifidum*												
Florida Torreya	*Torreya taxifolia*												
Starflower	*Trientalis borealis*												
Dwarf Trillium	*Trillium georgianum*	Mid											
Persistent Trillium	*Trillium persistens*	Mid	Mid										
Relict Trillium	*Trillium reliquum*	Mid											

		Spring			Summer			Autumn			Winter		
Common Name	**Scientific Name**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**
Carolina Hemlock	*Tsuga caroliniana*												
Ozark Bunchflower	*Veratrum woodii*												
Limerock Arrow-wood	*Viburnum bracteatum*		Mid	Mid									
Barren Strawberry	*Waldsteinia lobata*												
Eastern Turkeybeard	*Xerophyllum asphodeloides*			Late									
Tennessee Yellow-eyed Grass	*Xyris tennesseensis*												

Table 2. Population Reference Sites

Reference population locations are provided by the GADNR Wildlife Conservation Section (WCS) for use by the GDOT Office of Environmental Services and its consultants that are prequalified to conduct ecological surveys. These locations are provided as reference sites for visual identification of plant specimens only. Visitors of these sites are not authorized to collect biological specimens. Location information shall not be shared of distributed to any party other than those GDOT ecologists and consultants authorized to conduct surveys as outlined in this manual. Location information may not be shared to any party digitally via email, social media, or other internet platforms without permission from WCS. Please use the Element Occurrence Reporting Form included in this manual to report rare species that are observed during field surveys and reference site visits to WCS for updating the Georgia Rare Species Database. Any species-of-concern listed in the Rare Species Data Portal (http://georgiabiodiversity.org/ *) is of interest to WCS.*

Common Name	Scientific Name	Reference Sites	Notes
Carolina Trefoil	*Acmispon helleri*		
Flatrock Onion	*Allium speculae*		
Georgia Alder	*Alnus maritima ssp. georgiensis*		
Georgia Indigo Bush	*Amorpha georgiana*	Atlanta Botanical Garden (ABG) - Atlanta	
Pool Sprite	*Amphianthus pusillus*	Arabia Mountain Heritage Preserve, Stone Mountain State Park (SP), Heggies Rock Preserve (The Nature Conservancy-TNC), Camp Meeting Rock Preserve (TNC)	For access to TNC preserves, contact GADNR or TNC
Georgia Rockcress	*Arabis georgiana*		
Variable-leaf Indian-plantain	*Arnoglossum diversifolium*		
Purple Milkweed	*Asclepias purpurascens*		
Marl Spleenwort	*Asplenium heteroresiliens*		
Sandhill Milk-vetch	*Astragalus michauxii*	Ohoopee Dunes Wildlife Management Area (WMA), Alan Bailey Property	For access, contact GADNR
Spreading Yellow Foxglove	*Aureolaria patula*		
Purple Honeycomb Head	*Balduina atropurpurea*	Doerun Pitcher Plant Bog WMA; On GA-124, approx. 1 mile north of the Houston Co. Landfill	For specifics, contact GDOT
Hairy Rattleweed	*Baptisia arachnifera*	Paul Lewis Preserve (TNC)	For access contact Jacob Thompson (GADNR) or Alison McGee (TNC)

Common Name	Scientific Name	Reference Sites	Notes
American Barberry	*Berberis canadensis*	Safeguarded population at the GADNR, Wildlife Resources Conservation Center, Social Circle; Sprewell Bluff WMA-Pigeon Creek Tract	For access, contact GADNR
Heartleaf Brickellia	*Brickellia cordifolia*	In Powerline ROW along 1st Kolomolei Rd, approx. 1.5 mi north of Indian Mounds Rd (Kolomoki Mounds SP)	Three Notch EMC is property owner
Porter's Reed-grass	*Calamagrostis porteri*		
Ohoopee Wild Basil	*Clinopodium ashei*	Ohoopee Dunes WMA	For specifics, contact GADNR
Baltzell's Sedge	*Carex baltzellii*		
Granite Dome Sedge	*Carex biltmoreana*		
Velvet Sedge	*Carex dasycarpa*		
Wretched Sedge	*Carex misera*		
Radford's Sedge	*Carex radfordii*		
Nutmeg Hickory	*Carya myristiciformis*		
Sandhill Rosemary	*Ceratiola ericoides*	Ohoopee Dunes WMA	For specifics, contact GADNR
Atlantic White-cedar	*Chamaecyparis thyoides*	Chattahoochee Fall Line WMA; Black Creek Mitigation Bank	For access to Black Creek, contact Lisa Westberry (GDOT)
Cuthbert's Turtlehead	*Chelone cuthbertii*		
Fremont's Leatherflower	*Clematis fremontii*	Little Dry Creek Natural Area (NA)	For access, contact GADNR
Alabama Leatherflower	*Clematis socialis*	Little Dry Creek NA	For access, contact GADNR
American Lily-of-the-Valley	*Convallaria pseudomajalis*		
Floodplain Tickseed	*Coreopsis integrifolia*		
Broadleaf Tickseed	*Coreopsis latifolia*		
Three-flowered Hawthorn	*Crataegus triflora*		
Croomia	*Croomia pauciflora*		
Harper's Dodder	*Cuscuta harperi*	Camp Meeting Rock Preserve (TNC)	For access, contact TNC
Fraser's Sedge	*Cymophyllus fraserianus*	Cohutta WMA-Tumbling Creek	For specifics, contact GADNR
Pink Ladyslipper	*Cypripedium acaule*	Don Carter SP; Dawson Forest WMA; next to Oakwood Baptist Church on Martin Rd (Hall Co.)	For specifics, contact GADNR or GDOT

Common Name	Scientific Name	Reference Sites	Notes
Kentucky Ladyslipper	*Cypripedium kentuckiense*	ABG	
American Yellow Ladyslipper	*Cypripedium parviflorum*	Paulding Forest WMA; Swallow Creek WMA; Don Carter SP	For specifics, contact GADNR
Cream-flowered Tick-trefoil	*Desmodium ochroleucum*		
Radford's Mint	*Dicerandra radfordiana*	Townsend WMA	For specifics, contact GADNR
Hirst's Witch Grass	*Dichanthelium hirstii*	ABG	
Sun-loving Draba	*Draba aprica*	Rock and Shoals NA	For specifics, contact GADNR
Smooth Purple Coneflower	*Echinacea laevigata*		
Georgia Plume	*Elliottia racemosa*	Big Hammock WMA; SR 169/121/114 north of Big Hammock WMA (look for ESA signs)	For specifics, contact GADNR or GDOT
Greenfly Orchid	*Epidendrum magnoliae*	Broxton Rocks Preserve (TNC)	For access, contact GADNR or TNC
Dwarf Hatpins	*Eriocaulon koernickianum*		
Silky Morning-glory	*Evolvulus sericeus*		
Harper's Fimbry	*Fimbristylis perpusilla*		
Godfrey's Wild Privet	*Forestiera godfreyi*	Crooked River SP	For specifics, contact GADNR
Florida Wild Privet	*Forestiera segregata*	Sapelo Island WMA; Cumberland Island National Seashore; US 80 on either side of the Bull River bridge (ID: 151-0066-0)	For specifics, contact GADNR or GDOT
Dwarf Witch-alder	*Fothergilla gardenii*	Gordonia-Alatamaha SP; Fall Line Sandhills NA	For specifics, contact GADNR
Mountain Witch-alder	*Fothergilla major*	Zahnd WMA	For specifics, contact GADNR
Fringed Gentian	*Gentianopsis crinita*	On US 180 between Walnut Springs Rd and Old Toll Rd (Union Co.)	For specifics, contact GDOT
Rock Gnome Lichen	*Gymnoderma lineare*	Brasstown Bald	For specifics, contact GADNR
Michaux's Spider Orchid	*Habenaria quinqueseta*		
Hartwrightia	*Hartwrightia floridana*	Laura Walker SP-safeguarded population	For specifics, contact GADNR
Whorled Sunflower	*Helianthus verticillatus*	Coosa Valley Prairies Preserve (TNC)	For access to TNC preserves, contact GADNR or TNC
Swamp Pink	*Helonias bullata*		

Common Name	Scientific Name	Reference Sites	Notes
Goldenseal	*Hydrastis canadensis*		
Shoals Spiderlily	*Hymenocallis coronaria*	Big Lazer WMA	For specifics, contact GADNR
Florida Anise	*Illicium floridanum*		
Black-spored Quillwort	*Isoetes melanospora*	Mount Arabia Heritage Park	For specifics, contact GADNR
Mat- forming Quillwort	*Isoetes tegetiformans*	Heggie's Rock Preserve (TNC)	For access to TNC preserves, contact GADNR or TNC
Small Whorled Pogonia	*Isotria medeoloides*		
Alabama Warbonnet	*Jamesianthus alabamensis*	Paulding Forest WMA	For specifics, contact GADNR
Twinleaf	*Jeffersonia diphylla*	Pigeon Mountain WMA	For specifics, contact GADNR
Carolina Bog Laurel	*Kalmia carolina*		
Gladecress	*Leavenworthia exigua*		
Sand-myrtle	*Leiophyllum buxifolium*		
Corkwood	*Leitneria floridana*	Chickasawhatchee WMA-Ichauway Plantation	For access, contact GADNR
Michigan Lily	*Lilium michiganense*	Little Dry Creek NA	For specifics, contact GADNR
Wood Lily	*Lilium philadelphicum*	Cloudland Canyon SP	For specifics, contact GADNR
Pond Spicebush	*Lindera melissifolia*	Mayhaw WMA	Contact Mincy Moffett (USFWS) or Alan Isler (GADNR) for location information
Pond Spice	*Litsea aestivalis*	Townsend WMA	For specifics, contact GADNR
Fraser's Loosestrife	*Lysimachia fraseri*		
Curtiss' Loosestrife	*Lythrum curtissii*		
Carolina Bogmint	*Macbridea caroliniana*		
Hummingbird Flower	*Macranthera flammea*		
Coosa Barbara Buttons	*Marshallia mohrii*	Coosa Valley Prairies Preserve (TNC)	For access to TNC preserves, contact GADNR or TNC
Pineland Barbara Buttons	*Marshallia ramosa*	Broxton Rocks Preserve (TNC); Flat Tub WMA; Alligator Creek WMA	For access, contact GADNR or TNC
Alabama Milkvine	*Matelea alabamensis*		
Trailing Milkvine	*Matelea pubiflora*	Big Hammock WMA; Gordonia-Alatamaha SP; Townsend WMA; Little Satilla WMA	For specifics, contact GADNR

Common Name	Scientific Name	Reference Sites	Notes
Bighorn Hornwort	*Megaceros aenigmaticus*		
Sweet Pinesap	*Monotropsis odorata*	Tallulah Gorge SP; Rich Mountain WMA	For specifics, contact GADNR
Odorless Bayberry	*Morella inodora*	Doerun Pitcher Plant Bog WMA	For specifics, contact GADNR
Lax Water-milfoil	*Myriophyllum laxum*		
Narrowleaf Naiad	*Najas filifolia*		
Indian Olive	*Nestronia umbellula*	Stone Mountain SP; Ohoopee Dunes WMA; Little Ocmulgee SP	For specifics, contact GADNR
Alabama Snow-wreath	*Neviusia alabamensis*	Crockford-Pigeon Mountain WMA	For specifics, contact GADNR
Canby Dropwort	*Oxypolis canbyi*	Big Dukes Pond WMA-Neyami Oxypolis Tract (GDOT)	Contact GADNR or Lisa Westberry (GDOT) for access to Neyami
Allegheny-spurge	*Pachysandra procumbens*	Big Lazer WMA	For specifics, contact GADNR
Blue Ridge Golden Ragwort	*Packera millefolium*		
Yellow Nailwort	*Paronychia virginica*		
Swamp Lousewort	*Pedicularis lanceolata*		
Dixie Mountain Breadroot	*Pediomelum piedmontanum*	Along Burks Mountain Road approx. 1.5 miles before it dead-ends at the Savannah River (Columbia Co.)	For specifics, contact GDOT
Cutleaf Beardtongue	*Penstemon dissectus*	Broxton Rocks Preserve (TNC); Flat Tub WMA; Alligator Creek WMA; Bullard Creek WMA; Horse Creek WMA	For specifics, contact GADNR
Clearwater Butterwort	*Pinguicula primuliflora*		
Sandhill Golden-aster	*Pityopsis pinifolia*		
Monkeyface Orchid	*Platanthera integrilabia*	Tallulah Gorge SP; Chattahoochee Bend SP; Pine Log WMA	For specifics, contact GADNR
Barbed Rattlesnake Root	*Prenanthes barbata*		
Crestless Plume Orchid	*Pteroglossaspis ecristata*		
Harperella	*Ptilimnium nodosum*		
Oglethorpe Oak	*Quercus oglethorpensis*		
Plumleaf Azalea	*Rhododendron prunifolium*		
Dwarf Sumac	*Rhus michauxii*	Lower Broad River WMA; Panola Mountain SP	For specifics, contact GADNR

Common Name	Scientific Name	Reference Sites	Notes
Solitary Beakrush	*Rhynchospora solitaria*		
Swamp Black-eyed Susan	*Rudbeckia auriculata*		
Little River Black-eyed Susan	*Rudbeckia heliopsidis*	SR 48 at East Fork Little River (Structure: 055-0007-0)	
Cumberland Rose Gentian	*Sabatia capitata*	SR 48 at East Fork Little River (Structure: 055-0007-0)	
Climbing Buckthorn	*Sageretia minutiflora*	Sapelo Island WMA; Crooked River SP; Ossabaw Island WMA	For specifics, contact GADNR
Kral's Water-plantain	*Sagittaria secundifolia*	SR 48 at East Fork Little River, intersection of SR 48 and Riverhaven Lane	For specifics, contact GDOT
Florida Willow	*Salix floridana*		
Canada Burnet	*Sanguisorba canadensis*		
Soapberry	*Sapindus marginatus*		
Yellow Flytrap	*Sarracenia flava*	Doerun Pitcher Plant Bog WMA; on US-441 across from Homerville Airport	For specifics, contact GADNR or GDOT
Whitetop Pitcherplant	*Sarracenia leucophylla*		
Hooded Pitcherplant	*Sarracenia minor var. minor*	Doerun Pitcher Plant Bog WMA; on US-441 across from Homerville Airport	For specifics, contact GADNR or GDOT
Okenfenokee Giant Pitcherplant	*Sarracenia minor var. okefenokeensis*	Okefenokee Swamp	For specifics, contact GADNR
Green Pitcherplant	*Sarracenia oreophila*	Reed Branch Wet Meadow Preserve (TNC)	For access, contact GADNR or TNC
Parrot Pitcherplant	*Sarracenia psittacina*	Doerun Pitcher Plant Bog WMA	For specifics, contact GADNR
Mountain Purple Pitcherplant	*Sarracenia purpurea var. montana*		
Southern Purple Pitcherplant	*Sarracenia purpurea var. venosa*		
Rose Pitcherplant	*Sarracenia rosea*		
Gulf Sweet Pitcherplant	*Sarracenia rubra ssp. Gulfensis*	Sandhills West WMA	For specifics, contact GADNR
Sweet Pitcherplant	*Sarracenia rubra*	Gordonia-Alatamaha SP	For specifics, contact GADNR

Common Name	Scientific Name	Reference Sites	Notes
Bay Star-vine	*Schisandra glabra*	Allatoona WMA; Paulding Forest WMA; Hard Labor Creek SP; West Point WMA; Dawson Forest WMA	For specifics, contact GADNR
Chaffseed	*Schwalbea americana*	Doerun Pitcher Plant Bog WMA	For specifics, contact GADNR
Large-flowered Skullcap	*Scutellaria montana*	Resaca Battlefield State Historic Site	For specifics, contact GADNR
Ocmulgee Skullcap	*Scutellaria ocmulgee*	Yuchi WMA; Oaky Woods WMA	For specifics, contact GADNR
Nevius Stonecrop	*Sedum nevii*		
Granite Stonecrop	*Sedum pusillum*	Panola Mountain SP; Heggie's Rock Preserve (TNC)	For access, contact GADNR or TNC
Oconee Bells	*Shortia galacifolia*		
Mountain/Three-toothed Cinquefoil	*Sibbaldiopsis tridentata*		
Ohoopee Bumelia	*Sideroxylon macrocarpum*		
Swamp Buckthorn	*Sideroxylon thornei*	Chickasawhatchee WMA; Big Hammock WMA; Along Abbeville Highway at Bluff Creek (Structure: 251-0001-0)	For specifics, contact GADNR or GDOT
Ovate Catchfly	*Silene ovata*		
Fringed Campion	*Silene polypetala*	Big Lazer WMA	For specifics, contact GADNR
Royal Catchfly	*Silene regia*	Approximately 2.5 miles south of Trenton along SR 11 ROW & in GA Power ROW	Contact GDOT for specifics
Cliffside Goldenrod	*Solidago simulans*		
Virginia Spirea	*Spiraea virginiana*		
Great Plains Ladies-tresses	*Spiranthes magnicamporum*		
Silky Camellia	*Stewartia malacodendron*	DI-Lane WMA; Alapaha River WMA; Mistletoe SP; Reed Bingham SP	For specifics, contact GADNR
Rosy Twisted Stalk	*Streptopus lanceolatus var. lanceolatus*		
Pickering's Morning-glory	*Stylisma pickeringii var. pickeringii*	Fall Line Sandhills WMA; Alapaha River WMA	For specifics, contact GADNR
Georgia Aster	*Symphyotrichum georgianum*	Pickett's Mill Battlefield Historic Site; Paulding Forest WMA; Oaky Woods WMA; Red Top Mtn SP; Lower Broad River WMA; Coosawattee WMA; Chattahoochee	For specifics, contact GADNR

