

Lower Chickahominy Watershed Herpetological Inventory



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Lower Chickahominy Watershed Herpetological Inventory

Final Report

Prepared for:

VIRGINIA COASTAL ZONE MANAGEMENT PROGRAM

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Cover photo: Scarlet Kingsnake

Photo credit: Dane Conley

***THIS REPORT SHOULD NOT BE RELEASED TO THE PUBLIC. IT CONTAINS SENSITIVE INFORMATION ABOUT LOCATIONS OF SPECIES KNOWN TO BE POACHED FOR THE PET TRADE.**

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Executive Summary

The Chickahominy River is an 87-mile-long river named after the Chickahominy Indian Tribe. Its headwaters begin just northwest of Richmond as the border between Henrico and Hanover counties, and flows in a southeasterly direction until its confluence with the James River. The lower section of the watershed serves as the border between Charles City, New Kent and James City counties. Historically, this region has been primarily an agricultural community. Although it continues to serve as an agricultural area, it also serves as a major source of drinking water for the lower York-James Peninsula and for outdoor recreational activities (i.e. boating, hunting and fishing), and as a focal area for wildlife conservation.

According to the Virginia Fish and Wildlife Information System (VaFWIS), 69 species of reptile and amphibian have been documented within the lower Chickahominy River watershed. To better understand the distribution of the herpetofauna, we conducted an intensive 6-month herpetological survey of the lower section of the watershed and selected tributaries. We documented 64 of the 69 species known to occur in this region, including a new county record for Scarlet Kingsnake and a new location for the recently described Atlantic Coast Leopard Frog.

To aid in the management of this taxonomic group in this region, we produced 64 maps showing location and abundance of each species observed, list of observed species and number of observations, provided Management Recommendations, and produced two manuscripts *in prep* on the new county record and the observation of anophthalmia (absence of one or both eyes) in an adult Eastern Kingsnake. A spreadsheet of species observations was also submitted to VaFWIS to be entered into the database.

Introduction:

Several herpetological surveys have been conducted over the years by numerous individuals and organizations within the Chickahominy River watershed. In 2007 and 2016, the Virginia Herpetological Society conducted “herp-blitz” surveys at the Chickahominy Wildlife Management Area and the New Kent Forestry Center (Watson, 2008; Perry, 2017). However, these were relatively short 2-3 day surveys and limited in their spatial and temporal scale, which resulted in limited detection of species richness. The phenology (breeding season) of Virginia’s herpetofauna is highly variable with some species of anurans (frogs and toads) beginning to call in mid-February, while others may not start calling until late May or early June. Although activity in reptiles is not quite as variable, there is some variation as to when certain species start to become active. For example, while spotted turtles can be found basking on warm late winter days, six-lined racerunner may not become active until the warmer days of May. It is this variability that limits the detection success of previous surveys and justifies a more extensive broader scale survey.

The survey area included several tributaries to the Chickahominy River and the surrounding upland habitat from Rt. 106 in northwestern Charles City County; southeast to the Dressler Bridge at the confluence of the Chickahominy River and James rivers; north to Route 60 in New Kent County; south to Route 5 in Charles City County; and east to Freedom Park in James City County. Focal areas included the Chickahominy Wildlife Management Area (WMA), Game Farm Marsh WMA, Freedom Park, New Kent Forestry Center, Crawford State Forest and several privately owned properties (Map 1).

Natural habitats range from large expanses of cypress-gum swamps to upland mixed hardwood-pine forests and open early successional habitats. Agricultural areas are abundant throughout the watershed. The lower section of the river is tidal freshwater, while the upper section is regulated by Walker Dam that creates the Chickahominy River Reservoir. During the summer months, the lower section of the river is occasionally inhabited by species more associated with estuarine or marine habitats (i.e. Blue Crab, Atlantic Croaker, Bottle-nosed Dolphin). On a very rare occasion, Manatee and Green Sea Turtle has been observed.

New Kent Forestry Center and Game Farm Marsh WMA:

These properties are adjacent to each other for a combined total of 1,279 acres. Although the New Kent Forestry Center is located entirely in New Kent County, Game Farm Marsh WMA is bisected by the Chickahominy River with property on both sides. The western side of the WMA is only accessible by boat and was not surveyed. These properties have an abundance of cypress-gum swamp and upland areas, which are periodically burned to maintain their open pine savanna-like habitat.

Chickahominy WMA:

This 5,217 –acre Wildlife Management Area located in Charles City County is primarily a mixed pine-hardwood forest habitat with some cultivated areas and “open fields”. Morris Creek flows along its southern boundary with smaller tidal creeks and freshwater wetlands.

Crawford State Forest:

Located in New Kent County, this 258-acre forested tract. The habitat is primarily mixed pine-hardwood forest with some old growth cypress-gum swamps in the southern section near the Chickahominy River.

Freedom Park:

This 600-acre county park is located in James City County. The habitat is primarily mixed pine-hardwood with intermittent streams.

Private Lands:

- Upton property is located at the confluence of Diascund Creek and the Chickahominy River, and was selected as a potential location for Glossy Swampsnake.
- Parker property is located off Route 155 and was selected because of historic documentation of Common Rainbow Snake, Eastern Mud Snake, and Atlantic Coast Leopard Frog.

Methods:

This survey was conducted primarily by a field crew of two. Starting in mid-February to the end of July, they spent ~2,000 hours in the field. Survey methodologies included Visual Encounter Surveys (VES), auditory surveys, ProMar traps, commercial crayfish traps, artificial cover materials, and PVC pipes. Visual Encounter Surveys (flipping logs and other ground cover material) was the most implemented and success method of surveying and also included the use of “road-cruising” at night. We augmented this method by placing 65 8’X3’ sheets of tin at various locations around the Chickahominy WMA, New Kent Forestry Center and on the Upton property. Reptiles often use these materials to hide under and thermoregulate. Auditory surveys were conducted at night after heavy rainfall for calling anurans and were much more effective than PVC pipes for detecting Hylids (treefrogs). PVC pipes hung in trees are occasionally used in Hylid surveys. Commercial crayfish and ProMar traps (similar in appearance to minnow traps) baited with canned sardines in soybean oil and were also used in shallow, backwater areas to capture amphibians and turtles. No trapping was conducted on the main stem of the river. However, a canoe and motor boat were used to survey the shoreline of the main stem for basking snakes.

Once a species had been observed and recorded in a specific area, we no longer continued to record observations for that species in that area. Therefore, the **Number of Observations** shown in Appendix 1 may under represent the actually number of individuals observed in one area. Estimates for the number of frogs in a breeding chorus may also under estimate the actual number; since hundreds of individuals may be participating.

Results:

Of the 69 species of herpetofauna documented in the lower Chickahominy River watershed, 64 species were documented during this survey (Appendix 1) including two new species to the area; the Scarlet Kingsnake (*Lampropeltis elapsoides*) and Atlantic Coast Leopard Frog (*Lithobates kauffeldi*). The Glossy Swampsnake (*Liodytes rigida*), Northern Scarletsnake (*Cemophora coccinea*), Eastern Mudsnake (*Farancia abucura abucura*), and Slender Glass Lizard (*Ophisaurus attenuatus*) were not documented. Although the Green Sea Turtle (*Chelonia mydas*) has also been documented in Chickahominy River, this is an exceptionally unusual event and has only been observed once (Kleopfer pers. obs. 2015). The Glossy Swampsnake is only known to occur at the mouth of Diascund Creek and access to survey for this species was limited to only one property owner. Northern Scarletsnake is a rare observation north of the James River. The Eastern Mudsnake is very secretive, but has been documented multiple times in this area and photographic evidence of its occurrence at the New Kent Forestry Center was provided by Virginia State Forest staff. Although the two Sirens observed during the survey were not identified to species (one was dead and too decomposed and the other was only observed as it escaped beneath the leaf litter) it was assumed that both observations were Lesser Sirens (*Siren intermedia*), since the Greater Siren (*Siren lacertina*) has not been observed in this area. River Cooters (*Pseudemys spp.*) were frequently observed basking along the main stem of the rivers and larger tributaries. However, we did not record these observations, since we were not focused on these sections of the watershed, and suspected hybridization between River Cooters and Northern Red-bellied Cooters makes species specific identification difficult (Dillard, 2017).

Discussion:

The Chickahominy watershed is one of the most biologically diverse and pristine watersheds in eastern Virginia. Habitats within this watershed vary from tidal freshwater wetlands to seasonally flooded forested areas to pine savannas and grasslands. It is because of this habitat diversity that we were able to document a species rich herpetological community. Of the 64 species observed during this survey, nine are listed as Species of Greatest Conservation Concern in Virginia's Wildlife Action Plan (Appendix 1.). However, the diversity and abundance of the herpetofauna in this region isn't just the result of natural habitats.

Anthropomorphic habitats, such as farm fields and powerline right-of-ways (ROWs), often inadvertently function as surrogates for early successional habitats, which many species of reptile and amphibian require or need for specific aspects of their ecology. These areas often maintain elevated temperatures in comparison to the surrounding forested areas, so it wasn't a surprise that we discovered the highest concentration of Six-lined Racerunners (*Aspidoscelis sexlineata*) in a powerline ROW as this species prefers hot, open areas. These areas are also often used by turtles to nest and snakes seeking areas to thermoregulate, which plays a critical role in many biological functions, including locomotion, digestion, and gestation. Chorus frogs are also often found in these areas as they favor the grassy open wetlands for breeding.

The tilled soft soils of farm fields are often favorable for many species of reptile and amphibian to burrow or nest. However, naturally maintained early successional habitats were uncommon throughout much of the survey area as wildfires would have been the primary mechanism to maintain these habitats. This makes the New Kent Forestry Center and the Chickahominy WMA even more important in providing these habitat types, as they are the only

areas where fire is used as a land management tool to maintain open, savanna habitats. These open, pine savanna habitats also provide grassy, open wetlands, which chorus frogs and other species of amphibian prefer to for breeding habitat. If not maintained, these areas can become overgrown and shaded by hardwood encroachment.

Roads are serious problem in this area and probably one of the more significant threats as DORs (Dead On Road) were frequently encountered during this survey. Most roads in the survey area are bordered by large tracts of forests or farm fields with multiple stream crossings. This situation is particularly lethal for turtles and snakes as they attempt to cross roads or bask on the pavement, or amphibians migrating to breeding sites. Some studies have shown that a disproportionate number of reproductive-aged female turtles are struck on roads as they search for nesting sites (Steen and Gibbs, 2004). Over the past several decades a number of techniques to mitigate the effects of roads on wildlife have been piloted, trialed and constructed, some of the most common mitigation practices include signage, fencing, under road tunnels.

The threats and issues facing the conservation of the herpetofauna in the Chickahominy watershed are not unique (i.e. habitat loss and fragmentation, road mortality, and human persecution). However, there is great potential to make this region a core area for conservation through continued land acquisition, regulations protecting wetlands, and private landowner cooperation. However, land acquisition and restoration is by far the single most important action that can be taken to protect reptiles and amphibians in this region.

Management Recommendations:

PARTNERS IN AMPHIBIAN AND REPTILE CONSERVATION (PARC): HABITAT MANAGEMENT GUIDELINES FOR AMPHIBIANS AND REPTILES OF THE NORTHEASTERN UNITED STATES (Mitchell et al., 2006).

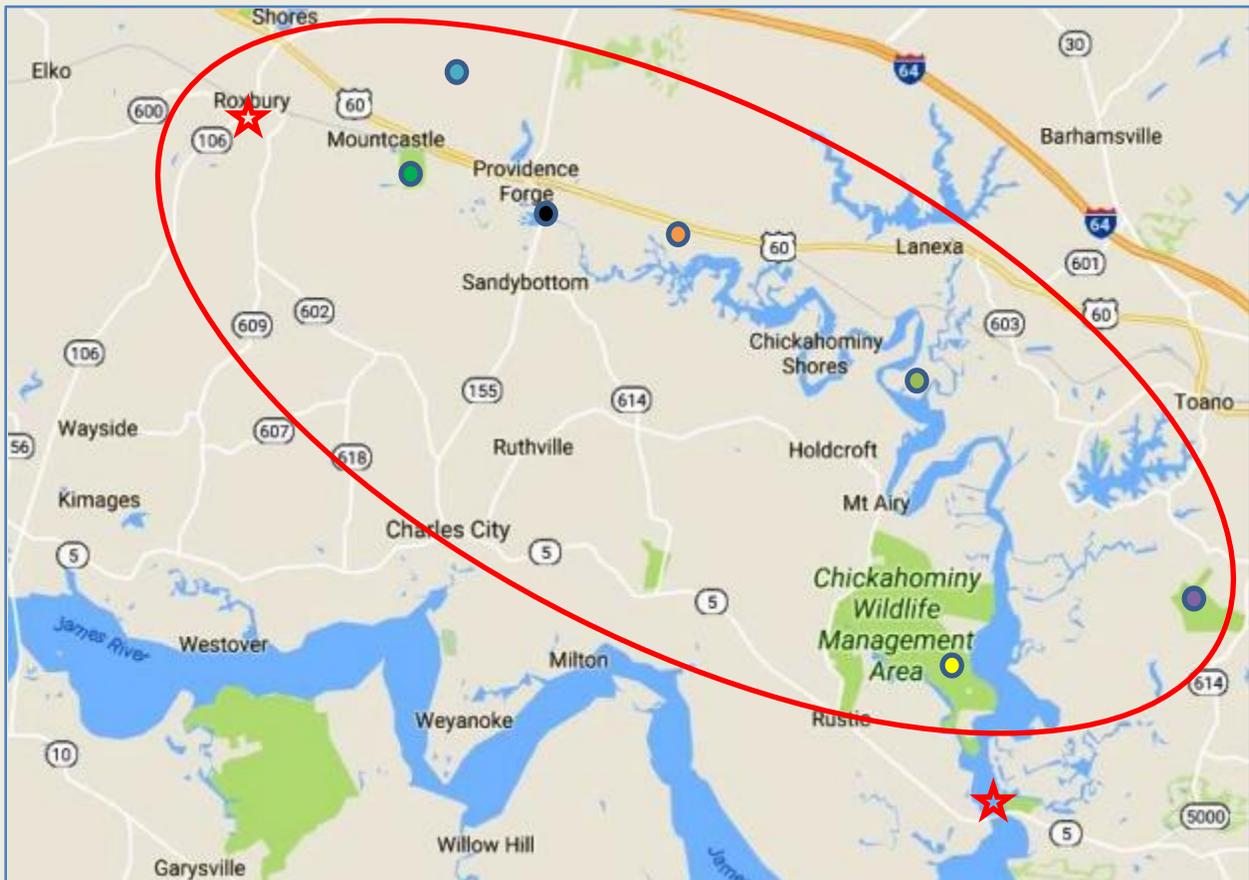
- **Roads**
 - Avoid construction of new roads next to waterways or isolated wetlands. Placement of roads should take into account the location of sensitive habitats and potential wildlife migration routes.
 - Evaluate and consider the use of fencing, overpasses, and underpasses.
 - Eliminate the use of synthetic, non-biodegradable soil erosion blankets (ECBs) products that can trap wildlife. Use ECBs (CoriFiber) that are wildlife-friendly and decompose rapidly.

- **Land acquisition**
 - Since most reptiles and amphibians need two or more habitats during their lifetimes (i.e. breeding, foraging, and hibernation), the Chickahominy watershed should be viewed and managed on a landscape scale. Land managers should consider connectivity and focus on land acquisitions that will provide corridors between these habitat types and areas already protected. This could be accomplished through a GIS exercise that would identify critical land parcels for acquisition or conservation easements.

- **Seasonal Wetlands**
 - Most seasonal wetland-breeding amphibians spend their entire lives within a few hundred meters of the wetland-used for breeding. Identify and protect significant seasonal wetlands and the surrounding forest cover.
 - Beaver are abundant around the watershed and their associated damming activities should be managed on a case-by-case basis to attain desired vegetation and open canopy conditions.

- **Habitat restoration**
 - Open, savanna-type habitats are limited around the Chickahominy River watershed. Where applicable promote the restoration of pine savanna and open, grassy wetland habitats.
 - Restore natural fire frequency. Fire-maintained habitats regenerate quickly and are favored by many species of herpetofauna.
 - Pine plantations are common throughout the watershed. However, they do not provide ideal habitat for most species of herpetofauna as they lack a system of rotting stumps, decaying roots and downed woody debris. Areas that support older growth pine, hardwood, or mix –pine-hardwood forests should be identified and managed accordingly.
 - Permanent protection of land is limited and acquisition through either direct purchases or conservation easements should continue to be a priority to maintain biological integrity and water quality. Since much of the wetland areas are undevelopable and many of the currently protected areas include large tracts of wetlands, protection and restoration within this watershed should focus on upland habitat.

Map 1. SURVEY AREA



Red circle shows the approximate survey area. Red stars are the northern and southern terminus of the project area, which is the Rt.106/Rt.60 intersection (northern) southeast to the Rt.5 Bridge (southern).

Northwest to Southeast ↘

- Crawford State Forest
- Private property off Mt. Olivet Church Rd.
- Parker property
- New Kent Forestry Center/Game Farm Marsh WMA
- Upton property
- Chickahominy WMA
- Freedom Park

Appendix 1.

SPECIES AND NUMBER OF OBSERVATIONS

(Max.100)

Snakes:

1. Eastern Ratsnake (n= 68)
2. Northern Black Racer (n=97)
3. Eastern Kingsnake (n=27)
4. Mole Kingsnake (n=2)
5. Eastern Wormsnake (n=61)
6. Northern Brownsnake (n=21)
7. Northern Red-bellied Snake (n=5)
8. Rough Earthsnake (n=3)
9. Smooth Earthsnake (n=3)
10. Northern Rough Greensnake (n=7)
11. ***Common Ribbonsnake (n=15)
12. Eastern Gartersnake (n=5)
13. ***Scarlet Kingsnake (n=2)
14. ***Eastern Hog-nosed Snake (n=4)
15. ***Common Rainbow Snake (n=3)
16. Northern Watersnake (n=93)
17. Brown Watersnake (n=21)
18. Copperhead (n=25)
19. *Northern Scarletsnake
20. *Eastern Mudsnake
21. *Glossy Swampsnake

Turtles:

1. ***Woodland Box Turtle (n=54)
2. ***Spotted Turtle (n=36)
3. Southeastern Mud Turtle (n=>100)
4. Striped Mud Turtle (n=42)
5. ***Yellow-bellied Slider (n=54)
6. ** Red-eared Slider (n=1)
7. Eastern River Cooter (n=1)
8. Northern Red-bellied Cooter (n=25)
9. Eastern Painted Turtle (n=>100)
10. Snapping Turtle (n=22)
11. Stinkpot (Eastern Musk Turtle) (n=45)
12. *Green Sea Turtle

*Indicates species that have been documented in this area, but not during this survey. ** Nonnative species. ***Species of Greatest Conservation Need

Lizards:

1. Broad-headed Skink (n=4)
2. Common Five-lined Skink (n=13)
3. Southeastern Five-lined Skink (n=3)
4. Little Brown Skink (n=66)
5. Six-lined Race Runner (n=>43)
6. Eastern Fence Lizard (n=9)
7. *Slender Glass Lizard

Frogs:

1. American Bullfrog (n=>91)
2. Green Frog (n=>100)
3. Pickerel frog (n=>58)
4. Southern Leopard Frog (n=>30)
5. Atlantic Coast Leopard Frog (n=>43)
6. Green Treefrog (n=>100)
7. Cope's Gray Treefrog (n=>100)
8. Pinewoods Treefrog (n=>26)
9. Squirrel Treefrog (n=>100)
10. Southern/Northern Cricket Frog (n=>100)
11. Spring Peeper (n=>100)
12. Upland Chorus Frog (n>55)
13. Brimley's Chorus Frog (n=2)
14. American Toad (n=>100)
15. Fowler's Toad (n=>100)
16. Narrow-mouthed Toad (n=>100)
17. ***Eastern Spadefoot (n=6)

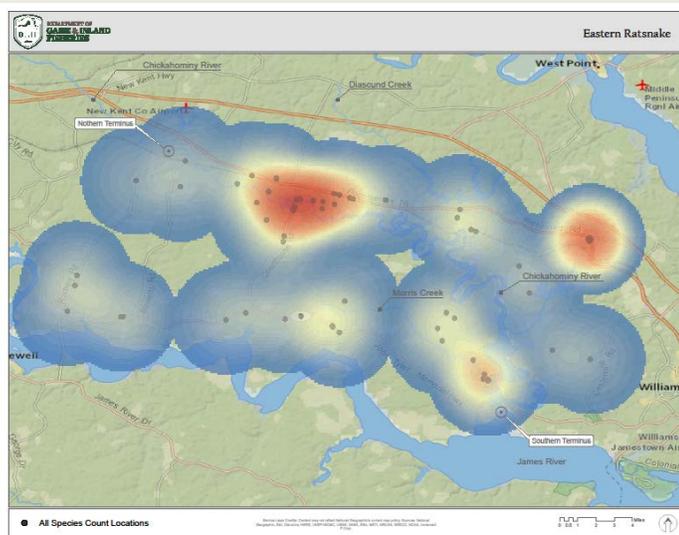
Salamanders:

1. Two-toed Amphiuma (n=5)
2. ***Lesser Siren (n=2)
3. Spotted Salamander (n=>100)
4. Marbled Salamander (n=>40)
5. Northern Dusky Salamander (n=5)
6. Four-toed Salamander (n=4)
7. Red-backed Salamander (n=1)
8. Atlantic Coast Slimy Salamander (n=13)
9. White-spotted Slimy Salamander (n=6)
10. Southern Two-lined Salamander (n=27)
11. Three-lined Salamander (n=3)
12. Northern Red Salamander (n=11)
13. Red-spotted Newt (n=46)

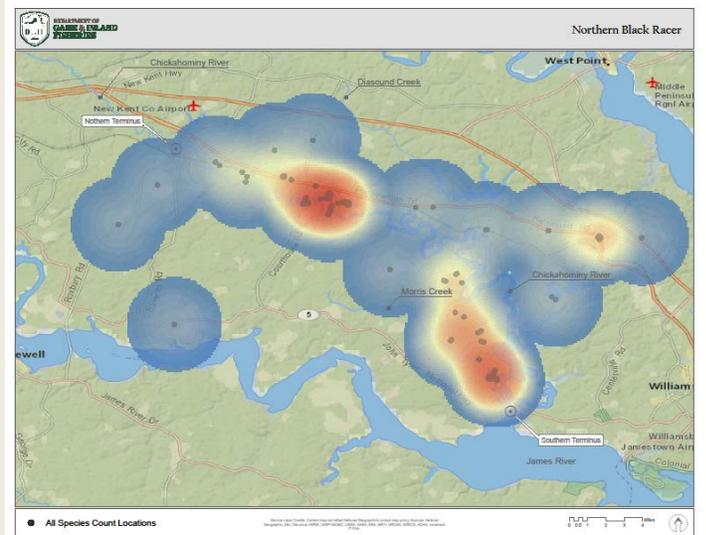
Species Maps.

The following maps used a combination of Kernel Density and Proportional Symbols to represent each species observation and the number of observations recorded. Heat Maps are a two dimensional map that use color to visually represent the density of dots or the number of individual observed. The larger the red area, the greater the number of observations. Kernel Density calculates the magnitude-per-unit area from a point using a kernel function to fit a smoothly tapered surface to each point. The result of this geoprocessing function is a two-dimensional depiction utilizing color variations to represent the density of related species in the map. For those species where only one observation was recorded the density model was not applicable, and as such, only the Proportional Symbol was utilized. *Black dots* represent an observation and its size is proportional to the number of observations. Proportional Symbols symbolize the point in a fashion where the point size is determined by a count or quantity field, in this case the number of collections at the given point. Note that the number of observations may not accurately represent the actual number of individuals as a mark-recapture methodology would have been necessary.