Common Name	Scientific Name	Reference Sites	Notes
		Bend SP; John's Mtn WMA; Wilson Shoals WMA; Lake Russel WMA	
Cooley Meadowrue	*Thalictrum cooleyi*		
Trailing Meadowrue	*Thalictrum debile*	Little Dry Creek NA; Along east side of I-75, south of Union Grove Rd exit (Gordon Co.)	For specifics, contact Mincy Moffett (USFWS), GADNR, or GDOT
Glade Meadowparsnip	*Thaspium pinnatifidum*		
Florida Torreya	*Torreya taxifolia*	Vogel SP; Smithgall Woods SP	For specifics, contact GADNR
Starflower	*Trientalis borealis*		
Dwarf Trillium	*Trillium georgianum*	Tallulah Gorge SP; Little Dry Creek NA	For specifics, contact Mincy Moffett (USFWS) or GADNR
Persistent Trillium	*Trillium persistens*	Little Dry Creek NA	For specifics, contact Mincy Moffett (USFWS) or GADNR
Relict Trillium	*Trillium reliquum*	Big Lazer WMA; Western side of I-475 SB just past Colaparchee Rd (at Colaparchee Creek); along west side of SR 219/River Rd, approx. 0.5 mile south of Schley Rd	For specifics, contact GADNR or GDOT
Carolina Hemlock	*Tsuga caroliniana*	Tallulah Gorge SP	For specifics, contact GADNR
Ozark Bunchflower	*Veratrum woodii*	Elachee Nature Center	For specifics, contact GADNR
Limerock Arrow-wood	*Viburnum bracteatum*	Crockford-Pigeon Mountain WMA	For specifics, contact GADNR
Barren Strawberry	*Waldsteinia lobata*	Dawson Forest WMA	For specifics, contact GADNR
Eastern Turkeybeard	*Xerophyllum asphodeloides*	Dawson Forest WMA	For specifics, contact GADNR
Tennessee Yellow-eyed Grass	*Xyris tennesseensis*	Pine Log WMA; private property sites; within I-75 cloverleaf in Bartow Co. (by Tellus Science Center)	For access contact Mincy Moffett (USFWS) or GADNR

Insert 10. – Photo Requirements for Rare Plant Species Identification Verification

Prior to conducting the Phase 2 survey, it is recommended that surveyor(s) consult/study the ***Weakley Flora***, and/or have a hard copy or electronic copy on hand. Another option is to have and use ***FloraQuest***.

The purpose of this consultation/study is to become familiar with the dichotomous key couplets and the features used to split the couplets at various points. For example, if a couplet splits based on the pubescence of an involucral bract, or type of chaff, or glands (stalked, punctate, etc.), then the photographs taken in the field will need to show these characteristics. This may be impossible at times due to the small size of the features requiring magnification. In this situation, the surveyor(s) should examine the specimen and make a determination on this couplet feature and report it.

The following photographs should be taken for post-survey identification of plant specimens:

1. General habitat photos (including subject plant) from two different directions/perspectives.

2. Photographs showing aspect of full plant from two different directions/perspectives with meter measuring stick in photo; or record and report the height taken with a metric measuring device. Do not generalize height, i.e., about knee high; couple of feet, etc.

3. Photographs of both the topside and underside of leaves (and/or leaflets) with a ruler in the photo. Use a white sheet of paper as a background OR measure and report the height and width dimensions in metric units. If the leaves are compound, make sure all leaflets are in a photo.

4. Close-up photograph of leaf petiole, stipule, and stem junction. Make sure photograph is taken at a distance where pubescence can be seen.

5. Multiple photographs of flower/inflorescence or fruit from different angles (side, top, bottom).

6. Close-up photograph of flower/inflorescence or fruit with a ruler using white paper as background.

Note: Photographs against a white paper background may necessitate removing that part of the plant from the growing plant (i.e., collecting, top-snatching). Doing this is acceptable, but care should be taken to leave as much of the plant as possible undamaged. Please collect from only one specimen. If surveyor(s) hold the applicable state and/or federal collection permit, and it is absolutely necessary, specimens can be pressed and sent for identification to the GADNR Wildlife Conservation Section in Social Circle.

Flora of the Southern and Mid-Atlantic States
By Alan S. Weakley
University of North Carolina Herbarium
North Carolina Botanical Garden
University of North Carolina at Chapel Hill
Campus Box 3280
Chapel Hill NC 27599-3280
http://www.herbarium.unc.edu/flora.htm

FloraQuest
http://www.floraquest.com/

Protected Plant Species
Survey Data Reporting Form

Protected Plant Survey Data Reporting Form

General Information

Surveyor(s): _____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Target Species: _____

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Reference site visited (Circle)**?** Yes No **If yes, list location:** _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Survey Data

Habitat Unit #: _____ **Habitat unit centroid point** (Lat/Long)**:** _____

Transect spacing: _____ **Total # of individuals detected:** _____

Other notes/findings: _____

_____

_____

_____

Habitat Unit #: _____ **Habitat unit centroid point** (Lat/Long)**:** _____

Transect spacing: _____ **Total # of individuals detected:** _____

Other notes/findings: _____

_____

_____

Habitat Unit #: _____ **Habitat unit centroid point** (Lat/Long)**:** _____

Transect spacing: _____ **Total # of individuals detected:** _____

Other notes/findings: _____

_____

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_____

_____

Habitat Unit #: _____ **Habitat unit centroid point** (Lat/Long)**:** _____

Transect spacing: _____ **Total # of individuals detected:** _____

Other notes/findings: _____

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Habitat Unit #: _____ **Habitat unit centroid point** (Lat/Long)**:** _____

Transect spacing: _____ **Total # of individuals detected:** _____

Other notes/findings: _____

_____

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_____

_____

Habitat Unit #: _____ **Habitat unit centroid point** (Lat/Long)**:** _____

Transect spacing: _____ **Total # of individuals detected:** _____

Other notes/findings: _____

_____

_____

_____

Species Survey Methodology for Greenfly Orchid (*Epidendrum magnoliae*)

Survey Techniques

Greenfly Orchid Survey (Phase 2 Survey)

A scientific collector's permit will not be required since plants will not be collected during this type of survey effort.

Species surveys (Phase 2 surveys) shall be conducted during the appropriate season(s) noted in **Table 1.** Any surveys conducted outside of the advised season may be considered invalid[1]. Approval from the GDOT Project Ecologist and GADNR must be given to perform surveys outside of the designated season. Species surveys shall consider the following:

- It is strongly recommended that prior to conducting the Phase 2 survey, at least one surveyor who will be present during the Phase 2 survey shall visit a known reference population (if available) of the species (Cypher, 2002).
    - Reference population observations are especially important for those species that require observation within a specific window that is of short duration. Reference sites should be chosen as near to the same latitude as the proposed project if possible.
    - Reference populations can be found in **Table 2.**
    - If a reference site visit occurs, GADNR's Survey 123 Plant Reference Visit Acknowledgement Form must be completed. Access guidance for the form can be found in **Appendix C.**
- Surveys are best conducted with at least 2 people (Cypher, 2002).
    - It is preferred that at least one of the surveyors have experience identifying *E. magnoliae* and has seen the species growing in natural habitat.
- Previously identified suitable trees and/or outcrops shall be thoroughly surveyed with the use of binoculars and/or spotting scopes (See: **Images 1.** & **2.**).
    - This includes all visible branches and/or crevices
    - Trees shall be completely circled in order to assess branches from multiple angles.

Regardless of the outcome of the Phase 2 survey, refer to **Appendix D.** for the minimum required avoidance and minimization efforts for this species.

[1] Some survey seasons in this table differ from those listed in the GADNR species profiles—surveyors shall default to this table in all cases.

Image 1. View of *E. magnoliae* on upper portion of live oak (*Quercus virginiana*) branch through a spotting scope
Image By: Dave Hedeen, GDOT, Ecology Section Manager

Image 2. Zoomed in view of the above *E. magnoliae*
Image By: Dave Hedeen, GDOT, Ecology Section Manager

Species Survey Methodology for Sweet Pinesap (*Monotropsis odorata*)

Survey Techniques

Sweet Pinesap Survey (Phase 2 Survey)

A scientific collector's permit will not be required since plants will not be collected during this type of survey effort.

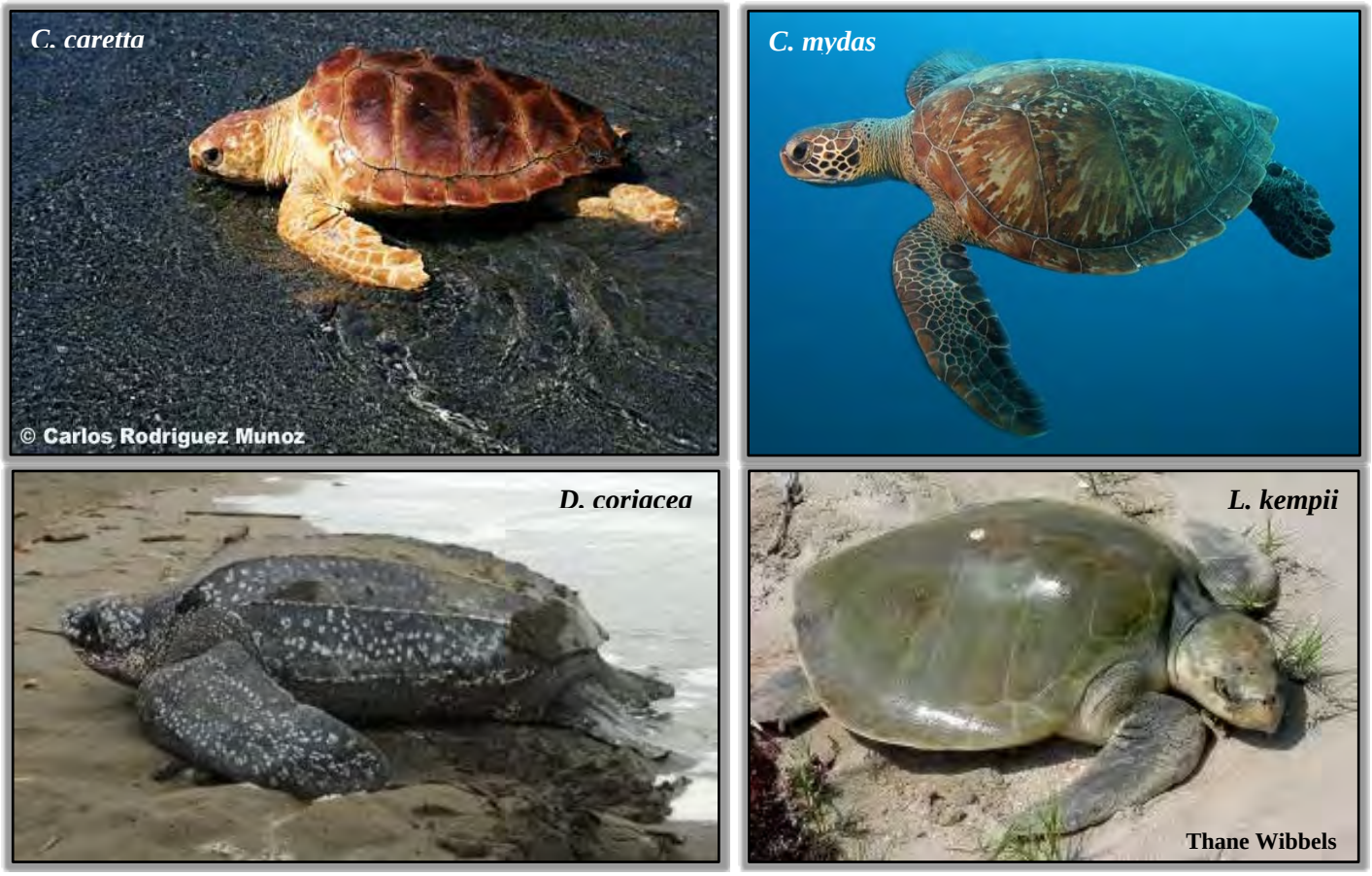
Species surveys (Phase 2 surveys) shall be conducted during the appropriate season(s) noted in **Table 1.** Any surveys conducted outside of the advised season may be considered invalid[1]. Approval from the GDOT Project Ecologist and GADNR must be given to perform surveys outside of the designated season. Species surveys shall consider the following:

- It is strongly recommended that prior to conducting the Phase 2 survey, at least one surveyor who will be present during the Phase 2 survey shall visit a known reference population (if available) of the species (Cypher, 2002).
    - Reference sites should be chosen as near to the same latitude as the proposed project if possible.
    - Reference populations can be found in **Table 2.**
    - If a reference site visit occurs, GADNR's Survey 123 Plant Reference Visit Acknowledgement Form must be completed. Access guidance for the form can be found in **Appendix C.**
- Surveys are best conducted with at least 2 people (Cypher, 2002).
    - It is preferred that at least one of the surveyors have experience identifying *M. odorata* and has seen the species growing in natural habitat.
- Though the acceptable survey season is longer, the last two weeks of March to early-April yields the best results as the very sweet, overpowering fragrance of the plant is very noticeable during this time frame (Patrick, 2018).
- Surveys shall be conducted in the same manner as described for Phase 2 surveys in the general Protected Plant Species section of this manual, however, the following additional steps must be taken to ensure increased detectability rates for *M. odorata:*
    - Leaf litter, especially at the base of mature trees, should be gently lifted from the organic humus layer of the forest floor to reveal the fragile, low-growing emerging, blooming, or fruiting sweet pinesap individuals.
        - Leaf litter disturbed in this fashion should be placed back on the forest floor in an even distribution.
    - The use of a leaf blower to reveal the forest floor and any potential *M. odorata* individuals is also an acceptable method for checking beneath leaf litter—though this method may make the requirement of the restoration of leaves a more labor-intensive activity.
    - As this species has a distinct cinnamon-like fragrance, areas possessing such a scent should be allotted additional scrutiny.

[1] Some survey seasons in this table differ from those listed in the GADNR species profiles—surveyors shall default to this table in all cases.

REPTILES

Habitat Survey Methodology for Loggerhead Sea Turtle (*Caretta caretta*), Green Sea Turtle (*Chelonia mydas*), Leatherback Sea Turtle (*Dermochelys coriacea*), & Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)



Survey Techniques

Habitat Survey for Loggerhead Sea Turtle, Green Sea Turtle, Leatherback Sea Turtle, & Kemp's Ridley Sea Turtle (Phase 1 Survey)

NOAA Fisheries, USFWS, and GADNR do not recommend GDOT perform Phase 2 surveys for these species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

- All 4 of these sea turtle species share the following habitats (Jensen et al., 2011a & c-e):
    - Primary habitat (NOAA Fisheries jurisdiction):
        - Oceanic—often in association with *Sargassum* weeds (See: **Image 1.**)
        - Shallow coastal waters
    - Nesting habitat (USFWS jurisdiction):
        - Barrier island beaches (See: **Images 2.** & **3.**)

Image 1. Oceanic habitat with *Sargassum* sp.
Source: https://environment.bm/open-ocean/

Image 2. Female nesting
Source: https://www.nps.gov/cuis/learn/nature/sea-turtles.htm

- *C. caretta*, *C. mydas*, and *L. kempii* may also be found within estuaries year round but are generally more abundant during the warmer months of April – October (Jensen et al., 2011c & e [See: **Image 4.**])

Image 3. *C. caretta* nest & tracks
Source: https://www.nps.gov/pais/learn/nature/current-nesting-season.htm

Image 4. *C. caretta* in estuarine habitat
Source: GADNR

Habitat & Species Survey Methodology for Spotted Turtle (*Clemmys guttata*)

Survey Techniques

Habitat Survey for Spotted Turtle (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, refer to **Appendix E.** for appropriate protective measures which should be applied to the Project. Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 surveys) can be conducted year round and should consider the following information.