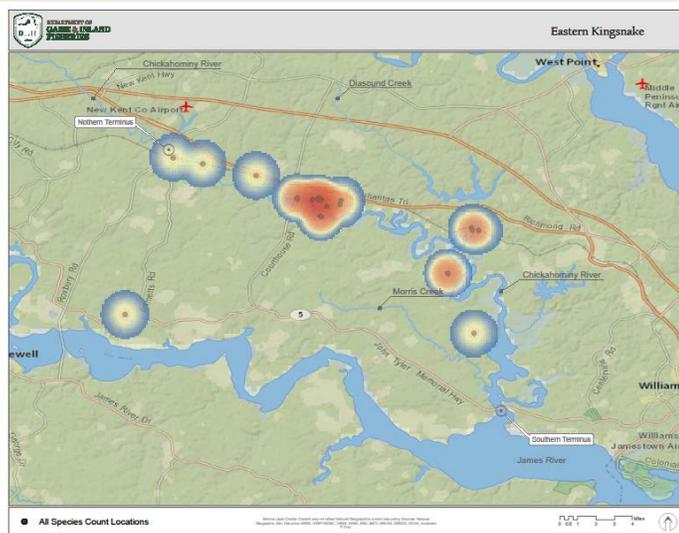
SNAKES



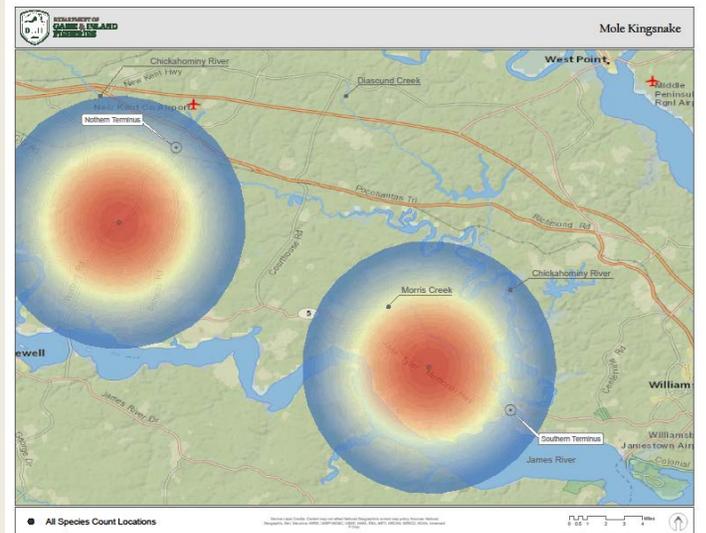
Eastern Ratsnake (*Pantherophis alleghaniensis*)



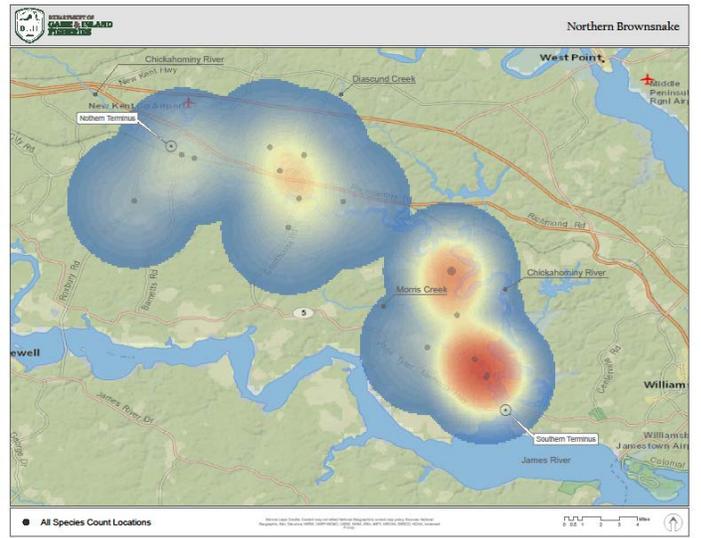
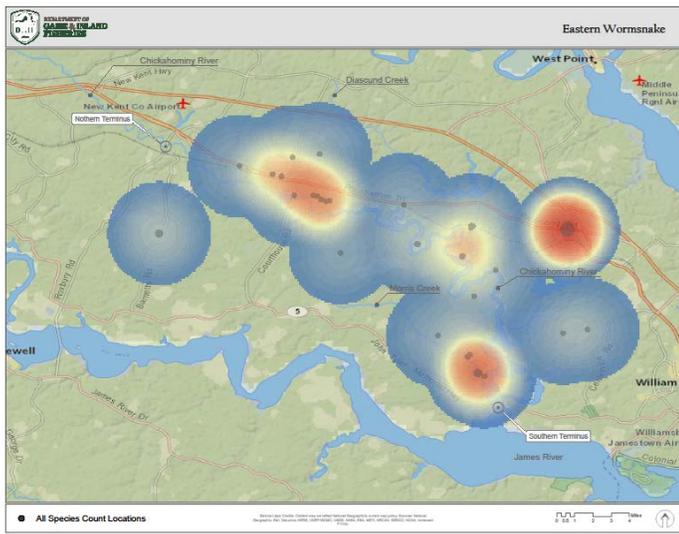
Northern Black Racer (*Coluber constrictor*)



Eastern Kingsnake (*Lampropeltis getula*)

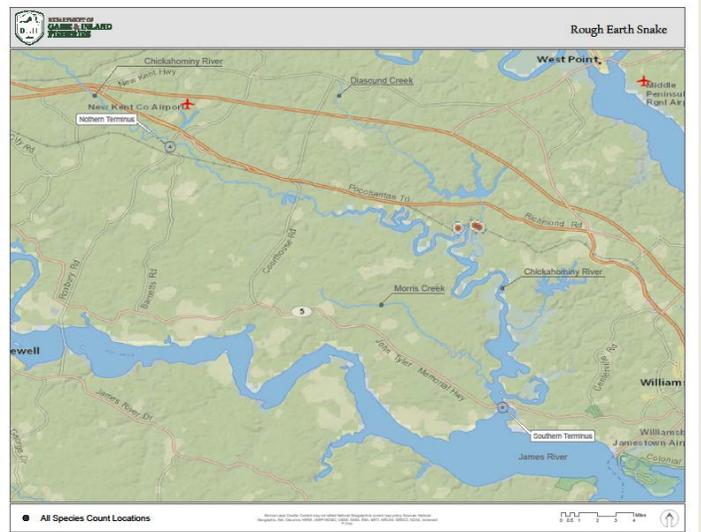
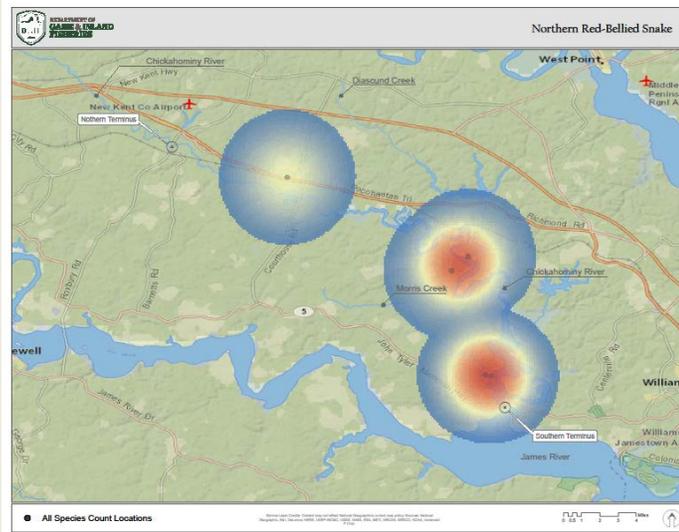


Mole Kingsnake (*Lampropeltis rhombomaculata*)



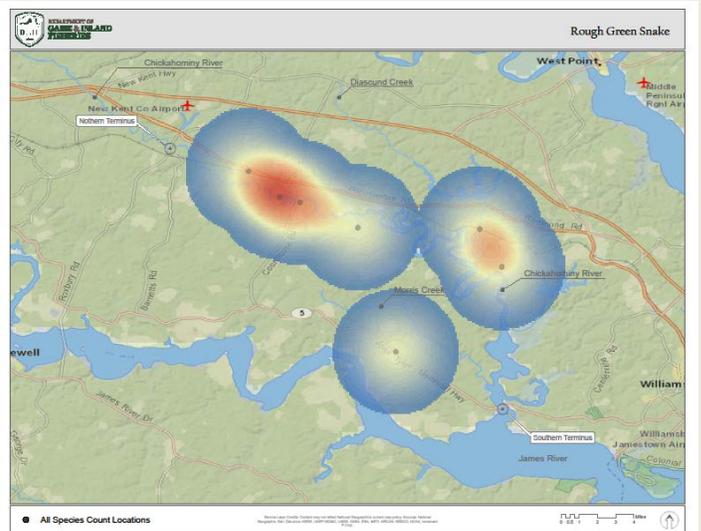
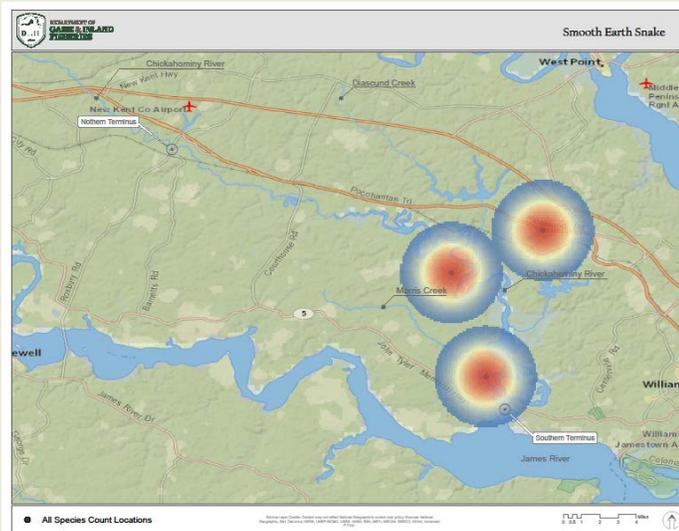
Eastern Wormsnake (*Carphophis amoenus*)

Northern Brownsnake (*Storeria dekayi dekayi*)



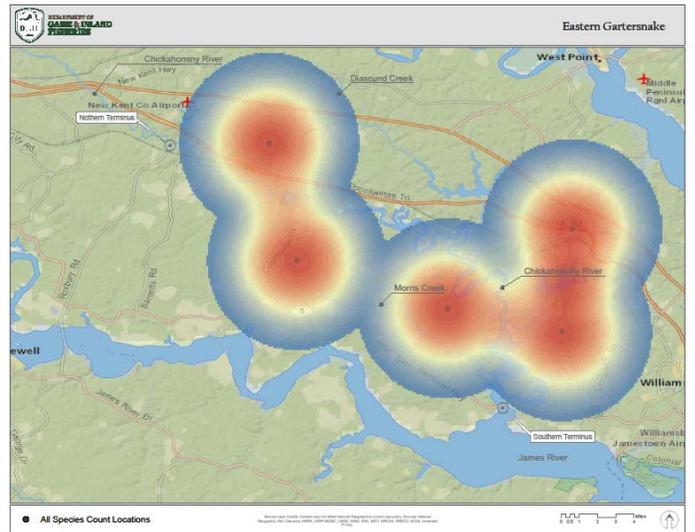
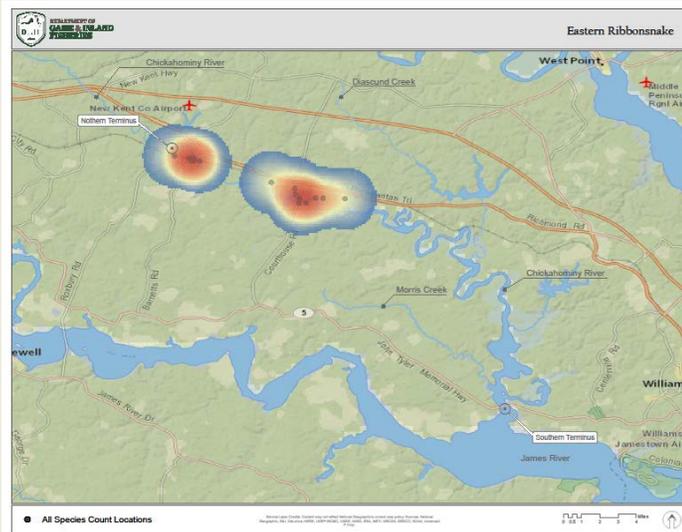
Northern Red-bellied Snake (*Storeria occipitomaculata*)

Rough Earthsnake (*Haldea striatula*)



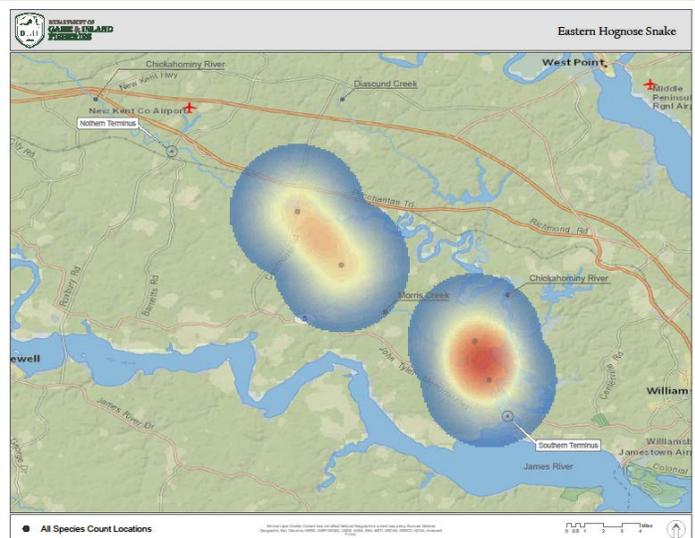
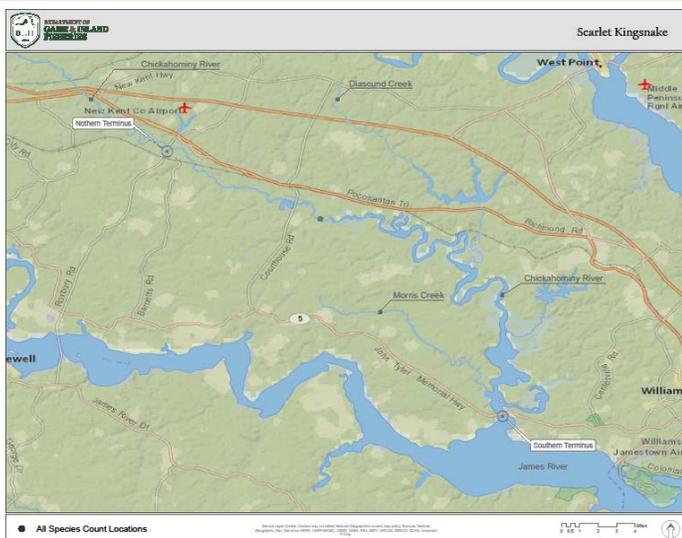
Smooth Earthsnake (*Virginia v. valeria*)

Northern Rough Greensnake (*Opheodrys a. aestivus*)



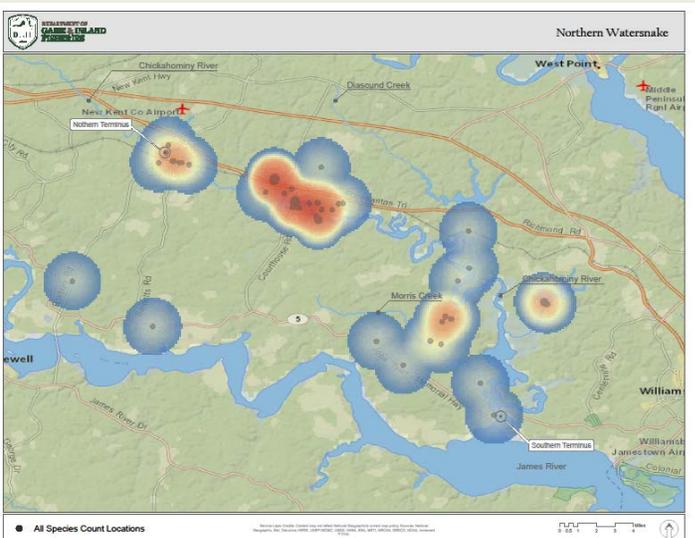
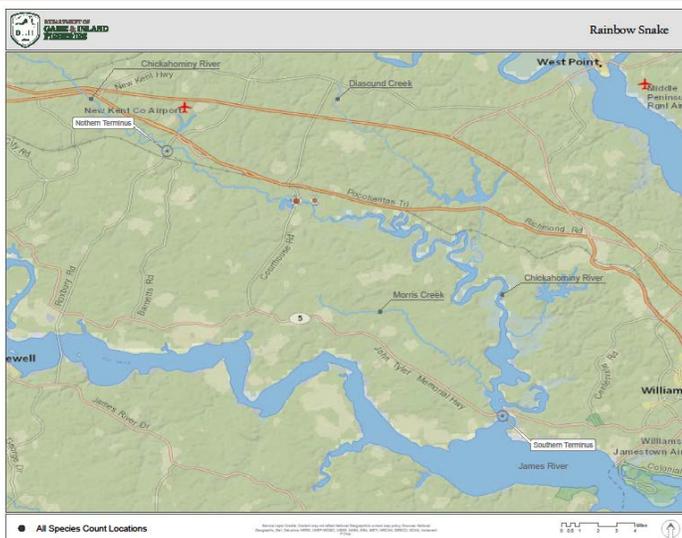
Common (Eastern) Ribbonsnake (*Thamnophis s. sauritus*)

Eastern Gartersnake (*Thamnophis s. sirtalis*)



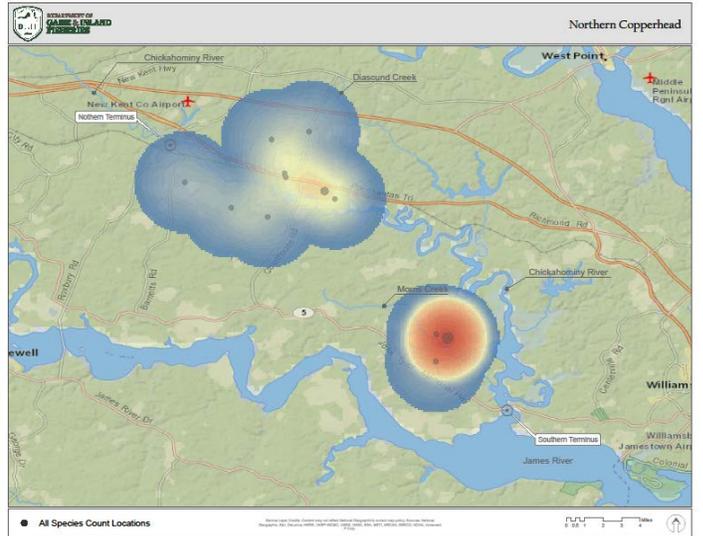
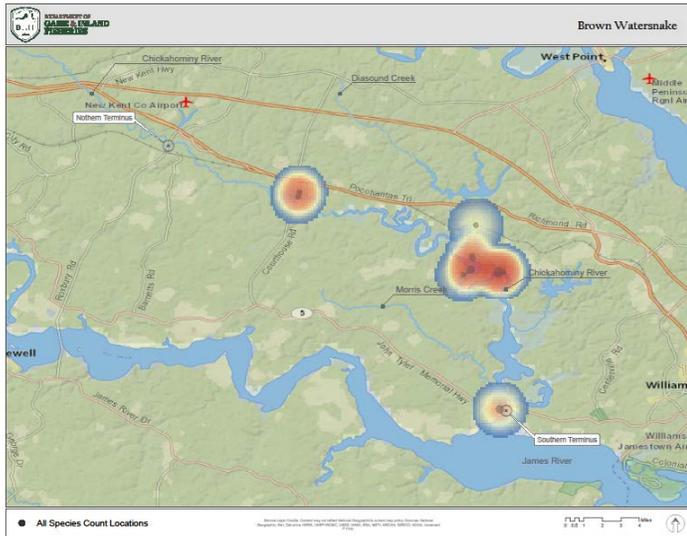
Scarlet Kingsnake (*Lampropeltis elapsoides*)

Eastern Hog-nosed Snake (*Heterodon platirhinus*)



Common Rainbow Snake (*Farancia e. erythrogamma*)

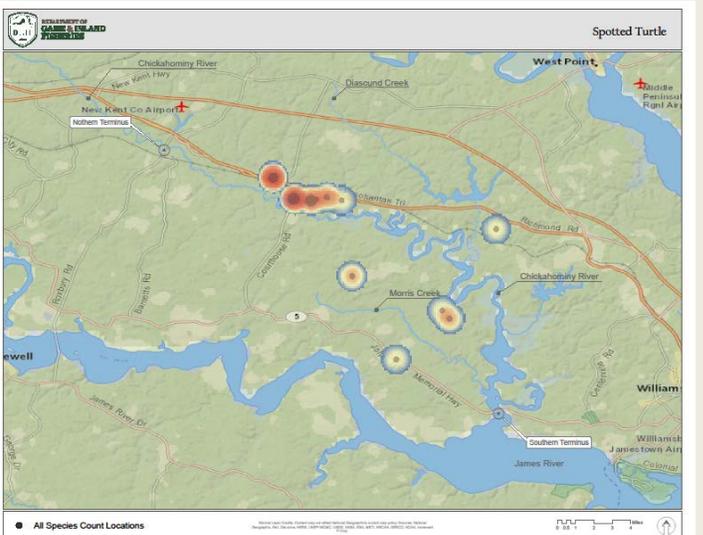
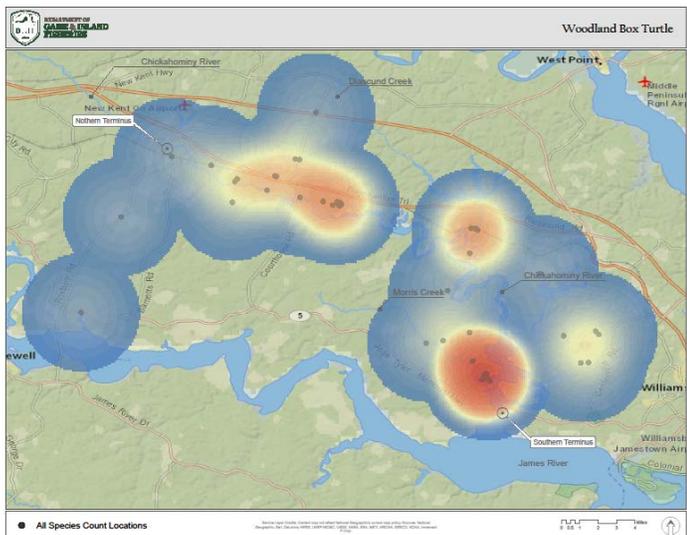
Northern Watersnake (*Nerodia s. sipedon*)



Brown Watersnake (*Nerodia taxispilota*)

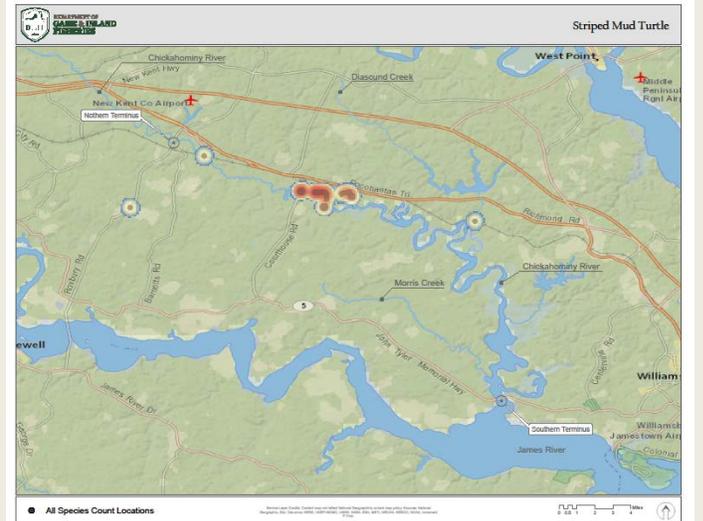
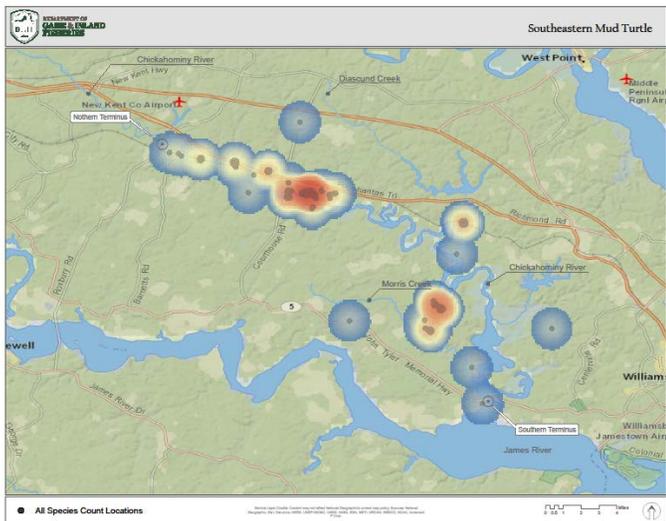
Copperhead (*Agkistrodon contortrix*)

TURTLES



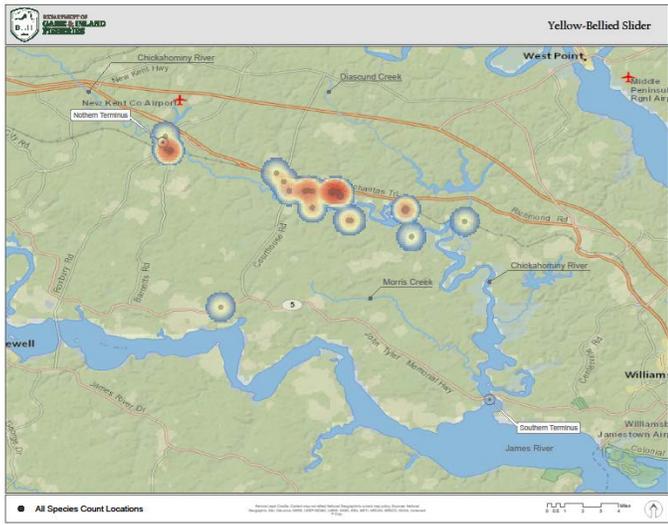
Woodland Box Turtle (*Terrapene c. carolina*)

Spotted Turtle (*Clemmys guttata*)