Throughout *C. guttata* range, the following should be identified as suitable habitat:

- Heavily vegetated (forested or herbaceous; see **Images 1** and **2**), shallow wetlands with standing or flowing water including Carolina Bays, bogs, swamps, marshes, and wet meadows*. (Jensen, 2018f)
    - Preferred habitat characteristics include:
        - <0.5m water depth
            - While the species may inhabit the wetlands only where shallower water depths are present, the suitable wetlands themselves are commonly subject to pronounced seasonal fluctuations in water level (Stevenson et al., 2015).
            - If assessing a wetland during a dry period (either a typical annual dry season or longer drought conditions), its suitability should not be ruled out strictly on the absence of standing water. In these scenarios, suitability can be dismissed if the moss trim lines and/or water marks on the trees are higher than 0.5m
                - It should be noted that although waters deeper than 0.5m are considered unsuitable, that does not inherently mean the entirety of the wetland is unsuitable. In these instances, the shallower fringes may still provide habitat for *C. guttata*.
            - If assessing a wetland during a wet season and/or after a large rain event, precaution should be taken to not rule out suitability strictly due to water levels being deeper than 0.5m. In these scenarios, a second Phase 1 survey should occur when conditions are more typical.
        - Standing and fallen trees and shrubs
        - Submerged aquatic vegetation
        - Emergent sedge, rush, and grass tussocks
        - Wetlands with soft, mucky substrates (Jensen, 2018f)

*Wet meadows are suitable only if they have standing water or are immediately adjacent to standing water in typical conditions.

Image 1. Shallow, heavily vegetated, swamp that provides suitable *C. guttata* habitat.
Photo By: Ryan Pawlikowski, GDOT, Ecologist

Image 2. Shallow, heavily vegetated marsh adjacent to a brackish stream that provides suitable *C. guttata* habitat.
Photo By: Dave Pearce, Edwards-Pitman Environmental, Inc., Senior Ecologist

- Tidally-influenced, deep-water brackish streams (Jensen, 2018f)
    - These streams are used as travel and foraging corridors; thus, impacts to these waters pose minimal threat to the species compared to impacts to the other previously mentioned habitat types.
- Canals and roadside ditches that mimic suitable habitats described above can also serve as habitat (Stevenson et al., 2015).
    - These features should have predominantly hydrophytic vegetation and be *at least* seasonally inundated (thus, likely will have hydric soils) to be considered suitable. Ditches that dry within hours of heavy rainfall events are not suitable.
    - Canals and ditches that otherwise mimic vegetative and hydrologic needs of *C. guttata* are not considered suitable if they occur in highly urbanized areas.

C. guttata spend a considerable amount of time on land throughout the year. However, preferred upland habitat types have not been identified at this time; thus, GDOT assesses only aquatic habitats for suitability.

Habitat & Species Survey Methodology for Eastern Indigo Snake (*Drymarchon couperi*)

Survey Techniques

Habitat Survey for Eastern Indigo Snake (Phase 1 Survey)

Eastern indigo snake (*Drymarchon couperi*) is found in the lower and middle Coastal Plain in Georgia. When *D. couperi* habitat is being assessed per early coordination procedures, it should be noted that male *D. couperi* move 5-8 km on average (Hyslop et al. 2014) and can make linear movements of 22 km (Stevenson and Hyslop 2010) which can result in snakes that use habitats extending from, and including, the immediate project corridor being impacted. For greater detail on the explanation of calculating buffer distances around occurrence records, please see the Species Status Assessment (SSA; USFWS 2019, pg. 58-59).

Phase 1 surveys can be conducted year round. *D. couperi* use a variety of habitats and partition their habitat use by season. Here, we will present the seasonal patterns of predominant and preferred habitats with the understanding that the presence of *D. couperi* cannot be dismissed anywhere in suitable habitats at any time of the year. Notably, while *D. couperi* moves between uplands and bottomlands seasonally, they exhibit a preference for upland habitats year round, particularly for breeding, wintering, and nesting habitats (Hyslop et al. 2014).

Wintering Habitat

- Breeding typically occurs in Nov-Jan but can extend into October and February in southern and near-coastal regions of their Georgia range or in warmer years.
- In late October-February for breeding and the wintering season, *D. couperi* select xeric habitats: open-canopied sandhill and scrub habitats characterized by longleaf pine (*Pinus palustris*) and turkey oak (*Quercus laevis*; See: **Image 1.**). For an in-depth description of xeric vegetation communities that host *D. couperi*, see Coppola 2004, Table 1, pg. 4.
    - Tend to have <25% canopy cover with interspersed open patches of diverse understory vegetation.
    - Use of these upland habitats during winter (November-March) is frequently associated with gopher tortoise (*Gopherus polyphemus*) burrows as they provide necessary retreats from winter cold and desiccation (Speake et al. 1978; Diemer and Speake 1983; Hyslop et al. 2009); *D. couperi* can use active, inactive, and abandoned *G. polyphemus* burrows.
    - Regular fires maintain the open-canopied conditions that allow for understory growth that provides for ample forage for all life stages of *G. polyphemus*, and therefore their commensals, including *D. couperi*. Additionally, properties which have been maintained as open-canopied by forces other than fire (e.g., extreme xeric conditions as typical on aeolian dunes, mechanical or chemical treatments) should not be discounted.
    - In preparation for the site visit, soil maps can be reviewed to determine if those suitable for *G. polyphemus* are present in the Project area.

- The USFWS Habitat Suitability Model can be viewed here: https://fws.maps.arcgis.com/apps/MapSeries/index.html?appid=2a3cabf66c56400a90a75d1a0920efa3

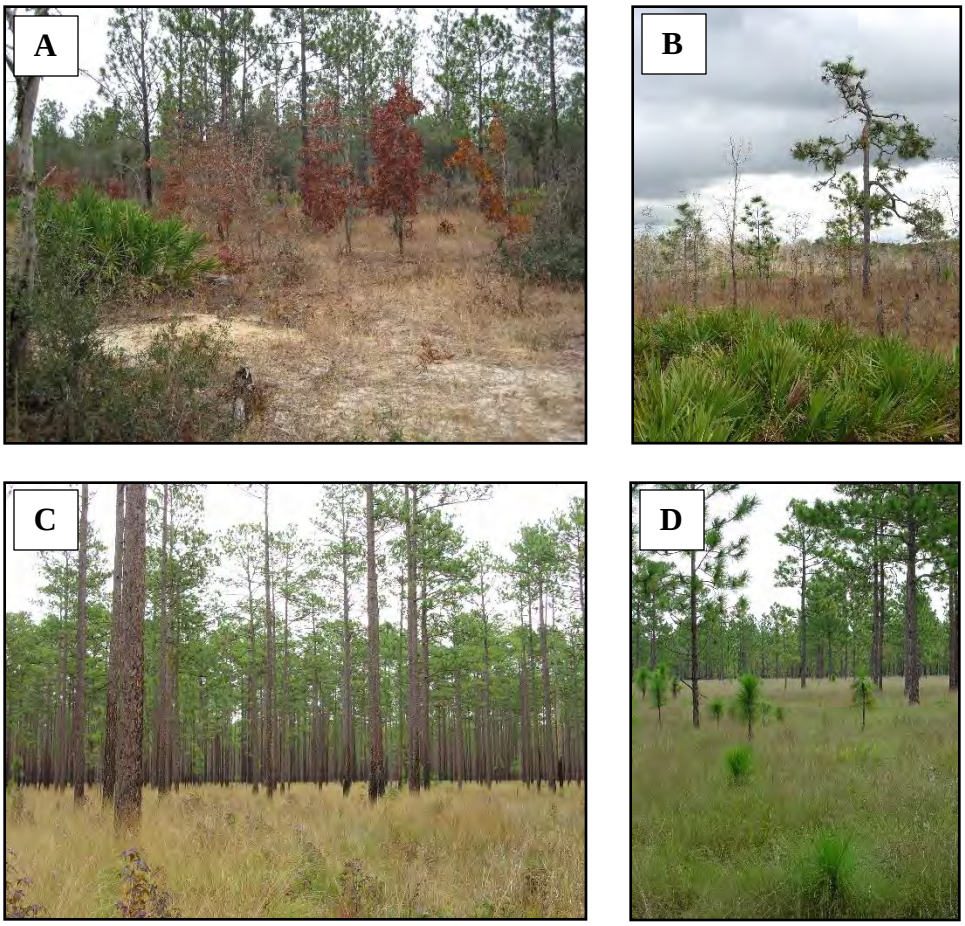


Image 1. A. Turkey oak scrub upland habitat that is fire-maintained and productive for *D. couperi* and *G. polyphemus*. **Photo By:** Kimberly Andrews **B.** Open canopy habitats interspersed with saw palmettos and understory grasses provide a gradient of thermal and cover options for various age classes of *D. couperi* for a range of temperature conditions. **Photo By:** Dirk Stevenson **C.** Established *P. palustris* stand. **Photo By:** Dirk Stevenson **D.** Recruiting *P. palustris*. **Photo By:** Dirk Stevenson

- In general, soil requirements are as follows:
  - Sand grain needs to be coarse enough that a burrow can be constructed without collapsing.
  - Low in clay or gravel/rock content (<25%) as these substrates challenge burrow construction.

- Another resource that can aid in site visit preparation is the "TOS_Tortoise_roads_Final" shapefile found on the GDOT Ecology SharePoint.
  - A description of attributes can be found in **Appendix G**.

- All lands within the known or contemporary range of *D. couperi* with *G. polyphemus* burrows (active or inactive) should be considered potential *D. couperi* habitat.
    - Presence of any number of *G. polyphemus* in the uplands can attract *D. couperi* to their burrows; therefore, the presence of even a single burrow should not be discounted. *D. couperi* demonstrate den site fidelity; as *G. polyphemus* burrows can be relatively stable features in the landscape, snakes may use the same burrows throughout their lives (Stevenson et al. 2003).
    - *G. polyphemus* can occupy degraded and fire-suppressed habitats, and their burrows in suboptimal and poor habitat can still attract *D. couperi*. *G. polyphemus* are long-lived; they can remain on the landscape as a "legacy" long after the habitat has degraded beyond the prescriptive forest or soil coverage. Degraded upland habitats should not be dismissed of having *G. polyphemus* occupants, and thus *D. couperi*.
        - A common example is open, developed edges such as those along roadsides, utility rights-of-way/powerline cuts, and old fields.
        - Additionally, *G. polyphemus* and *D. couperi* can be found in a diversity of pine-dominated habitats that lack *P. palustris*, including sand pine (*Pinus clausa*), loblolly (*P. taeda*) and slash pine (*P. elliottii*) plantations and turkey oak barrens.
- A GPS point shall be taken at all active, inactive, and abandoned *G. polyphemus* burrows noted during the Phase 1 in order to aid the efficiency with which surveyors can revisit burrows during the Phase 2 survey.

- Where *G. polyphemus* are absent in areas that are located in or proximate to sandhills habitat, *D. couperi* also can be found using the burrows of armadillos (*Dasypus novemcinctus*) or rodents, stump holes, underground hollowed root channels (Lawler 1977; Hyslop et al 2009).
- Surveyors should take caution as to not stand on top of *G. polyphemus* burrows (ground above the burrow opening) due to risk of collapse.
- Phase 1 surveys can be conducted year round; however, in the winter, any *G. polyphemus* burrows should be scoped with a camera as a secondary measure to investigate snake presence in the burrow (See Phase 2 below). It should be noted that burrow cameras are not foolproof in detecting all animals that are burrow occupants.

Foraging and Summer Ranging Habitat

- During warmer months (April-October), *D. couperi* frequently uses lower-lying bottomland habitats that are cooler than the open uplands (See: **Image 2.**). These "summer" habitats have more extensive canopy coverage than the uplands and tend to host abundant prey (e.g., snakes, frogs, mammals).
    - Warm-season habitats are interspersed with or adjacent to the winter-time upland habitats. This mosaic of multiple habitat types is critical to *D. couperi* (Landers and Speake 1980; Diemer and Speake 1983; Hyslop et al. 2014). Bottomland habitats

included within or adjacent to suitable habitat for *D. couperi* should be included as specified by buffer distances outlined in the SSA (USFWS 2018, pg. 58-59).

- Foraging habitats include xeric sandhills, xeric oak hammocks, pine plantations, mesic pine flatwoods, mixed oak-pine forests, bottomland hardwood forests, blackwater creek swamps, river swamps, marshes, cypress (*Taxodium ascendens*) ponds, bay swamps; basically all "wet" communities available to them both within and in the immediate vicinity suitable uplands, with the exception of large bodies of open water (e.g., lakes, reservoirs) and those isolated by development within a 5-mi vicinity (see also SSA; USFWS 2019, Appendix C).
- *D. couperi* can also be found within anthropogenically impacted landscapes where *G. polyphemus* burrows (active or inactive) still exist, including those dominated by silviculture and agriculture.
- Female *D. couperi* seek open, sandy environments for oviposition, laying 6-12 eggs in May/June (Godwin et al. 2011). *G. polyphemus* burrows in sandhill habitats have been documented as egg-laying sites in Georgia (Newberry et al. 2009).

Image 2. A. Blackwater swamp. **B.** Isolated cypress wetland. **C.** Mixed hardwood maritime forest. **Photos By:** Dirk Stevenson

Eastern Indigo Snake Survey (Phase 2 Survey)

As this activity does not pose a risk of mortality or harassment to *D. couperi*, a federal permit is not required; however, a GADNR scientific collection permit will be required since scoping *G. polyphemus* burrows is executed. If any other survey method is proposed for *D. couperi*, a Section 10(a)(1)(A) permit would be required. Phase 2 surveys should only be conducted when suitable upland habitats described in Phase 1 are present. Phase 2 surveys are not required when wetland foraging lowland habitat is the only habitat on site.

When to Conduct Surveys:

- Home ranges vary extensively on a seasonal basis ranging from 5-10 hectares in the winter and extending up to 800 hectares per individual during warm seasons (USFWS 2018 and references therein). Thus, it is relevant for surveyors to note that *D. couperi* are more likely to be observed during winter month surveys when their ranges are more condensed, rather than during the warm seasons when their movement activity and ranges are increased.

- *D. couperi* surveys should be conducted November-March when snakes are exhibiting regular use of tortoise burrow refugia and their daily movements, on average, are limited (Stevenson et al. 2003; Bauder et al 2017).

    - Ideal weather conditions are warm days with minimal wind and moderate cloud cover. It is thought that chances of detection are higher when warm days are preceded by several cool or cold days (Coppola 2004).

    - *D. couperi* are commonly active on the surface when temperatures are above 50°F (Jensen and Owers 2009) and are most commonly encountered on winter surveys when temperatures are 60°F-70°F (D. Stevenson, pers. obs.).

    - On sunny days, surveys can occur from 9:00 AM-4:00PM, with the optimal search period from 12:00PM-4:00PM on colder or overcast days. On overcast days, it takes longer to reach optimal temperatures. (D. Stevenson, pers. obs.).

- Since *D. couperi* activity can vary among years and detection of individuals is challenging, annual winter surveys until the project is Let are ideal on projects containing high quality habitat; however, at a minimum, re-surveys on all projects shall adhere to the Phase 2 Re-survey Protocol Flow Chart in the “Standard Operating Procedures” section of this manual.

How to Conduct D. couperi surveys:

- While *D. couperi* is commonly associated with *G. polyphemus*, the relationship is not exclusive; surveys within all suitable habitat should be conducted before it is determined that the species is not detected in the area of interest.

- As per GDOT standard methodology, Phase 2 surveys should be conducted throughout all previously identified suitable habitat within the environmental survey boundary.

- Surveyors should use visual-encounter surveys (VES) to detect *D. couperi*.

- The most common/successful method is to search for snakes, shed skins, and tracks at or near tortoise burrows from November-March (Stevenson et al. 2009; Bauder et al. 2017).

- *D. couperi* shed skins are commonly found on the ground near tortoise burrows, especially during the cooler months (See: **Image 3A.**). The shed skins may persist for weeks-months. Surveyors should look for intact or partial sheds close to downed logs, in saw palmetto clumps, and on the ground within 5-10 m of burrows (See: **Image 3B.**). Shed skins can be confused easily with several other species of sympatric snake species; consulting an expert to confirm identification is recommended. A GPS point should be recorded, and a high-quality photograph should be submitted to USFWS, GADNR, or another expert for identification and details of the communication and identification included in the survey report. If a high-quality photograph cannot be obtained, a couple of inches should be collected, and the remaining skin or fragments left in situ. Any collected skins should be individually stored in Ziplock bags and labelled with site identification, GPS coordinates, date/time, and collector information recorded on the bag. The skin then should be transferred to USFWS for identification and preservation.