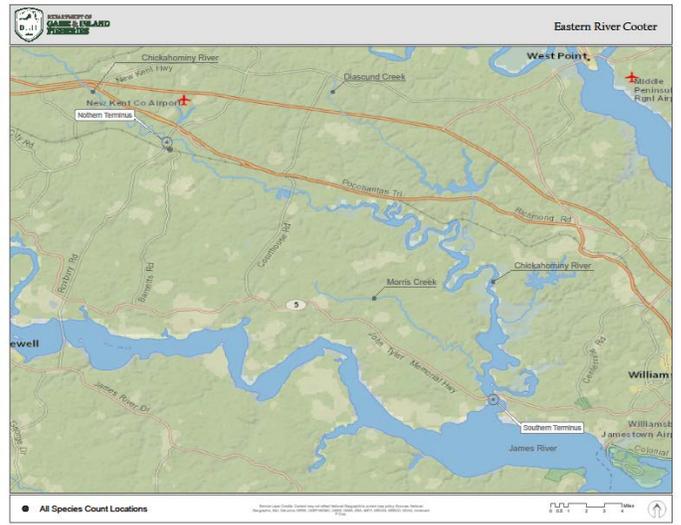


Southeastern Musk Turtle (*Kinosternon s. subrubrum*)

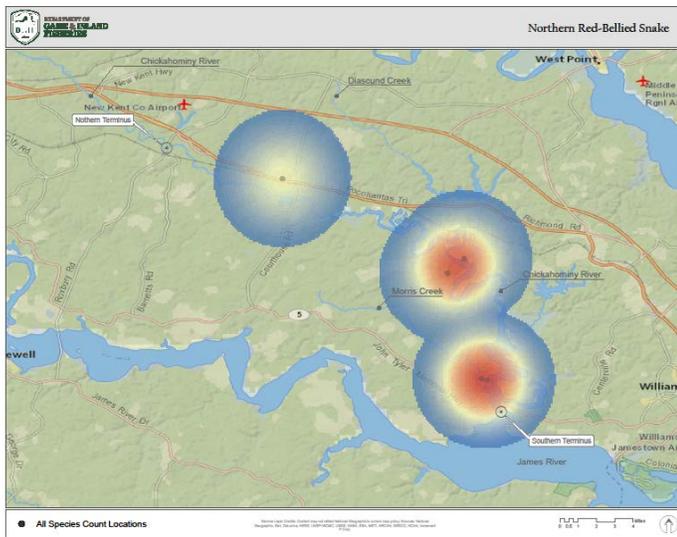
Striped Mud Turtle (*Kinosternon bairii*)



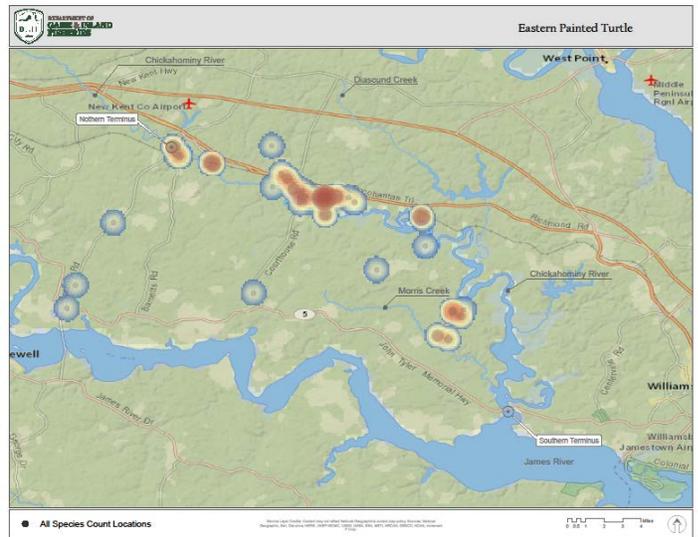
Yellow-bellied Slider (*Trachemys scripta scripta*)



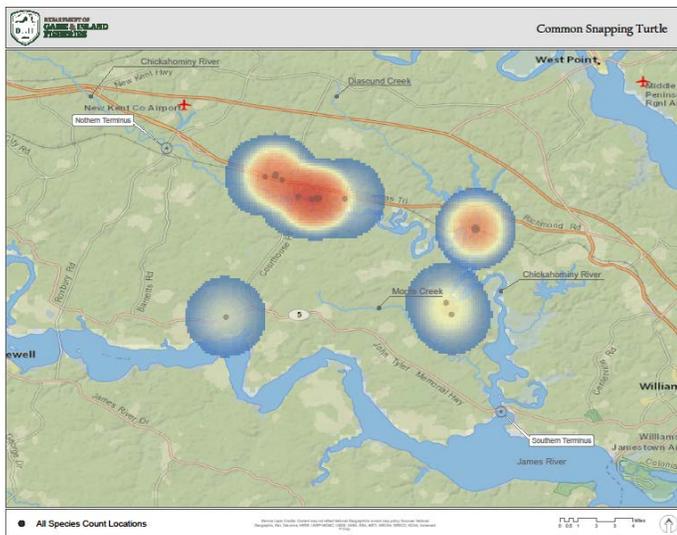
Eastern River Cooter (*Pseudemys c. concinna*)



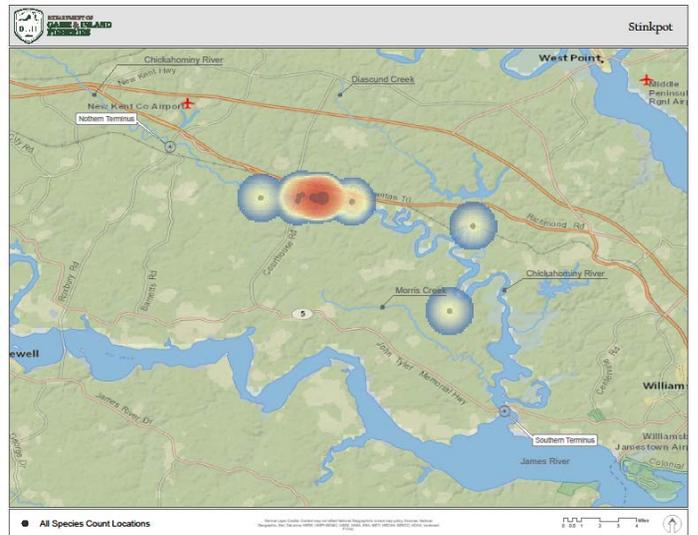
Northern Red-bellied Turtle (*Pseudemys rubriventris*)



Eastern Painted Turtle (*Chrysemys p. picta*)

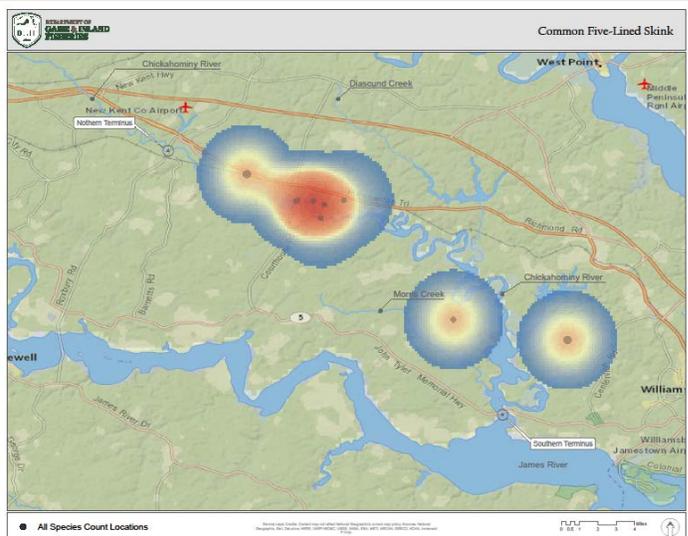
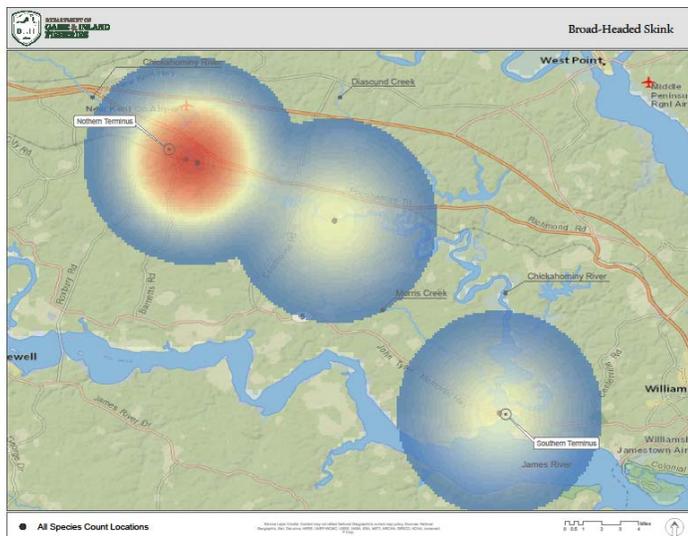


Snapping Turtle (*Chelydra serpentina*)



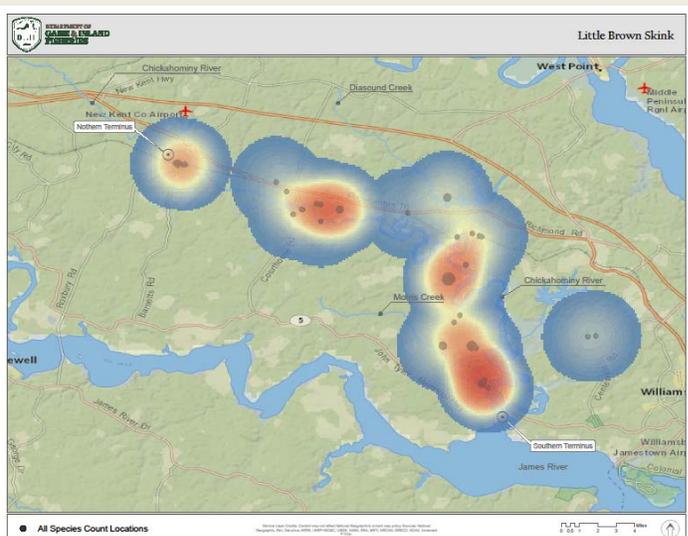
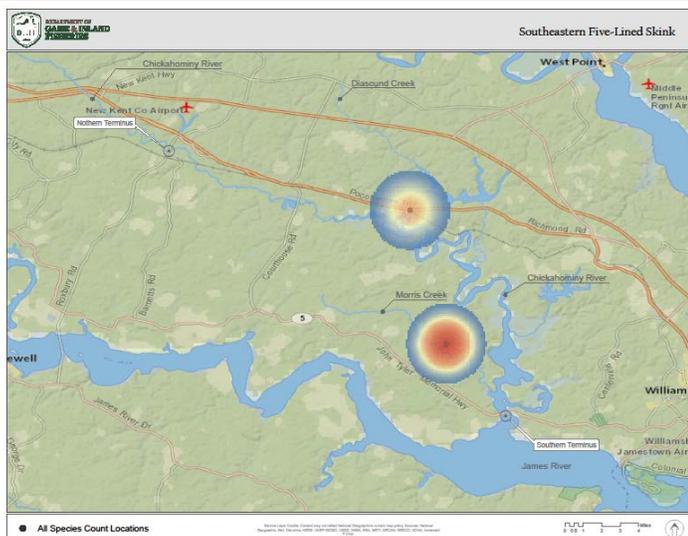
Stinkpot/Eastern Musk Turtle (*Sternotherus odoratus*)

LIZARDS



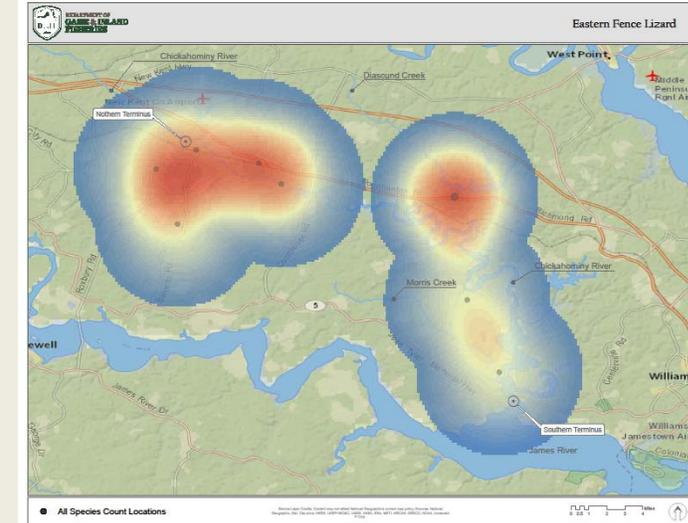
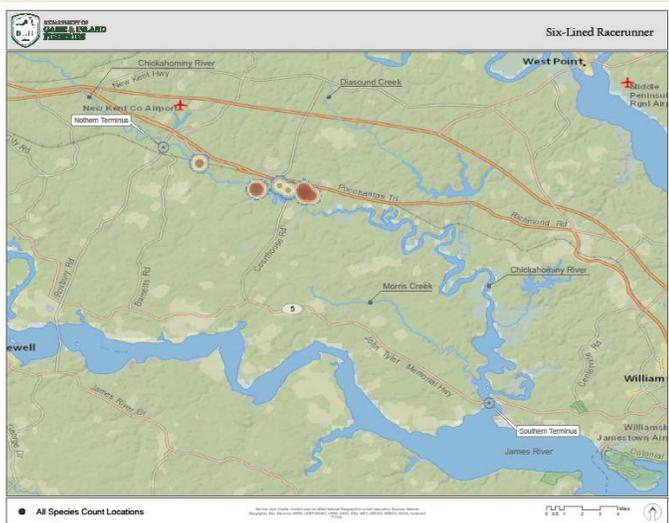
Broad-headed Skink (*Plestiodon laticeps*)