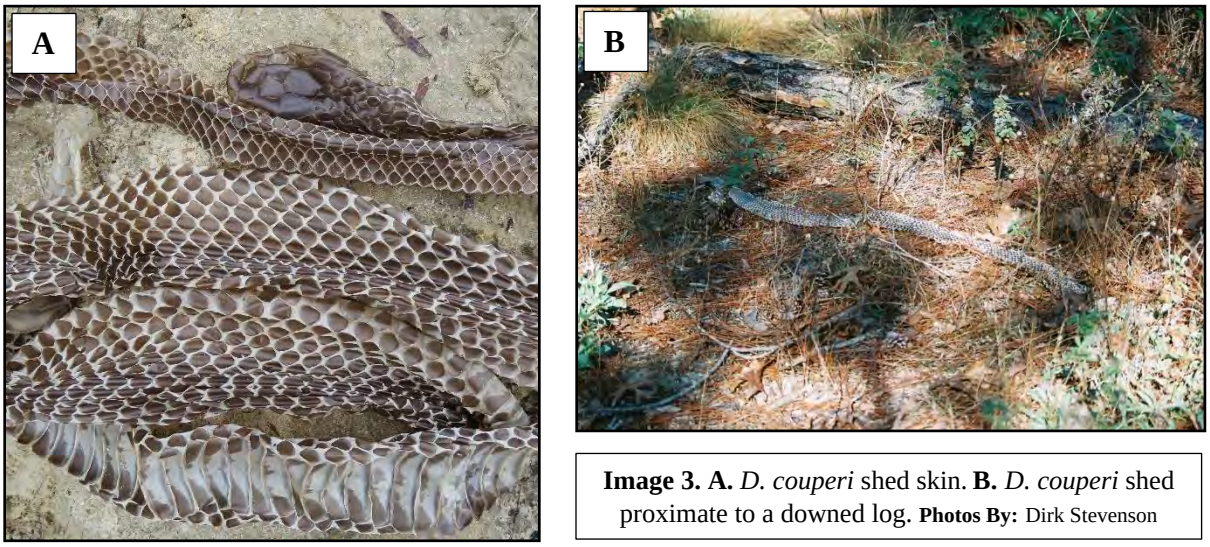


Image 3. A. *D. couperi* shed skin. **B.** *D. couperi* shed proximate to a downed log. **Photos By:** Dirk Stevenson

- VES surveys should be conducted in an organized manner to increase the detectability of potential refugia not previously noted during the Phase 1 survey and the chance of observing a snake while active or basking on the surface.

    - Transects should be conducted at a maximum width of 30 feet. If the vegetation density is thicker, transect width should be narrower. The goal is for each surveyor to be able to fully scan the ground surface between the adjacent transects.

    - Where possible, survey can be facilitated by using a GPS unit to track the survey paths and ensure sufficient coverage of the habitat.

    - Since juvenile *G. polyphemus* tend to place burrows under vegetation around the margins of open areas (e.g., wire grass clumps, palmetto fronds, cactus—See: **Image**

4.), using a snake hook or stick to lift vegetation increases detectability of shed skins under vegetation.

Image 4. A hatchling *G. polyphemus* burrow under a cactus for added security.
Photo By: Lance Paden

- Revisiting the GPS points taken during the Phase 1 survey, more intensive searches should be conducted within a 10-m radius of the refugium entrance for snakes, shed skins, and tracks.
    - Surveyors shall approach refugia in a quiet manner, so as not to encourage potential individuals in the area to flee prior to identification being made.
    - Surveyors also should be attentive to any new burrows that have been established or inactive burrows that have been reactivated since Phase 1 surveys.
- A mirror or flashlight can be used to shine down burrows for visibility of roughly 1 meter into the burrow. Be attentive to venomous snakes and biting and stinging insects. Thoroughly scan the ground surface before kneeling down or placing your hands on the ground. Do not extend head or hands into burrows.
- All *G. polyphemus* burrows (active and inactive) and another other burrows that are greater than 2 feet in length should be scoped. Scoping also can reveal other commensal species of interest, such as *D. couperi* (See: **Image 5.**). 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 opening) during scoping procedures due to risk of collapse. Therefore, burrows should be scoped with the researcher positioned on the apron.
    - Burrow scopes can be different lengths and include camera sizes suited for both juvenile and sub-adult/adult burrows.

- The camera should be maneuvered until the back of the burrow, or the scope cannot go farther if the burrow takes a sharp turn.
- Care should be taken while scoping to examine the entire width of the burrow chamber to not miss side channels or other places where *D. couperi* might be hiding.

Image 5. *D. couperi* as seen on a burrow scope.
Photo By: Dirk Stevenson

- Due to a concern regarding the transmission of highly contagious diseases, such as Upper Respiratory Tract Disease, all organic debris and soils should be wiped from the camera and scopes should be disinfected between burrows. Coppola (2004) recommends a 1:10 (10%) dilution of 5.25% bleach. The disinfectant should remain in contact with the equipment for a minimum of 2 minutes.
- Where signs of snake(s) are detected (e.g., shed skin), and further assessment of presence is warranted, remote means of survey (e.g., trail cameras) can be economical and effective in attempting to detect a snake while the shed skin is being identified. Trail cameras can also be productive in detecting ectothermic animals if the camera is positioned less than 3 feet and angled to face the burrow opening. Cameras should be installed off to the side of the burrow as to not interfere with *G. polyphemus* nesting. Additionally, installation of drift fences with box traps can be effective but are less common survey approaches as they are more labor expensive requiring repeat and frequent visitation.

It should be noted that while all survey methodologies in this manual are only Agency approved for GDOT projects, D. couperi, in particular, has a different methodology throughout other portions of its range. This methodology is only appropriate north of the frost line, including the state of Georgia and some northern portions of Florida. It should not be applied in more southern portions of its range because of differences in species ecology. For surveys outside of Georgia, we recommend coordinating with local USFWS and state biologists to ensure the proper methodology is proposed when working south of the frost line.

Drymarchon couperi
Survey Data Reporting Form

Eastern Indigo Snake (*Drymarchon couperi*) & Gopher Tortoise (*Gopherus polyphemus*)

Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Target Species (Circle all that apply)**:** Gopher Tortoise Eastern Indigo Snake

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Survey Data

General habitat and land use description(s): _____

_____

_____

Survey line tracked with GPS (circle)**?** Yes No **If yes, file name:** _____

If no, topographic quad: **Lat** _____ **Long** _____

UTM Zone: **Easting** _____ **Northing** _____

Datum: _____

Notes for table use: ♦ Burrow Depth = length able to be scoped ♦ Burrow Direction is taken in the direction the burrow heads from the opening ♦ Burrow Size, Condition, & Type columns should abbreviate using the bolded letters in column header subtext ♦ Burrow Size & Condition should be noted as "N/A" if surveying anything other than a GT burrow ♦ Final 2 columns are only necessary when EIS is being surveyed for in addition to GT

Burrow #	**Lat/Long**	**Burrow Details** (Width x Height x Length, Direction)	**Burrow Size** (**A**dult, **S**ubadult, **J**uv/hatchling, **N/A**)	**Condition** (**A**ctive, **I**nactive, **Ab**andoned, **N/A**)	**Occupied?** (List all spp. detected)	**Other Notes** (Side channels not scoped, blockage preventing further scoping, snake tracks/skin noted, etc.)	**Burrow Type** (**GT**, **M**ammal, **S**tump hole, etc.)	**Upland/ Bottomland**

Habitat Survey Methodology for Hawksbill Sea Turtle (*Eretmochelys imbricata*)

Source: https://www.researchgate.net/figure/Hawksbill-sea-turtle-Eretmochelys-imbricata-at-Aldabra_fig10_322581848

Survey Techniques

Habitat Survey for Hawksbill Sea Turtle (Phase 1 Survey)

NOAA Fisheries, USFWS, and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat (Jensen et al., 2011b).

- *E. imbricata* primary habitat (NOAA Fisheries jurisdiction) consists of shallow, hard-bottomed (e.g. coral reefs and rock outcroppings) waters (See: **Image 1.**)
- *E. imbricata* nest on barrier island beaches behind the high-water line and dunes, often within heavy vegetation (USFWS jurisdiction)

Image 1. *E. imbricata* with rock outcropping and coral in background.
Source: https://www.flickr.com/photos/mal-b/6981313535/

Habitat Survey Methodology for Bog Turtle (*Glyptemys muhlenbergii*)

Source: http://herpetologicalassociates.com/history.htm

Survey Techniques

Habitat Survey for Bog Turtle (Phase 1 Survey)

USFWS and GADNR do not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with the applicable Agencies to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian survey to identify suitable habitat. Surveyors must avoid stepping on the tops of hummocks because this can destroy turtle nests and eggs. Habitat assessment surveys (Phase 1 survey) can be conducted year round (except when significant snow and/or ice cover is present) and shall consider the following to be suitable habitat (Floyd and Jensen, 2011; USDOI, 2006).

- Bogs and wetlands along shallow, slowly flowing spring creeks and seepages (See: **Image 1.**)
    - The wetlands are typically interspersed with dry pockets as well.
- Wet meadows (See: **Images 2.** & **3.**)

Image 1. *G. muhlenbergii* habitat within a mountain bog alongside a slow-flowing stream
Source: https://www.be-roberts.com/se/natenv/bogs/tsb/tsb1.htm

- Required microhabitat characteristics within these include:
    - Presence of soft, deep, mucky-like organic or mineral soils
        - Some areas may be scattered pockets of peat, rather than muck; these are also considered suitable wetland habitats.

Image 2. *G. muhlenbergii* habitat within a wet meadow
Source: https://www.nps.gov/nature/customcf/nnl/assets/images/sites/RESP-PA.jpg

Image 3. *G. muhlenbergii* in a wet meadow
Source: http://www.thebigturtleyear.org/blog/2017/5/26/the-big-turtle-year-update-9

  - Areas with open, shallow water
  - Open canopy
    - Some forested wetlands with more closed canopy may still be suitable if the appropriate hydrology and soils are present.

- Common plant species associated with *G. muhlenbergii* include:
  - Sedges (*Carex* spp.)

- Rushes (*Juncus* spp.)
- Bulrushes (*Scirpus* spp.)
- Spike rushes (*Eleocharis* spp.)
- Rice cut grass (*Leersia oryyzoides*)
- *Sphagnum* spp.
- Grass-of-Parnassus (*Parnassia glauca*)
- Tearthumbs (*Polygonum* spp.)
- Jewelweeds (*Impatiens* spp.)
- Arrowheads (*Saggitaria* spp.)
- Sensitive fern (*Onoclea sensibilis*)
- Red maple (*Acer rubrum*)
- Alder (*Alnus* spp.)
- Willow (*Salix* spp.)
- Tamarack (*Larix laricina*)
- Swamp rose (*Rosa palustris*)
- Silky dogwood (*Cornus amomum*)
- Winterberry (*Ilex verticillata*)
- Witherod viburnum (*Viburnum cassinoides*)
- Possumhaw (*Viburnum nudum*)

Habitat & Species Survey Methodology for Gopher Tortoise (*Gopherus polyphemus*)

Survey Techniques

Habitat Survey for Gopher Tortoise (Phase 1 Survey)

Habitat assessments should be conducted via thorough transect survey methods to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round although the details of how searches are conducted, and the appearance of occupied burrows will vary seasonally with varying degree of *G. polyphemus* activity. Habitat assessment surveys shall consider the following to be suitable habitat.

- Open longleaf pine (*Pinus palustris*) habitats in the sandhills ecoregion (See: **Image 1A.**).
    - Tend to have <25% canopy cover with interspersed open patches of diverse understory vegetation.
    - Traditionally, regular fires cycle every couple of years maintaining this openness that allows for understory growth that provides for ample forage for all life stages of *G. polyphemus*.
- While references citing typical tree density and soil types provide sage guidance (e.g., Aresco and Guyer, 1999), more degraded upland habitats (See: **Images 1B.** & **1C.**) should not be dismissed of having *G. polyphemus* occupants without first conducting rapid, reconnaissance surveys. *G. polyphemus* are long-lived, they can remain on the landscape as a "legacy" long after the habitat has degraded beyond the prescriptive forest or soil coverage.
    - A common example is open, developed edges such as those along roadsides, utility rights-of-way/powerline cuts, and old fields.
    - Additionally, *G. polyphemus* can be found in a diversity of habitats that are unoccupied by *P. palustris*, including but not limited to: loblolly (*P. taeda*) and slash pine (*P. elliottii*), including silviculture stands, and turkey scrub oak.
- In preparation for the site visit, soil maps can be reviewed to determine if those suitable for *G. polyphemus* are present in the Project area.
    - General soil requirements:
        - Sand grain needs to be coarse enough that a burrow can be constructed without collapsing.
        - Low in clay or gravel/rock content (<25%) as these substrates challenge burrow construction.
    - The USFWS Habitat Suitability Model can be viewed here: https://fws.maps.arcgis.com/apps/MapSeries/index.html?appid=2a3cabf66c56400a90a75d1a0920efa3
    - "TOS_Tortoise_roads_Final" shapefile found on the GDOT Ecology SharePoint.
        - A description of the shapefile attributes can be found in **Appendix G**.
    - "GT Soils" shapefile found on the GDOT Ecology SharePoint.
        - Tier 1 = Preferred, Tier 2 = Suitable, Tier 3 = Marginal Suitability

        - Soil units with no associated data are considered unsuitable

- *G. polyphemus* are not found in wetland habitats or those that are presently inundated.
    - Water table levels are typically ≥1 m below the ground's surface for *G. polyphemus* to be present, although exceptions occur, especially in the lower Coastal Plain.
- If *G. polyphemus* burrows are discovered during the Phase 1 survey, advance to Phase 2 Survey below and reference **Appendix H.** for recommended avoidance and minimization measures.
    - If no burrows are detected in otherwise suitable habitat, no Phase 2 survey should be conducted; however, the project should still follow the re-survey protocol flow chart in the manual's SOP section to ensure potential new burrows do not go undetected as the project approaches Let.

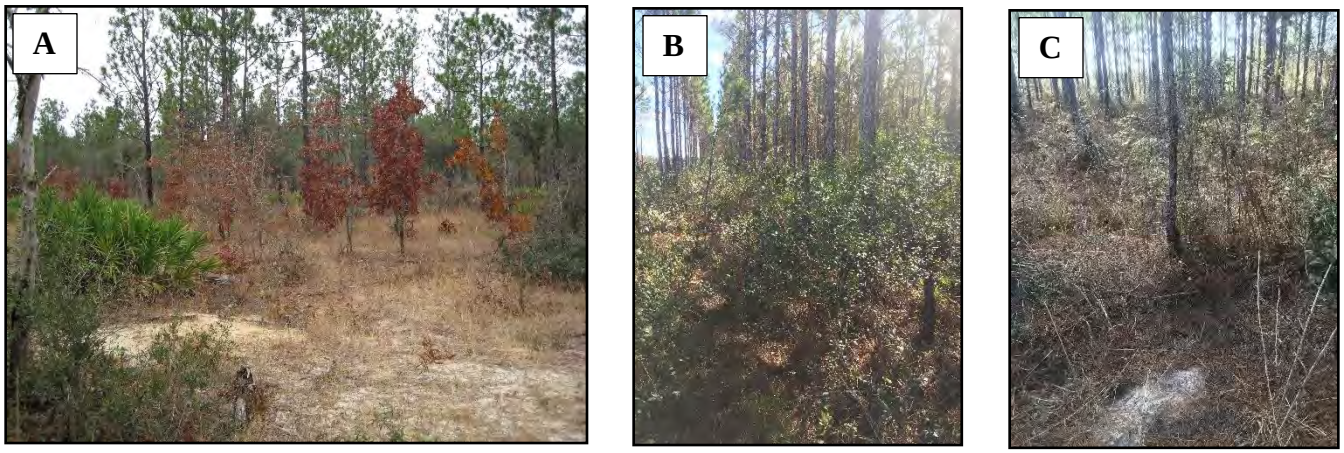


Image 1. A. Fire-maintained *G. polyphemus* habitat. Example from Fort Stewart, GA. **Photo By:** Kimberly Andrews. **B.** Overgrown pine plantation with thick understory in Charlton County. **Photo By:** Kimberly Andrews. **C.** *G. polyphemus* will still occupy and even reproduce in degraded pine plantation habitat, which should not be discounted as not being adequate *G. polyphemus* habitat. **Photo By:** Kimberly Andrews

Gopher Tortoise Survey (Phase 2 Survey)

A scientific collection permit will be required for this type of survey effort. The survey data reporting form provided within this methodology shall be completed for all Phase 2 surveys. If relocation is anticipated to be needed, contact the GDOT Project Ecologist immediately so discussions with the Agencies can be initiated; also, see **Appendices I** & **J** if relocation is anticipated.

When to Conduct Surveys:

- *G. polyphemus* surveys can be conducted year round.
    - *G. polyphemus* is typically the most inactive (i.e. more likely to be in burrows) in November – March, depending on the year, when night-time temperatures are below 50°F and days are below 60°F—making scoping burrows more productive.

        - Wintertime surveys are required when a Project area has also been determined to contain suitable habitat for indigo snakes (*Drymarchon couperi*) in an effort to facilitate multi-species assessments within the same survey.
    - When daily temperatures approach 100°F, *G. polyphemus* are typically less active.
    - Windy and rainy conditions also decrease *G. polyphemus* activity.
    - Due to the increased detectability of burrows rather than *G. polyphemus*, burrow counts and estimations of occupation are the most efficient and reasonable measure of estimating local occupancy and distribution. Stober et al. (2017) expand upon how counts can be applied in areas of low tortoise density to increase detection and survey efficiency.
    - Burrow visibility is increased during the active season (approximately, Apr-Oct), due to the apparent "aprons" of an active burrow (See: **Image 2A.**). *G. polyphemus* activity peaks in the spring (Apr-May) and early Fall (Sep-Oct) when conditions are warm but mild. Surveying during these periods can provide the best sense of *G. polyphemus* occupancy and activity within the population.
    - During the inactive season when *G. polyphemus* are not actively maintaining their burrows, the lack of fresh sand spray makes the burrow contrast less against the surrounding ground, and vegetation and plant debris are present in the apron (See: **Image 2B.**).

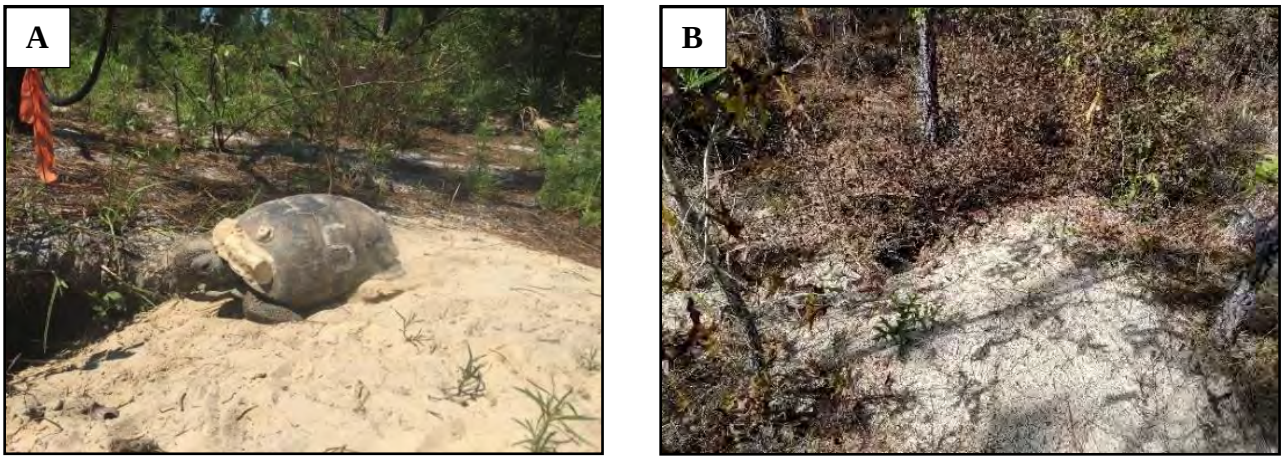


Image 2. A. A telemetered adult *G. polyphemus* at his active burrow. **Photo By:** Lance Paden **B.** An occupied yet inactive appearing *G. polyphemus* burrow during the inactive season. **Photo By:** Lance Paden

How to Conduct a "Rapid" Assessment of Burrow Counts:

- To adequately assess burrows, it is important to conduct a search that is thorough enough to detect burrows of all age classes.
- The saturation-line-transect survey (SLTS; Paden et al., in review) is adapted from the line-transect distance sampling surveys applied by Smith et al. (2009) and can be used when a total count needs to be achieved (where relocation is necessary, so all *G. polyphemus* must be extracted) or where habitats are degraded and vegetation density requires a more thorough survey for detection (See Smith and Howze (2016) for the updated handbook).

- Surveys can occur most efficiently with 2-4 surveyors, depending on the size of the survey area, timeframe, and vegetation density.
    - Distances between transects shall be determined by estimating that which is necessary to maintain each transect pass at a width less than the surveyors' estimated line-of-sight to burrows in a particular habitat.
    - Even in lower quality *G. polyphemus* habitat, this technique involves surveyors walking transects 5-10 m apart in unison in the same direction. Verbal communication among surveyors can assist with maintaining straight lines and consistent transect widths in thickly vegetated areas.
    - Where possible, survey can be facilitated by using a GPS unit to track the survey paths and ensure sufficient coverage of the habitat.
    - Since juveniles tend to place burrows under vegetation around the margins of open areas (e.g., wire grass clumps, palmetto fronds, cactus—See: **Image 3.**), using a snake hook or stick to lift vegetation improves detection for this age class.

Image 3. A hatchling *G. polyphemus* burrow under a cactus for added security.
Photo By: Lance Paden

- *G. polyphemus* overlap with oldfield mice (*Peromyscus polionotus*) and nine-banded armadillos (*Dasypus novemcinctus*) for much of their range and the same microhabitats can be selected for their burrows. The following characteristics should aid in distinguishing between the burrows of the two species:
    - Mammal burrows:
        - More circular
        - Short, typically $\leq$ 1 m
        - *D. novemcinctus* burrows tend to be somewhat obscured by leaf litter and vegetation around the entrance, with minimal sand piled in front of them ("apron;" See: **Image 4A.**).

        - *P. polionotus* burrows can be confused with hatchling *G. polyphemus* burrows but are also more circular in shape (See: **Image 4B.**).
    - Active *G. polyphemus* burrows (See: **Image 4C.**):
        - Dome or half-moon shaped
        - Fresh aprons (except in winter)
        - When burrow camera scoping (see below), *D. novemcinctus* burrows should be scoped as immature *G. polyphemus* and *D. couperi* snakes can occupy their burrows.
    - If uncertain, apply a "stick test" to distinguish between the tortoise and mammal burrows – if the stick will not go into the burrow more than a couple of feet (<1 m), it almost certainly is not occupied by a *G. polyphemus*.
- *G. polyphemus* burrows can be broadly classified into three age classes based on the rough size of the burrow opening:
    - Hatchling/juvenile, <13 cm/5" [grapefruit]
    - Subadult, 13-23 cm [melon]
    - Adult, 23+ cm [watermelon]

Image 4. A. Armadillo burrow (round). **Photo By:** Kimberly Andrews **B.** Oldfield mouse burrow (round). **Photo By:** John Jensen. **C.** Tortoise burrow (half-moon) during the inactive season as an

- Burrow condition should be noted as a measure of *G. polyphemus* activity and likelihood of *G. polyphemus* occupation.
    - "Active" designation: burrow that is "in good repair with the classic half-moon shaped entrance and appears to be in use by a *G. polyphemus* (FFWCC, 2017)."
    - "Inactive" designation: burrows that are "in good repair [shape and entrance form maintained] but does not show recent *G. polyphemus* use."
    - "Abandoned" designation: burrows "appear unused and dilapidated", including situations where "the entrance is partially or completely collapsed, and the burrow is partially or completely filled with leaves or soil."
    - If the status of the burrow is uncertain, classify it as inactive rather than abandoned.
    - Active and inactive burrows are both considered "potentially occupied" and shall be scoped.
    - If relocation is deemed necessary, both active and inactive burrows will need further assessment to determine occupancy of *G. polyphemus* or any priority commensal species that must be excavated.
- If a scoping survey is required, and the site allows, hanging brightly colored biodegradable flagging above the burrow or on the closest tree or other structure will aid in more efficient redetection of burrows.
- In the event that no burrows are detected, re-survey every two years until Let to ensure no new burrows are found.
    - If burrows are detected on a re-survey, the scoping protocol below shall be followed.

How to Assess G. polyphemus Occupancy:

Burrow occupancy of *G. polyphemus*, and thereby a true population site count, cannot occur without a hands-on survey method. The least intrusive of these is to use a burrow camera to scope the burrows. This method is also recommended as it produces data on other commensal species, some of which are state and federal priority species (e.g., *L. capito*, *D. couperi*). If capture of the animals will be necessary, burrow scoping also provides efficiency in confirming the burrows to target for the more time-consuming processes of trapping or excavation.

- Burrow scopes can be different lengths and include camera sizes suited for both juvenile and sub-adult/adult burrows (See: **Images 5A.** & **5B.**).
- Burrow scoping should be conducted in the shortest-time possible to reduce the possibility of counting individuals multiple times or missing some animals completely.
- In order to estimate a local count surrounding the impact boundaries, *G. polyphemus* surveys shall be continued within all previously identified suitable habitat within the Project.

Image 5. A. Scoping a *G. polyphemus* burrow. **Photo By:** Maranda Miller. **B.** *G. polyphemus* as seen on a burrow scope. **Photo By:** Lance Paden.

Gopherus polyphemus
Survey Data Reporting Form

Eastern Indigo Snake (*Drymarchon couperi*) & Gopher Tortoise (*Gopherus polyphemus*) Survey Data Reporting Form

General Information

Surveyor(s):_____

Date: _____ **Survey start/end time:** _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Target Species (Circle all that apply)**:** Gopher Tortoise Eastern Indigo Snake

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Estimated future re-survey date (as based on GDOT Re-survey Protocol Flow Chart)**:** _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Survey Data

General habitat and land use description(s): _____

_____

_____

Survey line tracked with GPS (circle)**?** Yes No **If yes, file name:** _____

If no, topographic quad: **Lat** _____ **Long** _____

UTM Zone: **Easting** _____ **Northing** _____

Datum: _____

Notes for table use: ♦ Burrow Depth = length able to be scoped ♦ Burrow Direction is taken in the direction the burrow heads from the opening ♦ Burrow Size, Condition, & Type columns should abbreviate using the bolded letters in column header subtext ♦ Burrow Size & Condition should be noted as "N/A" if surveying anything other than a GT burrow ♦ Final 2 columns are only necessary when EIS is being surveyed for in addition to GT

Burrow #	**Lat/Long**	**Burrow Details** (Width x Height x Length, Direction)	**Burrow Size** (**A**dult, **S**ubadult, **J**uv/hatchling, **N/A**)	**Condition** (**A**ctive, **I**nactive, **Ab**andoned, **N/A**)	**Occupied?** (List all spp. detected)	**Other Notes** (Side channels not scoped, blockage preventing further scoping, snake tracks/skin noted, etc.)	**Burrow Type** (**GT**, **M**ammal, **S**tump hole, etc.)	**Upland/ Bottomland**

Habitat Survey Methodology for: Barbour's Map Turtle (*Graptemys barbouri*), Northern Map Turtle (*Graptemys geographica*), & Alabama Map Turtle (*Graptemys pulchra)*

Barbour’s Map Turtle (*Graptemys barbouri*)

Image Source: https://www.flickr.com/photos/georgiareptiles/with/24148895728/

Survey Techniques

Habitat Survey for Barbour's Map Turtle (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, refer to **Appendix K.** for appropriate protective measures which should be applied to the Project. Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 surveys) can be conducted year round and shall consider the following to be suitable habitat.

In Georgia, *G. barbouri* occurs within the Apalachicola River drainage basin; more specifically, the range of this species includes the Flint River, the Chattahoochee River, and their larger tributaries (Jensen, 2018b). Suitable habitat throughout the species' range typically contains the following characteristics:

- Rivers and large (at least 15 feet wide), low-gradient streams with clear, moderately-flowing water (Jensen, 2018b) and the following microhabitats (Partymiller, 2018):
    - Substrate containing limestone/bed rock and cobble
    - Abundance of basking sites such as:
        - Rocky shoals
        - Fallen trees or snags within the water or along stream/riverbanks
    - Abundance of freshwater mussels and/or aquatic snails

When suitable aquatic habitat is detected within the Environmental Survey Boundary, a nesting habitat assessment should also occur.

- Suitable nesting habitat includes the following:
    - Sunny sandbars and sandy bluffs within 600 feet of the water
        - Should be high enough to avoid inundation in overflow events (i.e. at an elevation above typical high water)

Northern Map Turtle (*Graptemys geographica*)

Habitat Survey for Northern Map Turtle (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, refer to **Appendix K.** for appropriate protective measures which should be applied to the Project. Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 surveys) can be conducted year round and shall consider the following to be suitable habitat.

In Georgia, *G. geographica* occurs in the northwestern portion of the state in the Ridge and Valley and Cumberland Plateau physiographic provinces (Jensen, 2009b). All records of this species occur within the upper tributaries of the Coosa River drainage basin, primarily the Conasauga River, but also Little Chickamauga Creek of the Tennessee River drainage (Jensen, 2009b). Suitable habitat throughout the species' range typically contains the following characteristics:

- Rivers and large (at least 15 feet wide) streams with clear, medium to swift-flowing waters containing the following microhabitats:
    - Rocky or gravel substrates (Partymiller, 2018)
    - Abundance of basking sites such as (Jensen, 2009b):
        - Rocky shoals and exposed rocks
        - Fallen trees or snags within the water or along stream/riverbanks

When suitable aquatic habitat is detected within the Environmental Survey Boundary, a nesting habitat assessment should also occur.

- Suitable nesting habitat includes the following:
    - Sunny sandbars, sandy bluffs, and soft soils within 600 feet of the water
        - Should be high enough to avoid inundation in overflow events (i.e. at an elevation above typical high water)

Alabama Map Turtle (*Graptemys pulchra*)

Habitat Survey for Alabama Map Turtle (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, refer to Appendix K. for appropriate protective measures which should be applied to the Project. Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 surveys) can be conducted year round and shall consider the following to be suitable habitat.

G. pulchra is mostly endemic to its namesake state, found throughout the Mobile Bay drainage basin (Meadows, 2018). In Georgia, *G. pulchra* range is localized to the far northwestern portion of the state (Jensen, 2009a). Georgia's population is believed to be confined to the Coosa River drainage basin; specifically, the Coosa, Oostanaula, and Conasauga Rivers and their larger tributaries. Individuals have not been observed in the Oostanaula River since 1990, however (Jensen, 2016). Suitable habitat throughout the species' range typically contains the following characteristics:

- Swift-flowing rivers and large (at least 15 feet wide) streams with muddy or rocky substrates and the following microhabitats present (Meadows, 2018):
    - Both pools and shallow waters
        - Females prefer deep pools
        - Males and juveniles prefer shallow waters
    - Abundance of basking sites such as:
        - Rocky shoals
        - Fallen trees or snags in the water or along stream/riverbanks
        - Sand bars
        - Sandy stream banks

When suitable aquatic habitat is detected within the Environmental Survey Boundary, a nesting habitat assessment should also occur.

- Suitable nesting habitat includes the following:
    - Sunny sandbars and sandy bluffs within 600 feet of the water
        - Should be high enough to avoid inundation in overflow events (i.e. at an elevation above typical high water)

Habitat Survey Methodology for Southern Hognose Snake (*Heterodon simus*)

Survey Techniques

Habitat Survey for Southern Hognose Snake (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. Habitat assessment surveys (Phase 1 survey) can be conducted year round and shall consider the following to be suitable habitat.

Xeric habitats with well-drained, sandy soils within the survey area, including fire maintained sandhills, scrubby pine flatwoods, and some ruderal and agricultural habitats with similar characteristics (Jensen, 2018e; Jordan, 1998).

- Sandhills (See: **Image 1.**) – Natural habitat that typically consists of a rolling topography and deep sand substrate within a savanna of widely spaced longleaf pine (*Pinus palustris*) and/or turkey oak (*Quercus laevis*), often with a wiregrass (*Aristida stricta*) understory (FNAI, 2012).
    - Altered sandhills dominated by a variety of scrub oaks and/or planted pines that retain diverse herbaceous groundcover may still serve as suitable, though more limited, habitat.

Image 1. Suitable sandhill habitat for *H. simus*
Source: https://i.pinimg.com/originals/86/10/74/8610745e8f815dcd714c991819433d0d.jpg

- Scrubby pine flatwoods (See: **Image 2.**) – Natural habitat that typically occupies extensive areas of low relief having deep, sandy soils within a savanna of widely spaced longleaf pine, with a wiregrass and scrub-shrub understory (FNAI, 2012).
    - Altered scrubby pine flatwoods dominated by a variety of scrub oaks and/or planted pines that retain diverse herbaceous groundcover may still serve as suitable, though more limited, habitat.
- Disturbed/ruderal habitats in residential and commercial developments, and some agricultural sites with deep, well-drained, sandy soils and sparse vegetation, especially at remnant locations of the above described habitats can also offer suitable though more limited habitat (Willson, 2019).