Common Five-lined Skink (*Plestiodon fasciatus*)



Southeastern Five-lined (*Plestiodon inexpectatus*)

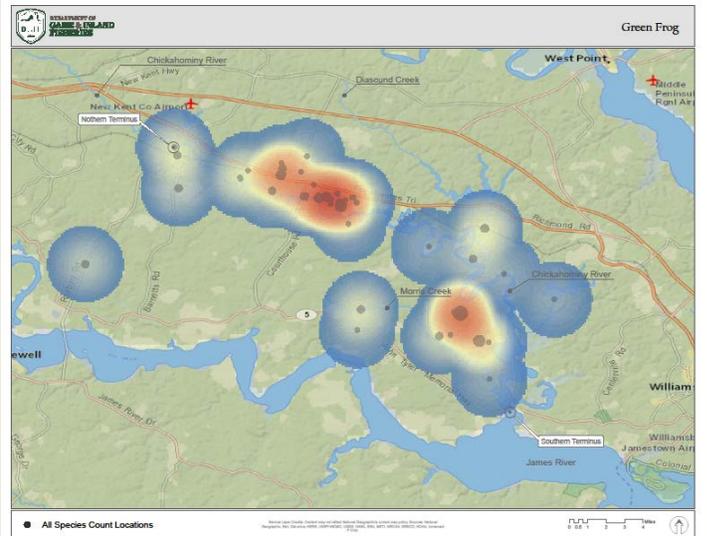
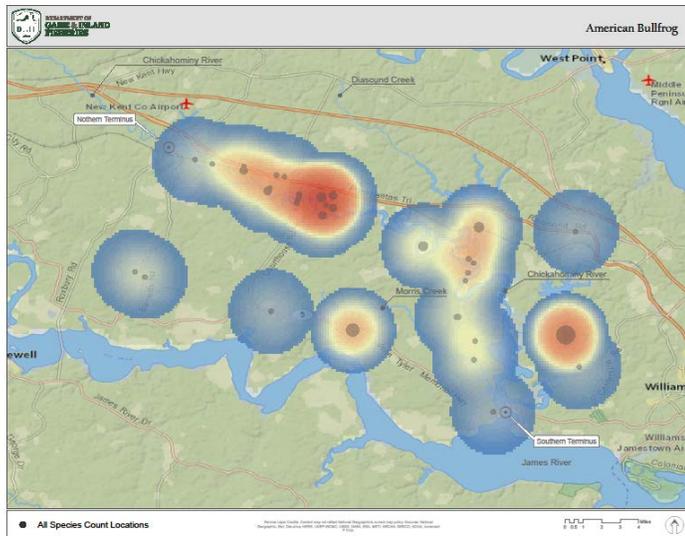
Little Brown Skink (*Scincella lateralis*)



Six-lined Racerunner (*Aspidoscelis sexlineata*)

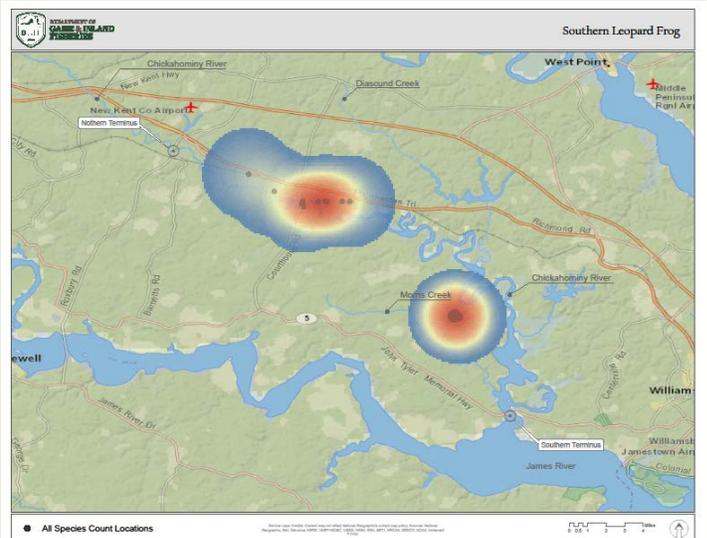
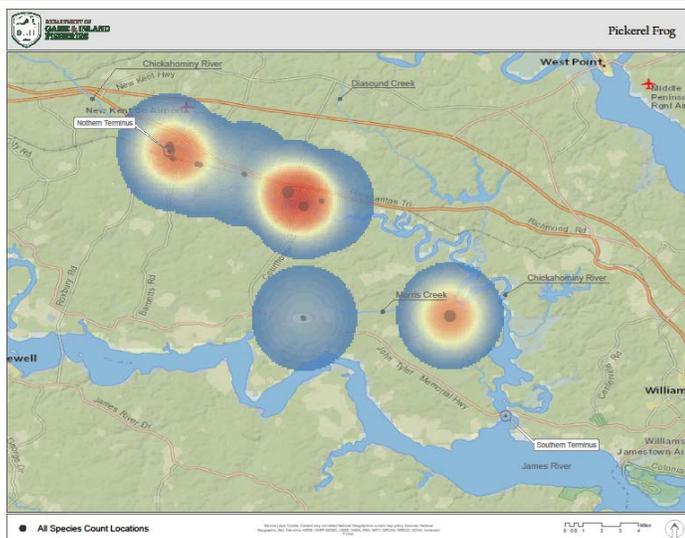
Eastern Fence Lizard (*Sceloporus undulatus*)

FROGS



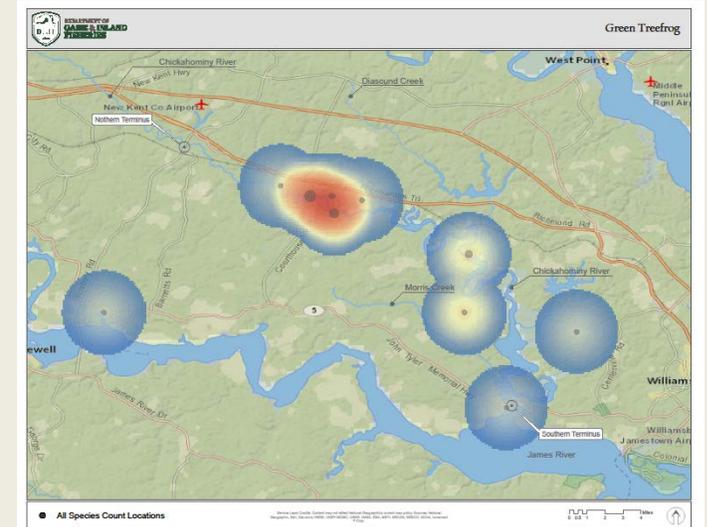
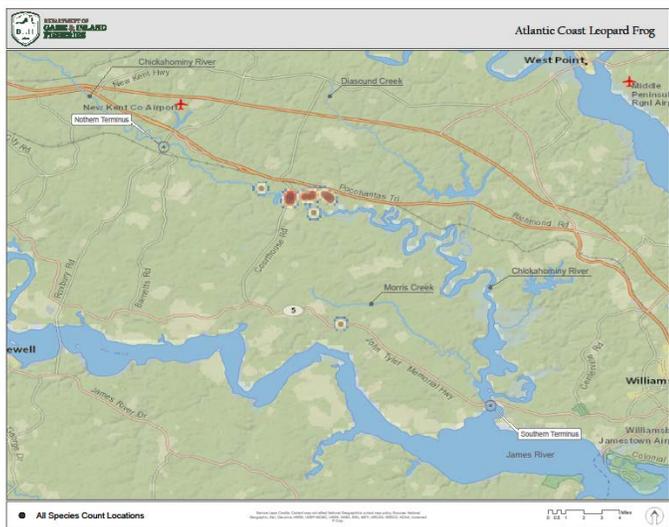
American Bullfrog (*Lithobates catesbeianus*)

Green frog (*Lithobates clamitans*)



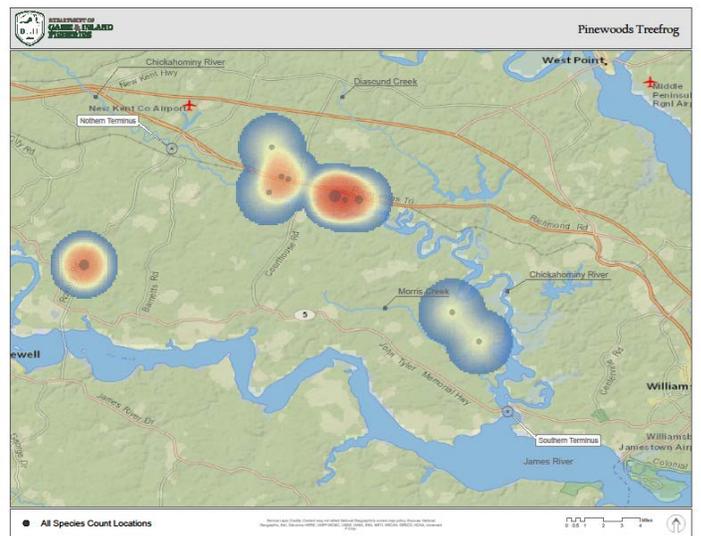
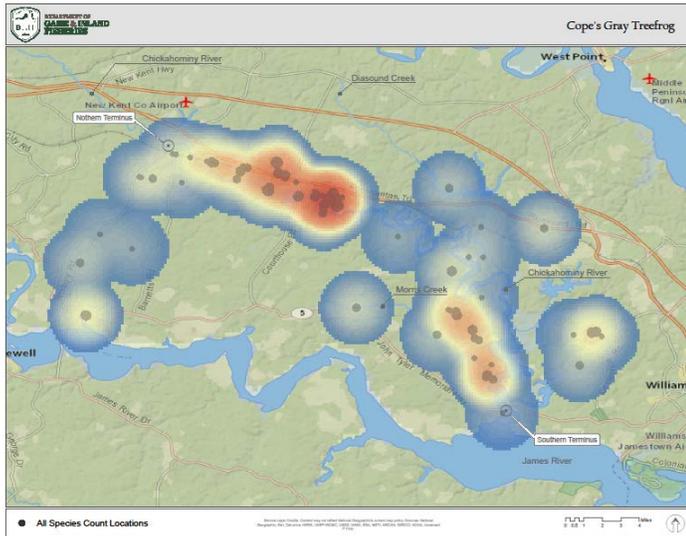
Pickerel Frog (*Lithobates palustris*)

Southern Leopard Frog (*Lithobates sphenoccephalus*)



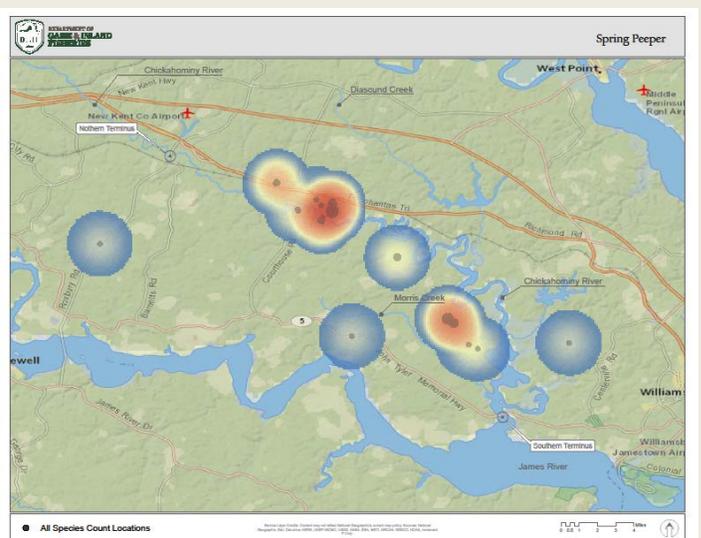
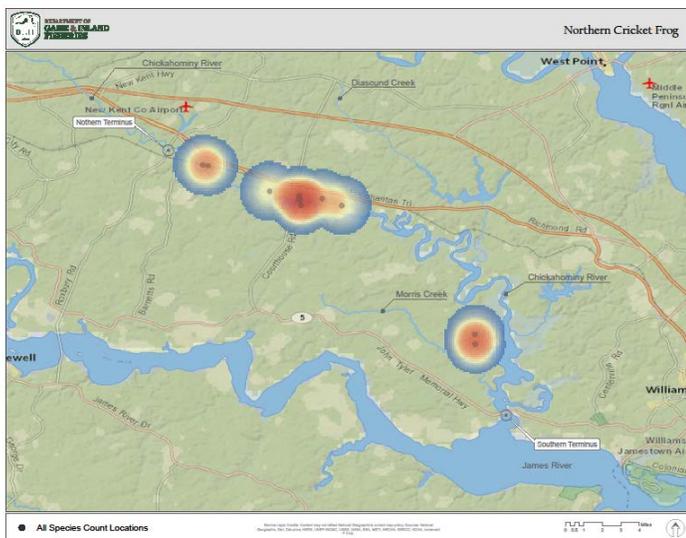
Atlantic Coast Leopard Frog (*Lithobates kauffeldi*)