Image 2. Suitable scrubby pine flatwoods habitat for *H. simus*
Source:
http://www.sfrc.ufl.edu/extension/florida_forestry_information/images/phmj4.jpg

Habitat Survey Methodology for Alligator Snapping Turtle (*Macrochelys temminckii*) & Suwannee Alligator Snapping Turtle (*Macrochelys suwanniensis*)

Survey Techniques

Habitat Survey for Alligator Snapping Turtle & Suwannee Alligator Snapping Turtle (Phase 1 Survey)

USFWS and GADNR do not recommend GDOT perform surveys for this species. If habitat as noted below is determined to be present on a Project site, refer to **Appendix L.** for appropriate protective measures which should be applied to the Project. This Phase 1 survey can be conducted year round and should consider the following information.

In Georgia, these species' ranges span much of those Gulf of Mexico drainages of the Coastal Plain. *M. temminckii* occurs in the middle and lower Chattahoochee and the entirety of the Flint and Ochlockonee River drainages. *M. suwanniensis* occurs within the Suwannee River drainage including the Suwannee, Alapaha, Little, and Withlacoochee Rivers (and lesser tributaries), as well as the St. Marys River drainage of the Okefenokee Swamp (but not the main stem of this river).

- The preferred habitats of both species include:
    - Deeper lotic (flowing) waters of large rivers and major tributaries (especially spring-fed portions)
    - Lentic (still) waters:
        - Canals
        - Impounded ponds & lakes (particularly of larger rivers)
        - Oxbows
        - Swamps, including turbid and tannin-stained backwaters of swamp forest floodplains (See: **Image 1.**)

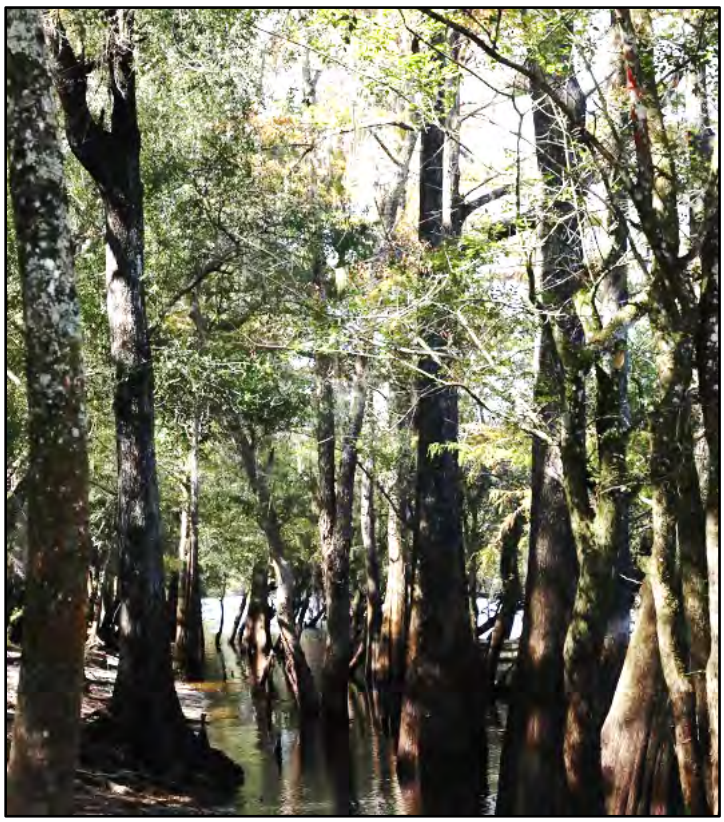


Image 1. Backwater system
Photo By: Chris Coppola, USFWS, Fish & Wildlife Biologist

Except for floodplain systems, as depicted in **Image 1.**, if any of the above habitats are noted in the Environmental Survey Boundary, a 1.06g certified aquatic ecologist must conduct an in-water survey to determine if any microhabitat characteristics are also present. It should be noted that this is not a Phase 2 presence/absence survey, but rather an in-depth Phase 1 habitat assessment, thus, must be completed prior to completion of the Ecology Resource Survey Report (ERSR).

- Microhabitats necessary for both species contain the following characteristics:
    - The bottoms of water bodies with deeper beds, or at least the portions of which contain deeper beds in quiescent or slow-moving water
        - Signs to determine if areas are deep enough to decrease flow rates include detritus accumulation & fish congregation
    - Areas with large woody debris, such as logs and debris jams embedded in streambed (See: **Image 2.**)
    - Undercut riverbanks
    - Deep pools on the outsides of river meander bends
    - Deep pools in shoot cut-offs and braids
    - It should be noted that scour at bridge bents can mimic pools and undercut banks, creating artificial, yet still suitable, habitat.
        - When possible, assess level of scour and potential pooling depth at bents; if water is too deep to reach bents or too tannic to see, bridge inspection reports should be referenced to see if scour is noted at bents. If so, suitable habitat should be considered present.

Image 2. Large woody debris microhabitat
Photo By: Chris Coppola, USFWS, Fish & Wildlife Biologist

- In the Flint River basin, *M. temminckii* can also be found in pooled spring heads & in limestone bedrock microhabitats.
- If any of these microhabitats are detected on site, an Alligator Snapping Turtle Habitat Assessment Datasheet shall be completed and included within the ERSR and the surveyor should then proceed to **Appendix L** for avoidance and minimization guidance.
    - When completing the datasheet, approximate bankfull dimensions of the channel by identifying the crest of stable banks, or the highest dominant scour line in entrenched/confined/incised stream channels; where active floodplains and swamps exist immediately adjacent to the channel, use the crest of the levy occurring at a consistent elevation as the lateral limit of the bankfull width. Numerous photos shall also be taken of microhabitats, overall aquatic habitat conditions, and any other relevant areas.
    - GPS data shall be taken of microhabitat locations.
        - Location information can also be noted using a measuring tape, but accuracy is crucial (e.g., Undercut bank present on left bank, 19ft upstream from farthest left bent in the channel)

If suitable adult aquatic habitat is detected in the Project survey limits, assessments for nesting habitat and juvenile aquatic habitat (beyond what is also suitable for adults) within the ESB should also occur at that time.

- When found within 600 feet of the aquatic habitat, the following is considered suitable nesting habitat for both species:
    - Areas high enough to avoid inundation in overflow events (i.e., at an elevation above typical high water)
        - Usually within 60 ft of water and < 9 ft above the Ordinary High Water Mark (See: **Image 3.**)

Image 3. Suitable aquatic habitat with 8-9ft bank and nesting habitat beyond
Photo By: Chris Coppola, USFWS, Fish & Wildlife Biologist

- It should be noted that riverbanks themselves that meet the above criteria are also used as nesting habitat; however, highly eroded, steep banks aren't stable enough to be considered suitable nesting habitat, nor are particularly shallow ones where streams readily enter the surrounding floodplain.

- Open sandbars and low forested areas are not suitable nesting habitat (See: **Image 4.**)

Image 4. Sand bar and forested area too close to aquatic system to serve as nesting habitat due to frequent flooding
Photo By: Chris Coppola, USFWS, Fish & Wildlife Biologist

- Additional suitable juvenile aquatic habitat includes the following:
  - Shallower, slower backwater areas
  - Braided channels, oxbows, and sloughs that can be disconnected from main channels during times of low flow (See: **Image 5.**)
  - Slow flow areas where small fish congregate

Image 5. Disconnected, lentic system suitable for juveniles
Photo By: Chris Coppola, USFWS, Fish & Wildlife Biologist

Macrochelys temminckii & *Macrochelys suwanniensis*
Habitat Assessment Data Reporting Form

Alligator Snapping Turtle & Suwannee Alligator Snapping Turtle Habitat Assessment Datasheet

General Information

Surveyor(s):_____

Date: _____

Survey start/end time (specific to Snapper habitat assessment portion): _____

GDOT P.I. #(s): _____ **County(ies):** _____

Species Information

Target Species (Circle)**:** Alligator Snapping Turtle Suwannee Alligator Snapping Turtle

Returned on GNAHRGIS Coordination (Circle)**?** Yes No **If yes, minimum distance reported:** _____

GDOT Methodologies Manual version referenced: _____

Weather Information

Average temperature during survey: _____

Typical weather conditions during survey: _____

Survey Data

Water body name (as reported in ERSR if not a named feature)**:** _____

Wetted Dimensions (W x D)**:** _____ **Bankfull Dimensions** (W x D)**:** _____

Microhabitat(s) noted (Circle all that apply)**:** Deep run bottom Large woody debris Undercut bank

Pool Spring head Scoured bridge bents Limestone formations/bedrock

Detailed description of microhabitat(s) noted: _____

_____

_____

Was suitable nesting habitat detected in the survey area (Circle)**?** Yes No

If yes, please describe: _____

_____

If yes, note additional microhabitats suitable for juveniles in the survey area (Circle all that apply)**:**

Low backwater area(s) Area(s) often disconnected from mainstem during low flow Slow-flow area(s) w/small fish

Sketch

Prepare a simple sketch map of the water body that includes a minimum of: habitat and microhabitat callouts, existing roads/bridges/structures, and cardinal direction arrow. If possible, add proposed structures (temporary &/or permanent) to sketch prior to transmittal to USFWS and GADNR.

Habitat Survey Methodology for Carolina Diamondback Terrapin (*Malaclemys terrapin*)

Survey Techniques

Habitat Survey for Carolina Diamondback Terrapin (Phase 1 Survey)

GADNR does not recommend GDOT perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. *M. terrapin* is largely aquatic by nature. Individuals occasionally leave water to cross to other areas of suitable habitat over land, to seek nesting habitat, or while hatching and moving initially towards water. Habitat assessment surveys (Phase 1 survey) can be conducted year round and should consider the following to be characteristics of suitable habitat.

- Suitable habitat for this species is found in:
    - Brackish and saltwater tidal and estuarine habitats including (Dodd, 2009; NatureServe, 2018 [See: **Image 1.**]):
        - Herbaceous wetlands,
        - Creeks
        - Rivers
        - Lagoons
        - Sounds
        - Flats
        - Bays
        - Other coastal marine habitats

Image 1. Suitable tidal marsh and tidal creek habitat for *M. terrapin*.
Photo By: Ryan Niccoli, Arcadis U.S., Ecologist

- Terrestrial habitats adjacent to (within 100 m) previously mentioned aquatic habitats, which are used for nesting
- Terrestrial habitats may also include grassy lowlands during high tide.

- Suitable micro-habitat for this species consists of:
  - Open water areas
  - Marsh grassed areas where their main prey of snails, bivalves and small crabs (especially salt marsh periwinkles – *Lottoraria irrorata* [See: **Image 2.**] and fiddler crabs – *Uca pugilator, U. pugnax, and U. minax* in Georgia) may be present (Dodd, 2009)
  - Upland areas within 100m of tidal estuarine waters including:
    - Beaches
    - Dunes
    - Hammocks
    - Bluffs
    - Road or causeway embankments
    - Household gardens adjacent to salt marsh which are used for nesting
  - Juveniles may utilize mats of decaying marsh grasses for shelter (NatureServe, 2018)

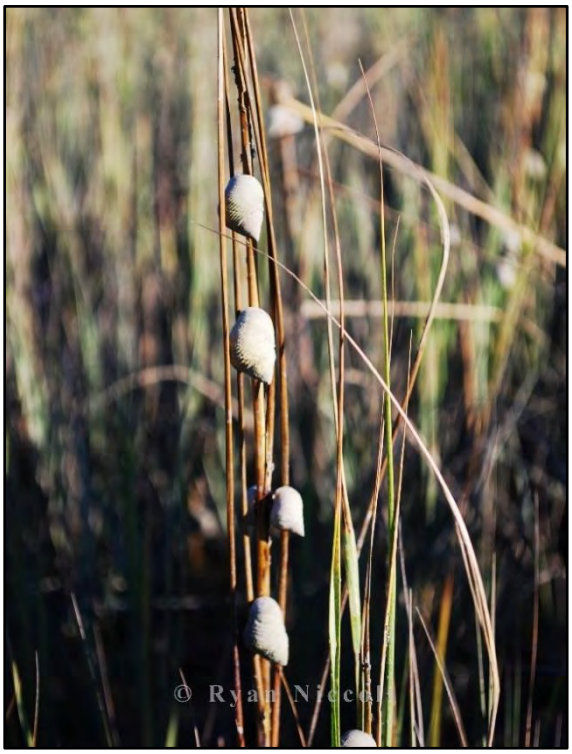


Image 2. Salt marsh periwinkles on marsh grasses in *M. terrapin* suitable habitat.
Photo By: Ryan Niccoli, Arcadis U.S., Ecologist

Habitat Survey Methodology for Mimic Glass Lizard (*Ophisaurus mimicus*)

Survey Techniques

Habitat Survey for Mimic Glass Lizard (Phase 1 Survey)

GADNR does not recommend GDOT to perform Phase 2 surveys for this species. If habitat as noted below is determined to be present on a Project site, the GDOT Project Ecologist shall be notified immediately and will initiate conversations with GADNR to determine appropriate protective measures.

Habitat assessments should be conducted via pedestrian surveys to identify suitable habitat. *O. mimicus* can be fossorial (i.e. adapted for and practicing a burrowing lifestyle) by nature (NatureServe, 2018), but can also be found under debris or foraging above ground within suitable habitats. Habitat assessment surveys (Phase 1 survey) can be conducted year round and should consider the following to be characteristics of suitable habitat.

- Suitable habitat for this species is found in within (Hammerson, 2007; Jensen, 2018d):
    - Areas dominated by pines including:
        - Sandy flatwoods and hillsides with longleaf pine
        - Scattered oaks
        - Ericaceous shrubs
        - Wiregrass and longleaf pine-wiregrass communities
        - Mesic pine flatwoods and savannas (See: **Images 1.** & **2.**)
    - Open, sunny pitcherplant and/or seepage bogs
- Suitable micro-habitat for this species consists of:
    - Debris such as boards, leaves, logs, etc. (Willson, 2018)
    - Intact groundcover dominated by grasses is a characteristic of most, if not all, sites where *O. mimicus* occurs (Jensen 2018d [See: **Images 1.** & **2.**]).

Image 1. Suitable pine savanna habitat for the mimic glass lizard.
Photo By: John Jensen, GADNR, Senior Wildlife Biologist

Image 2. Suitable seepage slope pitcher plant habitat within pine savanna habitat for *O. mimicus*.
Photo By: John Jensen, GADNR, Senior Wildlife Biologist

APPENDICES

Appendix A: GADNR EO Reporting Form Guidance

GADNR Element Occurrence (EO) Reporting Form Guidance

After downloading the Survey123 application to a mobile device and/or tablet, complete the following steps to use the GADNR EO Reporting Form during Phase 2 surveys. No login is required, so if prompted, this step may be skipped.

1. From a location where the device has service, select this web link.
2. Select the "Open in Field App" option.

The form will now be available for use within the application, regardless of connectivity. Simply open the application and click on the form to begin entering data.

Please Note: The form ends with a question asking if a separate report regarding the survey will be submitted—this answer should always be "Yes" for GDOT projects, as the agencies will receive a Protected Species Survey Report for all Phase 2 surveys.

If the Phase 2 survey occurs in an area without quality cell service, the user should select "Save in Outbox" in order to submit the data at a later point. Once the user is back in an area with quality cell service or is connected to a wireless network, re-enter the application, open the survey, and select "Send Now" to submit the data.

Appendix B: GADNR Bats in Bridges Datasheet Guidance

GADNR Bats in Bridges Datasheet Guidance

After downloading the Survey123 application to a mobile device and/or tablet, complete the following steps to use the GADNR Bats in Bridges Datasheet during bridge and culvert surveys. No login is required, so if prompted, this step may be skipped.

1. From a location where the device has service, select this app link.

OR

1. Open the application.
2. Open the QR code scanner within the search bar and use the code below:

The form will now be available for use within the application, regardless of connectivity. Simply open the application and click on the form to begin entering data. If the survey occurs in an area without quality cell service, the user should select “Save in Outbox” in order to submit the data at a later point. Once the user is back in an area with quality cell service or is connected to a wireless network, re-enter the application, open the survey, and select “Send Now” to submit the data.

Appendix C: GADNR Plant Reference Visit Acknowledgement Form Guidance

GADNR Plant Reference Visit Acknowledgement Form Guidance

After downloading the Survey123 application to a mobile device and/or tablet, complete the following steps to use the GADNR Plant Reference Visit Acknowledgement Form during reference site visits ahead of Phase 2 surveys. No login is required, so if prompted, this may be skipped.

1. From a location where the device has service, select this app link.

OR

1. From a location where the device has service, select this web link.
2. Select the "Open in Field App" option.

The form will now be available for use within the application, regardless of connectivity. Simply open the application and click on the form to begin entering data. If the site visit occurs in an area without quality cell service, the user should select "Save in Outbox" in order to submit the data at a later point. Once the user is back in an area with quality cell service or is connected to a wireless network, re-enter the application, open the survey, and select "Send Now" to submit the data.

Appendix D: Greenfly Orchid (*Epidendrum magnoliae*) Avoidance & Minimization Measures

Greenfly Orchid (*Epidendrum Magnolia*) Avoidance & Minimization Measures

Due to the cryptic nature of this species occurring in small crevices that may not be viewable even through a spotting scope/binoculars, regardless of the outcome of the Phase 2 survey, a Special Provision (SP) 107.23H shall be implemented all projects where impacts will occur to suitable habitat for *E. magnoliae*. The SP shall state the following:

- If Project personnel believe to have identified greenfly orchid on any trees that are cleared during project construction, the portion(s) of the tree containing the greenfly orchid shall be spared and placed out of the Project Area. The Engineer shall immediately notify the State Environmental Administrator, Georgia Department of Transportation, Office of Environmental Services at (404) 631-1101. The State Environmental Administrator will in turn notify Georgia Department of Natural Resources to arrange the salvaging and transplanting of the species. No Project activities shall stop prior to the retrieval of the species by Georgia Department of Natural Resources and/or their designated representative.

Appendix E: Spotted Turtle (*Clemmys guttata*) Avoidance & Minimization Measures

Spotted Turtle (*Clemmys gutatta*) Avoidance & Minimization Measures

If suitable habitat for *C. gutatta* is within the Project limits, attempts should first be made to avoid impacting the habitat in its entirety. If avoidance is infeasible, apply the below protections which best fit the Project scenario. If relocation efforts are required, proceed to **Appendix F**.

- Regardless of the distance of the nearest EO, if the only impacted suitable habitat on site is a deep-water, brackish habitat (otherwise, advance to primary bullets below):
    - Implement enhanced erosion and pollution control measures via Special Provisions
- If there is a *C. gutatta* EO ≤0.5mi from the Project, but the Project will **not** impact *either* ≥0.5 acre *or* ≥33% of contiguous suitable habitat; **or** if all *C. gutatta* EOs are >0.5mi from the Project:
    - Implement enhanced erosion and pollution control measures via Special Provisions
    - Contact GADNR and the GDOT Project Ecologist to determine which, if any, additional protection measures are warranted based on site conditions and proposed Project activities.
        - Potential additional protections could include: permanent water quality BMPs, in-water construction method limitations, etc.
- If there is a *C. gutatta* EO ≤0.5mi from the Project **and** the Project will impact *either* ≥0.5 acre *or* ≥33% of contiguous suitable habitat:
    - Implement enhanced erosion and pollution control measures via Special Provisions
    - Notify the GDOT Project Ecologist of the need to establish a plan for a relocation effort to occur immediately prior to site disturbance
    - Relocation effort can be conducted between GDOT/consultant ecologists & GADNR or can be a requirement imposed on the contractor via hiring a pre-qualified biologist

Appendix F: Spotted Turtle (*Clemmys guttata*) Relocation Protocol

Spotted Turtle (*Clemmys gutatta*) Relocation Protocol

A scientific collector's permit will be required since animals will be captured and handled during this type of survey effort. No trapping efforts shall occur without prior coordination with GDOT and GADNR.

- Trapping should occur late winter or early spring when temperatures are 15-32°C (59-90°F) to increase trap success; however, trapping may be required immediately preceding the start of any site disturbing activities, regardless of temperatures.
- Trapping methods consist of using baited, modified crab traps (Jones Trap; See: **Image 1.**) placed overnight in suitable habitat. Traps should be anchored, particularly in flowing water, and shall be checked daily to prevent mortalities (Stevenson et al., 2017).
- Captured individuals shall be relocated either to the nearest suitable habitat or transported to an institution approved by GADNR for temporary housing. If held in captivity, *C. guttata* individuals would be released back on site following Project completion.

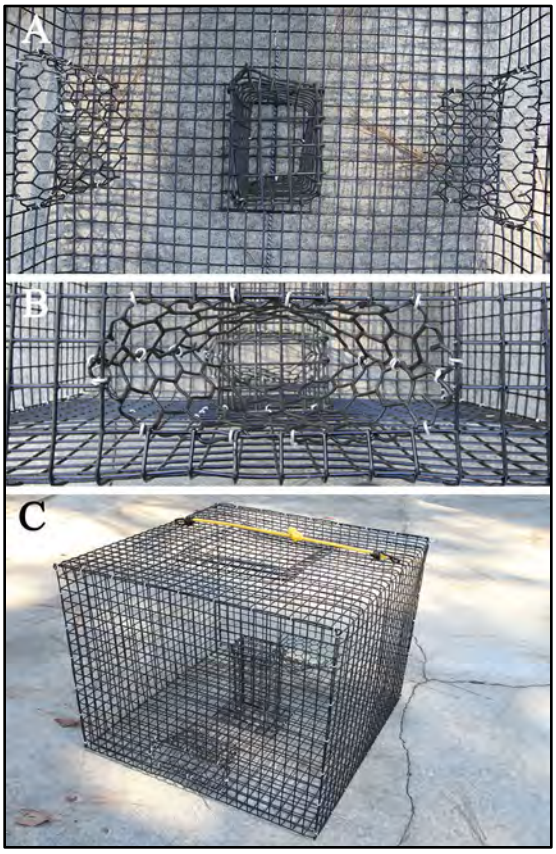


Image 1. Modified crab trap (Jones Trap) designed to catch small freshwater turtles.
Photo By: Dirk Stevenson

Spotted Turtle (*Clemmys guttata*) Capture Data Form

General Information

Collector Name(s): _____

GDOT P.I. #(s): _____ **County(ies):** _____

Collection Permit #: _____ **GDOT Methodologies Manual version referenced:** _____

Trap Setting Data

Trap set date: _____ **Trap set time:** _____

Total # of traps set: _____ **Trap bait:** _____

Trap location(s) (Lat/Long)**:** _____

Average temperature: _____

Typical weather conditions: _____

Trap Removal Data

Trap removal date: _____ **Trap removal time:** _____

Average temperature: _____

Typical weather conditions: _____

Total # of individuals trapped: _____

Notes (behavior, habitat, health, etc.)**:** _____

_____

Other spp. trapped: _____

Holding Location Information

Location: _____

_____

Contact Name: _____ **Phone number:** _____

Other notes: _____

Appendix G: Gopher Tortoise (*Gopherus polyphemus*) Shapefile Information

Gopher Tortoise (*Gopherus polyphemus*) Shapefile Information

File name: TOS_Tortoise_roads_Final.shp

Description: Road layer created by the Orianne Society for GDOT using GDOT roads file, 2018 traffic volumes, and data describing *G. polyphemus* habitat and currently known populations

Attributes:

The following attributes are those most likely to provide useful information in desktop survey and/or field survey preparation in order to gain an idea of what suitability is at your Project site.

- GT_HSI: Average habitat suitability for tortoises along each road segment
- Scr_Hbt: Suitability values score based on quality of habitat (3 = high, 2 = medium, 1 = low, 0 = unsuitable)
    - Uses a suite of variables, including landcover type, fire frequency, and soil characteristics to create the overall value rating
- Scr_VPp: Whether or not segment passes through buffered (100 m) viable populations (1 = yes; 0 = no)
    - Minimum Viable Population: ecological threshold that specifies the smallest number of individuals in a population capable of persisting at a specific statistical probability level for a predetermined amount of time
- Scr_CnH: Whether or not segment passes through a ≥ 100 ha piece of high-quality habitat (1 = yes; 0 = no)
- GT_Scor: Gopher tortoise score ranging from 0–5 (sum of previous 3 categories)
    - Higher value = higher quality GT habitat in the area

The following are additional attributes discernable from the shapefile that are less likely to be used:

- FUNCTION_1: Road functional classification (1 = Interstate; 2 = Freeways, & Expressways; 3 = Principle Arterial, Other; 4 = Minor Arterial; 5 = Major Collector; 6 = Minor Collector; 7 = Local)
- Scr_RdT: Score from 1–3 based on functional classification (Classes 1-3 = 3; Classes 4-6 = 2; Class 7 = 1)
- Scr_RdS: Score based on surface type (1 = Asphalt/Concrete; 0 = Unpaved/Unclassified)
- Scr_RdW: Score based on road width (1 = >25ft; 0 = <25ft)
- Rod_Scr: Total road score (sum of previous 3 columns)
    - Higher value =
- Score-com: Gopher tortoise and road score combined to give a single 2-digit number, 1st digit is tortoise score and second digit is road score

Appendix H: Gopher Tortoise (*Gopherus polyphemus*) Avoidance & Minimization Measures

Gopher Tortoise (*Gopherus polyphemus*) Avoidance & Minimization Measures

G. polyphemus are communal animals that rely on a social network and frequently exhibit multiple paternity (polygamy). Therefore, the chance of success of relocation efforts, and persistence of remaining *G. polyphemus* at the source site, are greatest if *G. polyphemus* are assessed as a community (group) rather than as a number of individuals. A community-based assessment includes counting the number of *G. polyphemus* in and around an impact area and assessing the demography (sex ratio and age class). While sex is usually not determinable even from scoping surveys, it is important to record information on size classes during surveys. Due to these social behaviors, even if *G. polyphemus* do not immediately occupy the impact area, those *G. polyphemus* will be affected negatively if adjacent individuals on which they rely for reproduction are removed and they are avoided. If a subset of the population needs to be relocated, it is especially important that they are moved to a site with a larger, established population. If a few, scattered individuals are going to be left at the source site, these individuals may have a more uncertain long-term outcome as the local population is already reduced below that necessary for a biologically viable population. As stated in the species methodology, the GDOT Project Ecologist should be consulted regarding how many *G. polyphemus* are likely being relocated vs. avoided and he/she will initiate coordination with GADNR and USFWS.

If Impacts to Resident G. polyphemus Can be Avoided

- If the alignment of the construction plan allows for avoidance of *G. polyphemus*, temporary silt fencing should be installed and buried at a minimum depth of 8" to prevent *G. polyphemus* from wandering into the impact area during construction activities. For *G. polyphemus*, the "grass is greener" in more open habitats so they will readily move into a clear-cut area or right-of-way.
    - Orange barrier fencing should be installed just outside of the silt fencing as well.
- When installing silt fencing, the fence should angle back into the unimpacted habitat and be "dog-eared" on either end to reduce the propensity for *G. polyphemus* to trespass the fence.
- Fence repairs should be assessed no less than weekly to ensure that the fence is still operational in excluding the *G. polyphemus* from the impact area. Breaches and repairs can usually be performed immediately with a staple gun and extra stakes.

If impacts to resident *G. polyphemus* cannot be avoided, please proceed to **Appendix F** for relocation protocol that should be followed.

Appendix I: Gopher Tortoise (*Gopherus polyphemus*) Relocation Protocol

Gopher Tortoise (*Gopherus polyphemus*) Relocation Protocol

If Impacts Cannot be Avoided, What is the Process for Relocation?

- Identifying and preparing a recipient site are the most time-sensitive aspects of conducting a *G. polyphemus* relocation. If the site is populated by resident *G. polyphemus* or other translocated individuals, GADNR must confirm that the recipient site can accommodate the number of individuals expected based on the survey data above.
    - Depending on the timing and resource availability, habitat restoration through longleaf planting or re-establishment of fire can increase recipient site capacity and contribute to site stewardship.
    - A quarantine pen constructed of silt fencing should be installed to receive the gopher *G. polyphemus*. Silt fencing must be buried a minimum of 8" to prevent tortoise escape from burrowing under the fence. Penning prevents the *G. polyphemus* from wandering outside of the intended area and expedites the acclimation process to the new site. Pens are usually maintained for 10-12 months (Tuberville et al. 2005, Bauder et al. 2014). It appears that establishment can be achieved in 6 months if overwintering occurs while the pen is installed and provided that sufficient forage and other *G. polyphemus* are present (Paden 2018, UGA, unpubl. data).
- *G. polyphemus* relocation ideally should be conducted in moderate temperatures - depending on the local climate conditions in Apr-May and Sep-Oct. Preferably, *G. polyphemus* will have a month to acclimate at their recipient site before the onset of hot days (>90°F) and cold nights (<50°F). This conservative approach will greatly reduce stress to the animals from extreme conditions and increase the probability of animal survival post-relocation.
- During the relocation, the datasheets included in this appendix shall be completed.
- During the relocation, burrows should be scoped one last time to assess occupancy and which burrows need to be excavated. This labor can be reduced by scoping burrows immediately prior to the excavation.
- *G. polyphemus* can be excavated from their burrows safely by using a mini-excavator and a trained operator, by installing bucket traps in the apron, by using hand tools, or another authorized means. Given that burrows can exceed 10 m in length, we recommend use of a mini-excavator if the equipment or rental resources are available. For purposes of expedition, this approach is the most cost effective in terms of personnel time invested. However, it is imperative that heavy machinery only be used if personnel trained in excavating *G. polyphemus* are available. Bucket traps can be highly effective in capturing *G. polyphemus* but trapping a single individual can take weeks if not more, and the risk of overheating and stressing an animal left in a bucket makes the process tedious and time consuming. Finally, even juvenile burrows can take an extensive amount of time using hand excavations. The following recommendations are precautionary measures that can be taken to prevent injury to *G. polyphemus* when excavated using heavy machinery.
- Heavy machinery can result in burrow collapse if the equipment operates too closely to the burrow. The excavator should maintain a minimum buffer of 4 m from the burrow entrance (Smith et al. 2015).
- To prevent accidently hitting a *G. polyphemus* with a shovel or excavator bucket, a PVC pipe (~2 m length, either 1.27 cm or 1.91 cm diameter) should be inserted into each burrow before digging into it. The PVC pipe can be adjusted continually as it digs farther into the burrow until reaching the terminal chamber and removing the *G. polyphemus* or commensal species found within (Paden et al., in review).

- Upon removal of the *G. polyphemus* from the burrow, or if the burrow is confirmed to be unoccupied, the burrow should be "collapsed" completely using the backhoe or a shovel to prevent *G. polyphemus* or other commensals from moving back into the burrow while the rest of the impact area is being "cleared" of *G. polyphemus*.
- If *G. polyphemus* exhibit any symptoms of an infectious disease, namely nasal or ocular discharge, wheezing, emaciated body conditions, please consult with the GADNR prior to releasing it at a recipient site.
- If space in bins and transport allows, *G. polyphemus* can be placed in separate containers respectively sized such that they can turn around. A thin layer of sand and air holes should be in the container.
- A minimum of 2-3 "starter" burrows for each individual animal should be dug at the recipient site. *G. polyphemus* do not always take to a new burrow and acclimation is facilitated if the *G. polyphemus* have a choice. This step is particularly important if integrating translocated animals into a resident population where residents may also elect to take over a starter burrow. "Starter" burrows should be appropriate for the respective sizes (age classes) in terms of width and should be at least 0.5 – 1 m in depth.

Proceed to **Appendix G** for post-relocation monitoring protocol.