Green Treefrog (*Hyla cinerea*)



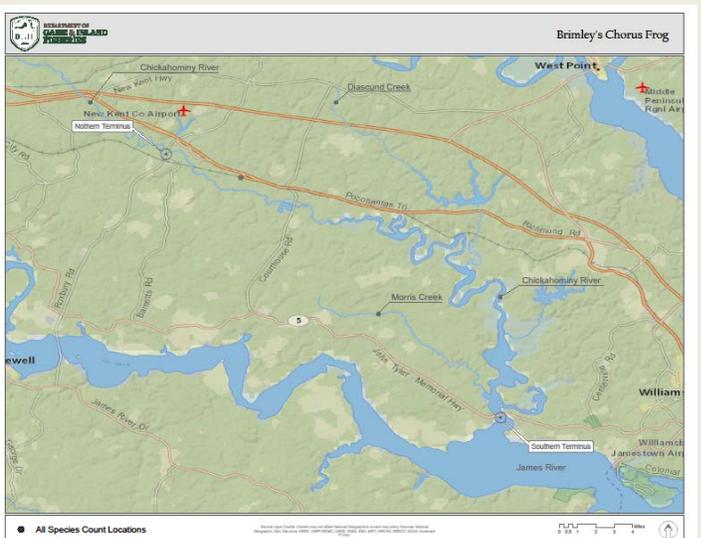
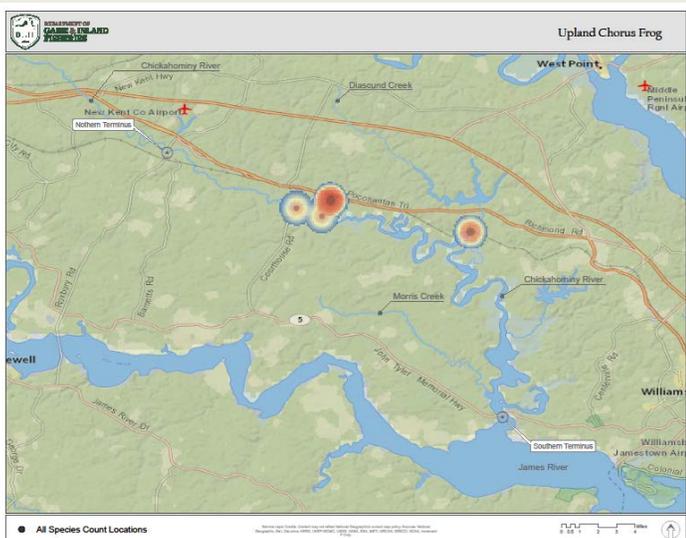
Cope's Gray Treefrog (*Hyla chrysoscelis*)

Pinewoods Treefrog (*Hyla femoralis*)



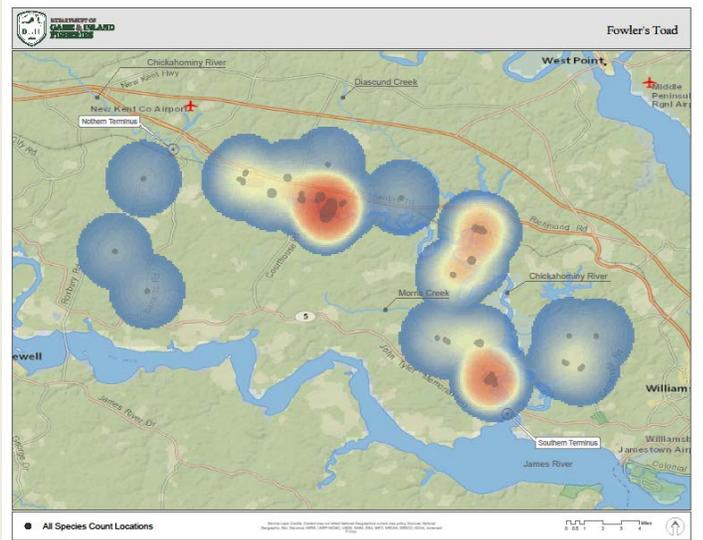
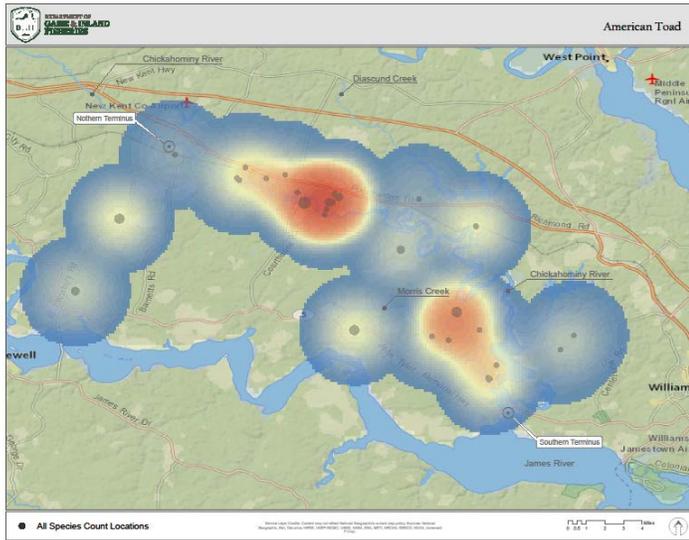
Southern/Northern Cricket Frog (*Acris gryllus/crepitans*)

Spring Peeper (*Pseudacris crucifer*)



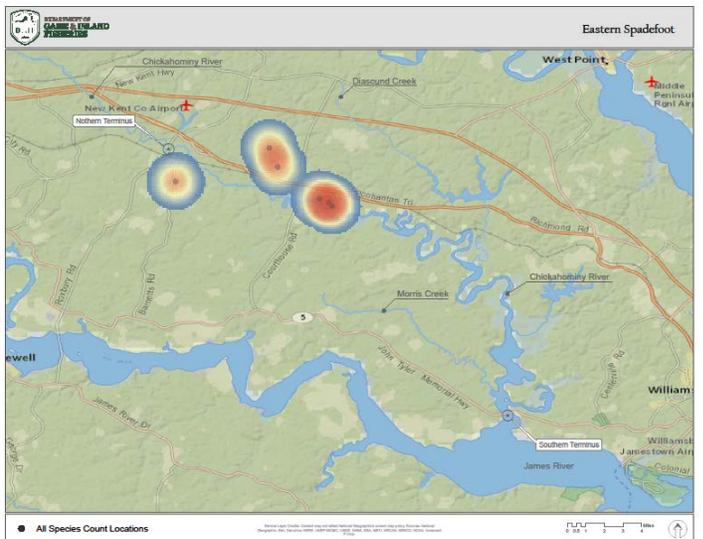
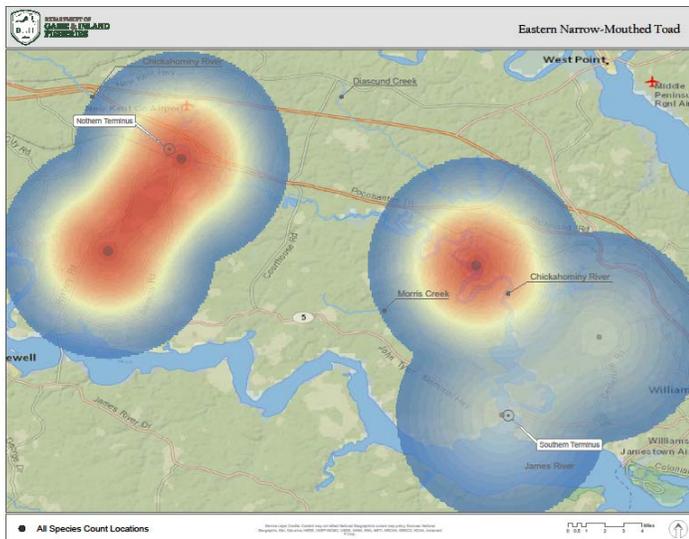
Upland Chorus Frog (*Pseudacris feriarum*)

Brimley's Chorus Frog (*Pseudacris brimleyi*)



American Toad (*Anaxyrus americanus*)

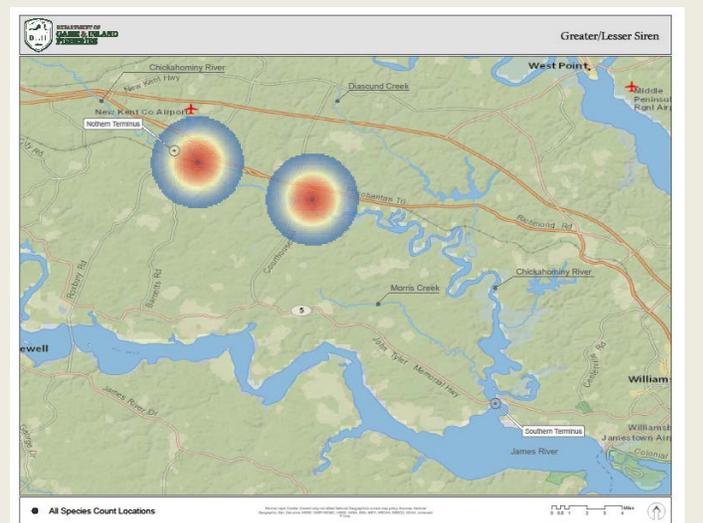
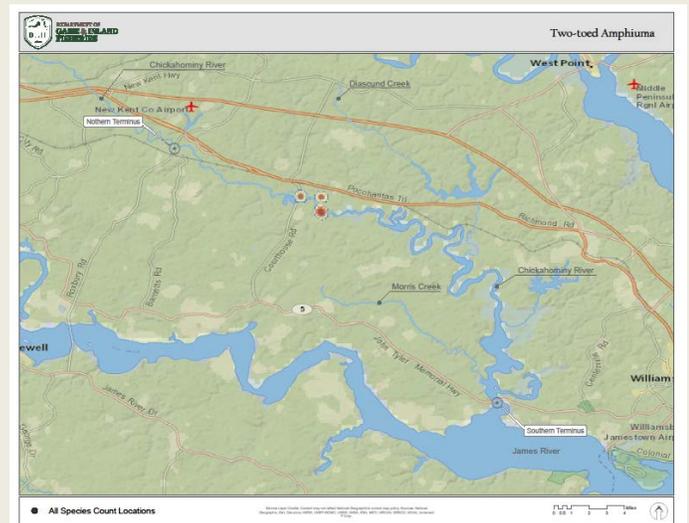
Fowler's Toad (*Anaxyrus fowleri*)



Eastern Narrow-mouthed Toad (*Gastrophryne carolinensis*)

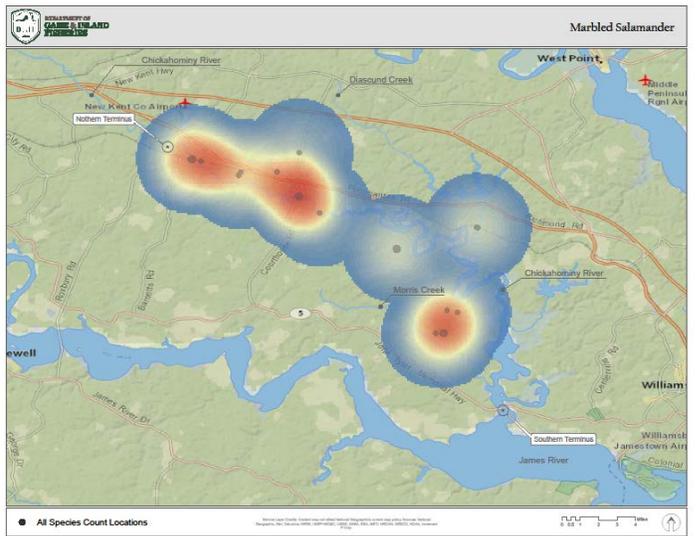
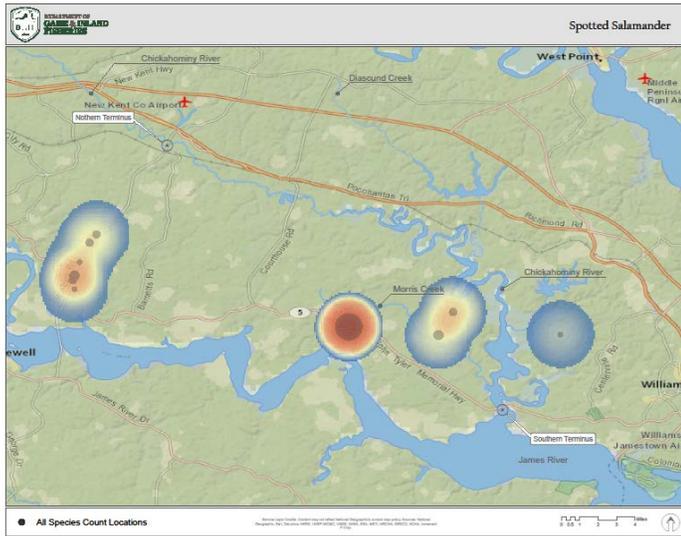
Eastern Spadefoot (*Scaphiopus holbrooki*)