Gopher Tortoise (*Gopherus polyphemus*)
Capture Data Form

Date (mm/dd/yy): _____ _____ _____ Collected By: _____

Collection Permit #: _____ Recorded By: _____

Time of capture (24-hr) ____:____

Capture Site		
Location Description: _____		
UTM (NAD83): _____, _____		**Waypoint #:** _____
Recapture?	**Capture Method**	**Notes (habitat, animal behavior)**
☐ Yes ☐ No	☐ Hand – on surface ☐ Bucket/Cage trap (burrow # _____) ☐ Excavated	

Excavation Tools Used (check all that apply)	**Burrow Notes**
☐ Hand – pulled out ☐ Shovel ☐ Excavator ☐ Other: _____	Burrow Size: _____ Burrow Appearance: _____ Burrow Length: _____ Depth: _____ (surface to end chamber) Collapsed? ☐ Yes ☐ No

Release Location	
Date (mm/dd/yy)**:**_____	**Site name:** _____
	Waypoint: _____
	Burrow #: _____
Time (24hrs.)**:**_____	**UTM (NAD83):** _____, _____

Date (mm/dd/yy): _____ _____ _____

Measured By: _____ Recorded By: _____

Measurements

Sex/size class: □ Hatchling (Criteria (CL): < 68 mm, Still in its 1st year) □ Juvenile (< 130 cm, Scutes still yellow) □ Subadult (≥ 130 and < 230 mm, Plastron not concave) □ Adult Male (≥ 180 mm, Plastron concave) □ Adult Female (≥ 230 mm, Plastron not concave)

CL (notch-notch) _____ mm Width (max) _____ mm Height (max) _____ mm

Gular Length _____ mm Weight (kg) at capture _____ kg Weight (kg) w/ new equipment _____ kg

Notch Code _____ No. Annuli _____

Marks

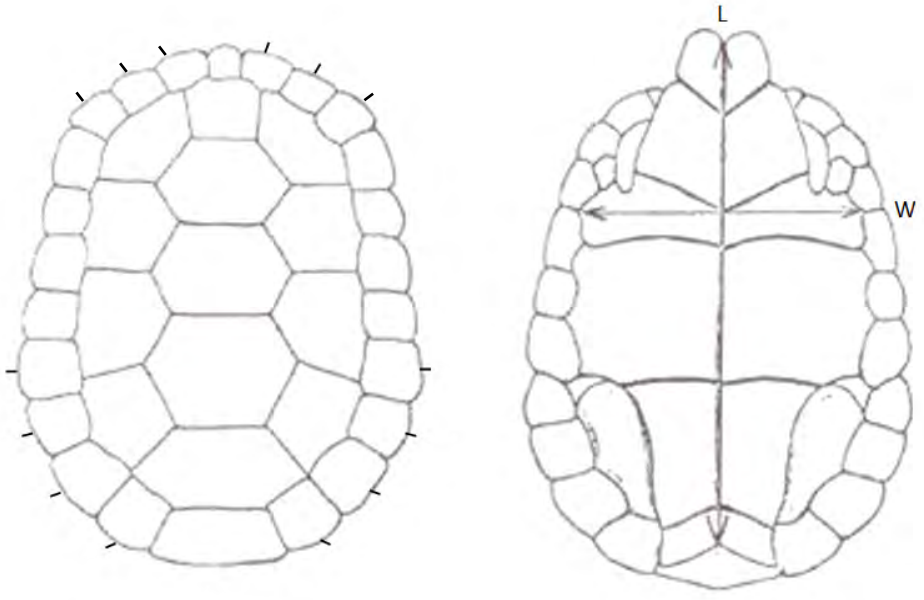
Circle which scutes are marked and draw position of marks on each scute (Check one):

☐ ID certain

Redrilled? Yes No

☐ ID uncertain

Other possible IDs: _____



Add-ons: (Check all that apply)

☐ Transmitter (Freq:_____)

☐ Logger

☐ iButton (Serial:_____)

Took photos (Dorsal, ventral, & anterior)? Yes No

Note any shell deformities or other distinguishing characteristics on figures

Date (mm/dd/yy): _____ _____ _____

Examined By: _____ Recorded By: _____

Physical Exam:

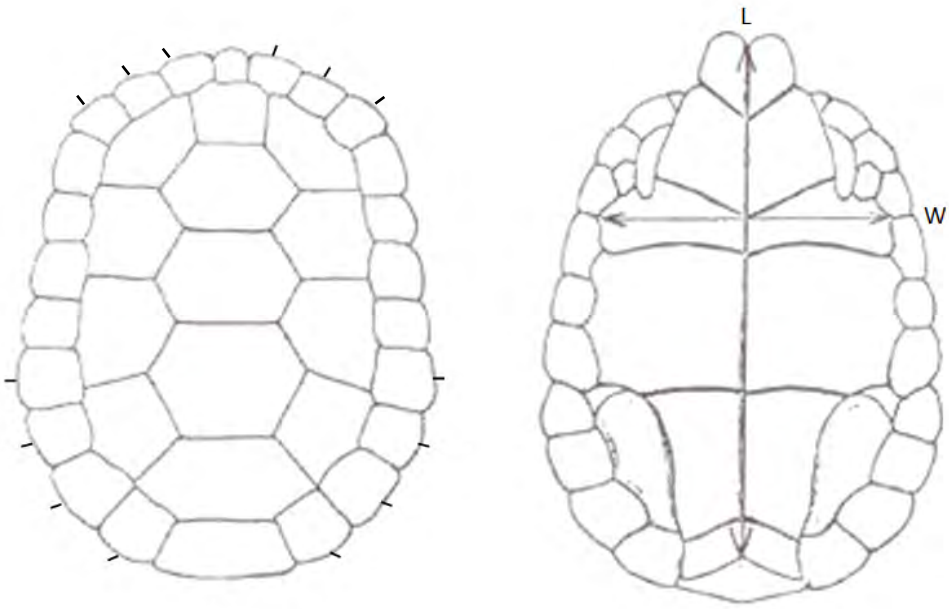
Body Location	Norm.	Abn.	Not Examined	Body Location	Norm.	Abn.	Not Examined
1. Oral Cavity	☐	☐	☐	8. Resp	☐	☐	☐
2. Nares	☐	☐	☐	9. Nervous	☐	☐	☐
3. Eyes	☐	☐	☐	10. Musculoskeletal	☐	☐	☐
4. Integument	☐	☐	☐	11. Urinary/repro	☐	☐	☐
5. Carapace	☐	☐	☐	12. Inguinal/pectoral	☐	☐	☐
6. Plastron	☐	☐	☐	13. Cloaca	☐	☐	☐
7. Tympanum	☐	☐	☐	14. Other:_____	☐	☐	☐

Describe and draw abnormalities (include number for system 1-14):

_____

_____

_____



Ectoparasites: Yes ☐ No ☐

Comments:_____

_____

Appendix J: Gopher Tortoise (*Gopherus polyphemus*) Post-Relocation Protocol

Gopher Tortoise (*Gopherus polyphemus*) Post-Relocation Protocol

We are still learning a great deal, including basic details, about how to mitigate impacts to *G. polyphemus* populations and their many commensal species and how we best achieve biological success for our long-term outcomes. Through monitoring efforts, we also have learned that translocating *G. polyphemus* individuals successfully and in a manner that is conducive to their short-term health and long-term persistence of populations can be more challenging than initially thought. Here, we recommend steps that are low-cost economically and have high gains ecologically in contributing to the likelihood of biological success. These steps should be included as part of the relocation process and short-term monitoring following their release at a recipient site. While these measures could be incorporated as part of the mitigation process for the GDOT, we encourage professional and scientific collaboration with other agencies and research institutions whose existing presence and resources may be leveraged to accomplish these beneficial tasks.

- As discussed above, silt fencing can be installed as a temporary pen to increase the acclimation of *G. polyphemus* and retention in a new area. This pen also can serve as a quarantine for non-resident *G. polyphemus* to ensure that they are not at risk of introducing infectious diseases to resident *G. polyphemus* at the recipient site. Note this quarantine is only possible if disease testing and follow-up field surveys occur of infected individuals.
- Health screening can provide results that have critical effects on the ultimate survival of translocated animals and impacts on the recipient *G. polyphemus* population. Of priority interest are *Mycoplasma*, *Ranavirus*, and *Herpesvirus* which cause bacterial and viral infections that can be readily transferred among these social animals. There are various labs with whom an agency can work, and disease panels can be conducted so that multiple diseases can be screened at once. To explore the option of testing translocated individuals, contact the GADNR.
- Some translocated *G. polyphemus* experience stress behaviors upon release that present immediate risk to their health and survival. Specifically, they will pace the fence and overheat rather than settling into a burrow. If personnel are available, the fence should be monitored regularly (daily if personnel are already on site); any *G. polyphemus* found “pacing” can be picked up and placed in the mouth of a nearby, appropriately sized burrow.
- Many biologists are seeking research opportunities to conduct investigations on *G. polyphemus* populations. These interests provide scientific opportunities through collaborations facilitated by DOT and can yield valuable information for GDOT management needs. Where possible, mitigation actions can lead to a progress in scientific knowledge and a better way of doing business for our economy and our ecology.

Appendix K: Map Turtles (*Graptemys spp.*) Avoidance & Minimization Measures

Map Turtles (*Graptemys spp.*) Avoidance & Minimization Measures

If suitable habitat for *Graptemys spp.* is within the Project survey limits, attempts should first be made to avoid impacting the habitat in its entirety. If avoidance is infeasible, apply the below protections which best fit the Project scenario.

- Projects with no water impacts (beyond those in-water activities deemed not a risk to the species*), activities only above the water, or with impacts to sites containing only aquatic habitat (*i.e.* no nesting habitat) should:
    - Implement enhanced erosion and pollution control measures via Special Provisions
    - Contact GADNR and the GDOT Project Ecologist to determine which, if any, additional protection measures are warranted based on site conditions and proposed Project activities.
        - Potential additional protections could include permanent water quality BMPs, in-water construction method limitations, etc.
- For projects with suitable nesting habitat present and impacts to suitable aquatic habitat (beyond those in-water activities deemed not a risk to the species*):
    - Implement seasonal restriction via Special Provision 107.23H prohibiting activity in nesting habitat from May 15- September 30
    - Implement enhanced erosion and pollution control measures via Special Provisions in vicinity of both suitable aquatic habitat and terrestrial nesting habitat.
        - Project Ecologist should ensure proposed installation of orange barrier fencing and silt fencing would not function as a barrier to adult female movement to a potential nest site and/or hatchling migration to aquatic habitats following hatching and emergence.
    - Contact GADNR and the GDOT Project Ecologist to determine which, if any, additional protection measures are warranted based on the site conditions and proposed Project activities.
        - Potential additional protections could include permanent water quality BMPs, in-water construction method limitations, etc.

*The following in-water activities are deemed ***not*** a risk to the species:

1. Removal of existing piles via cutting/breaking off at ground line or being pulled from the banks
2. Pile jacketing
3. Drift removal in accordance with Standard Specification 201.3.05F

Appendix L: Alligator Snapping Turtle (*Macrochelys temminckii*) & Suwanee Alligator Snapping Turtle (*Macrochelys suwanniensis*) Avoidance & Minimization Measures

Alligator Snapping Turtle (*Macrochelys temminckii*) & Suwanee Alligator Snapping Turtle (*Macrochelys suwanniensis*) Avoidance & Minimization Measures

If suitable habitat for *M. temminckii* or *M. suwanniensis* is within the Project limits, attempts should first be made to avoid impacting the habitat in its entirety. If avoidance is infeasible, apply the below protections which best fit the Project scenario. If trapping efforts are required, proceed to **Appendix J**.

- The following in-water activities are deemed ***not*** a risk to the species if ***only*** these are occurring:
  - Removal of existing piles via cutting/breaking off at ground line or being pulled from the banks
  - Pile jacketing
  - Drift removal in accordance with Standard Specification 201.3.05F
- Projects with only activities above, no microhabitat impacts, or no water impacts:
  - Implement enhanced erosion and pollution control measures via Special Provisions
    - Approved, standardized language for these measures can be found in the "GDOT Templates" folder on the Ecology SharePoint site in the SAST-AST SP document. Only Items 2 and 3 are relevant in this scenario.
    - Contact USFWS, GADNR, and the GDOT Project Ecologist to determine which, if any, additional protection measures are warranted based on site conditions and proposed Project activities. Potential additional protections could include permanent water quality BMPs, in-water construction method limitations, *etc.*
  - Implement SP 713.6
- Projects with juvenile habitat impacts:
  - For the majority of construction activities, implement the same measures noted above.
  - For pile driving activities:
    - Within floodplain habitats: implement the same measures noted above
    - Within juvenile habitats likely to be nearly permanently flooded (*e.g.* oxbows, side channel pools, *etc.*): implement measures below
- Projects with microhabitat habitat impacts:
  - Implement pre-construction surveys and enhanced erosion and pollution control measures via Special Provisions
    - Approved, standardized language for these measures can be found in the "GDOT Templates" folder on the Ecology SharePoint site in the SAST-AST SP document. Items 1-3 apply in this scenario.
    - Contact USFWS, GADNR, and the GDOT Project Ecologist to determine which, if any, additional protection measures are warranted based on site conditions and proposed Project activities. Potential additional protections could include permanent water quality BMPs, in-water construction method limitations, *etc.*
  - Implement SP 713.6
- Projects with nesting habitat on site:
  - Implement seasonal restrictions for any activities impacting the nesting habitat
    - Nesting season is considered April 15 – September 15
  - Project Ecologist should ensure proposed installation of orange barrier fencing and silt fencing would not function as a barrier to adult female movement to a potential nest site and/or hatchling migration to aquatic habitats following hatching and emergence in late summer.

Appendix M: Alligator Snapping Turtle (*Macrochelys temminckii*) & Suwanee Alligator Snapping Turtle (*Macrochelys suwanniensis*) Relocation Protocol

Alligator Snapping Turtle (*Macrochelys temminckii*) & Suwanee Alligator Snapping Turtle (*Macrochelys suwanniensis*) Relocation Protocol

While very rare, there may be occasions where USFWS recommends a pre-construction trapping survey to relocate known individuals in the area. The following protocol shall be adhered to for relocation efforts in those instances. A scientific collector's permit will be required since animals will be captured and handled during this type of survey effort.

Trapping is ideally conducted March through November, however, since these efforts are required immediately preceding the start of construction activities, they may occur outside of this period. The preferred method involves the use of large, heavy-duty hoop traps as follows. Snorkeling and diving in clear water may also be conducted to visually locate individuals. (Jensen, 2018a; Floyd, 2018).

- Prior to setting traps, a location for trapped specimens to be temporarily relocated to must be determined.
  - The GDOT Project Ecologist, USFWS, and GADNR shall be included in the determination and approval of this site.
- Set baited hoop traps within or just upstream of the proposed construction Project site.
  - Research studies have successfully used single-funnel hoop traps of various sizes, depending on different field situations such as water depths, baited with cut fish (Johnston et al., 2015; Thomas, 2013).
- Set a minimum of two single-entrance hoop net traps, one on each opposing stream bank, in a stream section having detectable to moderately flowing current, upstream of the proposed construction Project site.
  - Trap entrance shall be facing downstream.
  - Bait the hoop net traps using cut fish in a partially open container secured inside the back of the trap throat and suspended into the approximate center of the trap diameter.
  - Ensure that at least the front and second trap hoops are secured to the bottom of the water body and that the longitudinal axis of the hoop trap is approximately parallel to the stream flow with the current flowing through the throat of the trap (Johnston et al., 2015).
  - If suitable rocks, limbs or root systems are unavailable for securing traps, staking may be required to secure the traps (Thomas, 2013).
  - Set and secure traps to allow a portion of the upper part of the hoop trap to be emergent from the water surface, to allow animals, including alligator snapping turtles, to surface and avoid drowning.
    - Consider the timing and feasibility of placement of traps on stream and river segments that may be regulated by flow release schedules from dams, or that may be rising in flood conditions, wherein high flows may inundate otherwise suitable habitats and exceed the top of the set hoop trap, creating a drowning hazard for captured animals.
    - Conversely, fluctuating river discharge creating a lack of flow may render otherwise suitable habitats suboptimal and encourage turtles to move to more stable habitats (Jensen and Birkhead, 2003).
- Traps shall be allowed to remain in place overnight for a period of at least 12 to 20 hours at each site.

- Traps may be checked as soon as every hour or two, but shall be checked at least daily, to remove any animals caught, and to avoid escapes and drownings (Jensen and Birkhead, 2003).
    - If overnight rainfall occurs on site or upstream in the watershed, the trap should be checked as soon as possible to ensure it wasn't submerged or dislodged, which could result in species mortality. Photographs shall be taken of all *M. temminckii* and *M. suwanniensis* individuals captured.
    - Dorsal view showing posterior marginal scutes and side profile view required at a minimum
- Trapped individuals shall be temporarily relocated to a pre-determined off-site location.
- Individuals shall be released back into the habitat where they were captured as soon as possible following completion of in-water activities with the potential to cause direct harm to the species.
    - If demolition has been completed and temporary construction methods have been installed (work/detour bridges and debris containment structures) and all remaining construction activities will occur "in the dry", individuals may be released at this point when the only remaining activities would be the removal of these temporary structures at a later date.

Alligator Snapping Turtle Capture Data Form

General Information

Collector Name(s) & Permit #: _____

GDOT P.I. #(s): _____ **County(ies):** _____

Trap Setting Data

Trap set date: _____ **Trap set time:** _____

Total # of traps set: _____ **Trap bait:** _____

Trap location(s) (Lat/Long)**:** _____

Water Temperature: _____ **Turbidity:** _____

Average temperature: _____

Typical weather conditions: _____

Trap Removal Data

Trap removal date: _____ **Trap removal time:** _____

Average temperature: _____

Typical weather conditions: _____

Total # of individuals trapped: _____

Notes (behavior, habitat, health, etc.)**:** _____

_____

Other spp. trapped: _____

Holding Location Information

Location: _____

_____

Contact Name: _____ **Phone number:** _____

Other notes: _____

_____

Credits

Methodologies were written, reviewed, and compiled by the following agencies and partners:

Agencies:

Partners:

Citations

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