SALAMANDERS



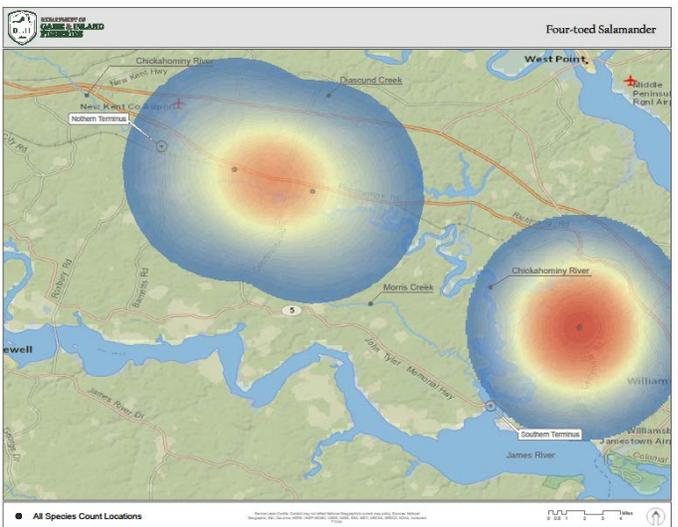
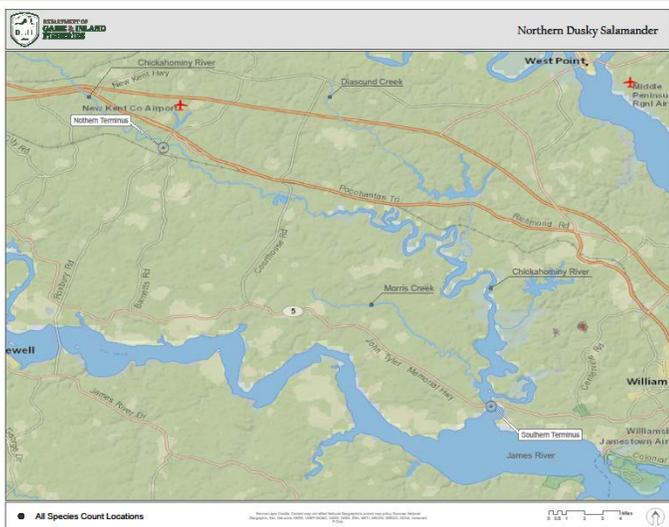
Two-toed Amphiuma (*Amphiuma means*)

Lesser Siren (*Siren intermedia*)



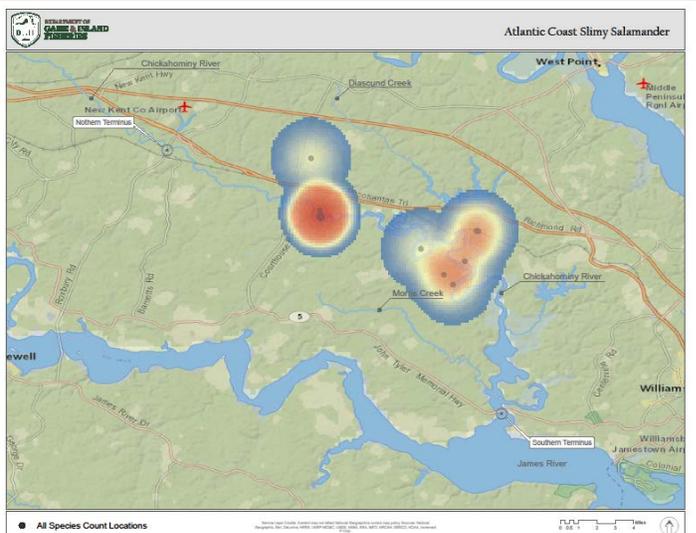
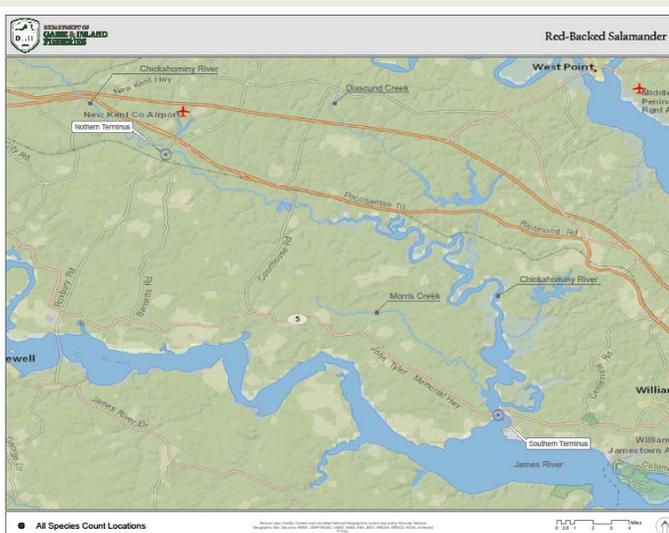
Spotted Salamander (*Ambystoma maculatum*)

Marbled Salamander (*Ambystoma opacum*)



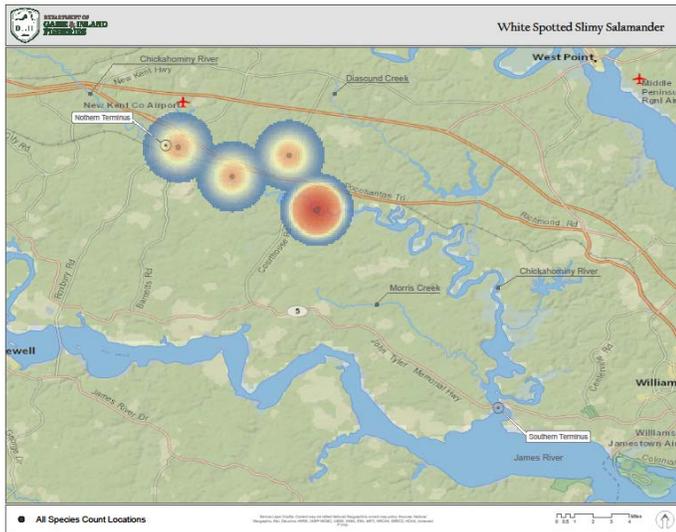
Northern Dusky Salamander (*Desmognathus fuscus*)

Four-toed Salamander (*Hemidactylum scutatum*)

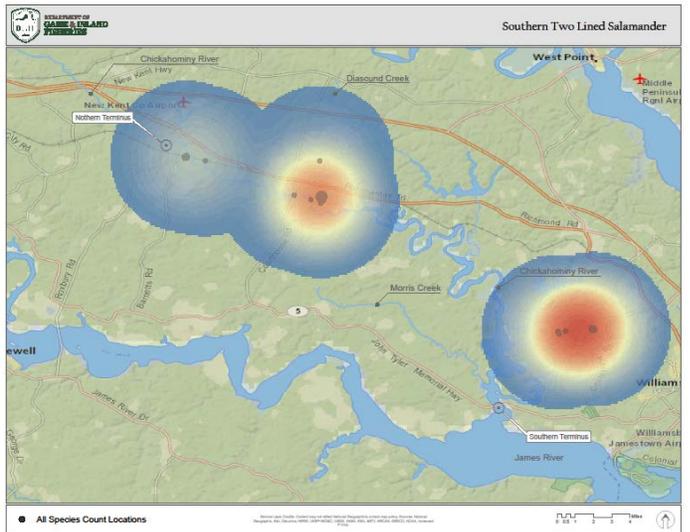


Red-backed Salamander (*Plethodon cinereus*)

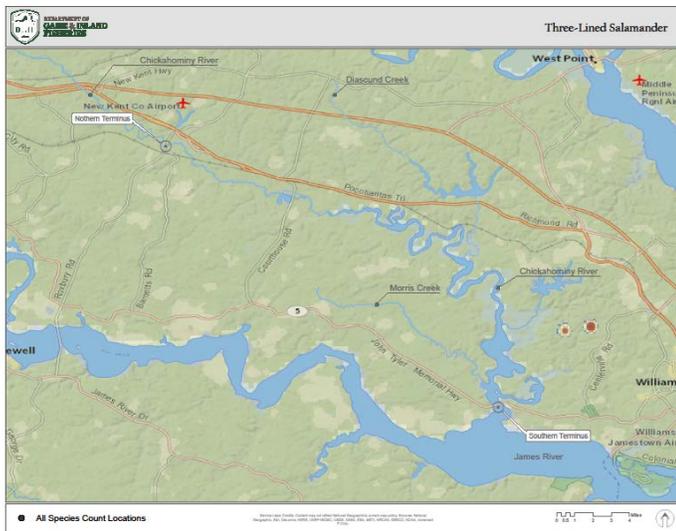
Atlantic Coast Slimy Salamander (*Plethodon chlorobryonis*)



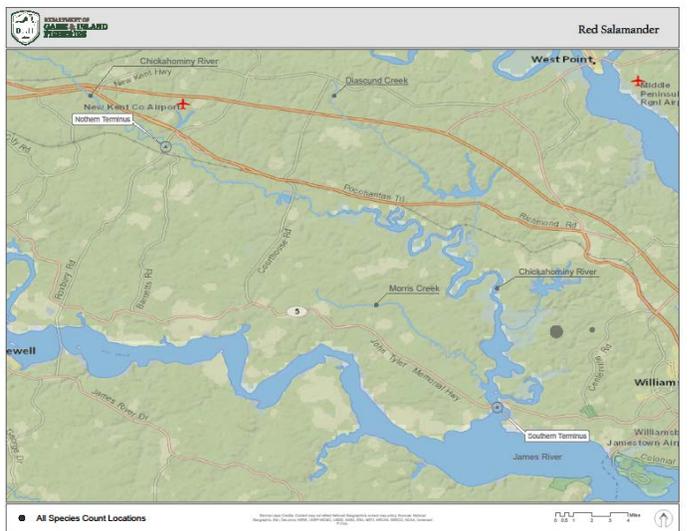
White-spotted Slimy Salamander (*Plethodon cylindraceus*)



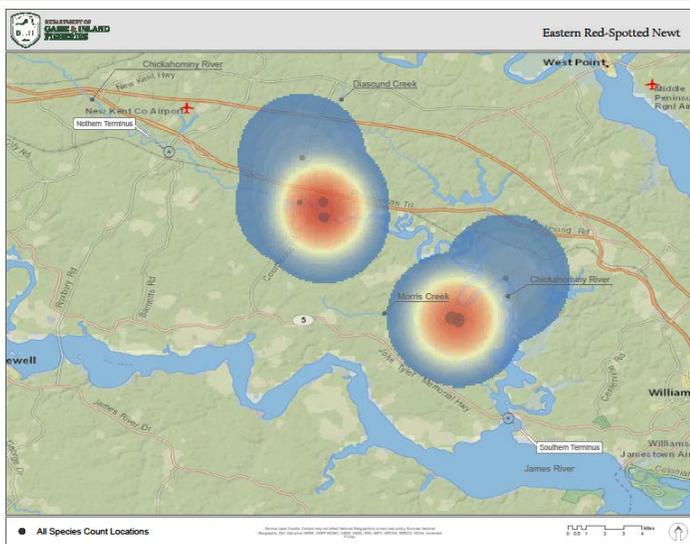
Southern Two-lined Salamander (*Eurycea cirrigera*)



Three-lined Salamander (*Eurycea guttolineata*)



Northern Red Salamander (*Pseudotriton ruber*)



Eastern Red-spotted Newt (*Notophthalmus v. viridescens*)

Literature Cited and Suggested Reading

- Dillard, K.C. 2017. A comparative analysis of geometric morphometrics across two *Pseudemys* turtle species in east central Virginia. Unpublished Master's thesis. Virginia Commonwealth University. 59 pp.
- Kleopfer, J.D. and C.S. Hobson. 2011. A Guide to the Frogs and Toads of Virginia. Bureau of Wildlife Resources Species Publication Number 3, Virginia Department of Game and Inland Fisheries. Richmond. VA. 44 pp.
- Kleopfer, J.D., T.S.B. Akre, S.H. Watson and R. Boettcher. 2014. A Guide to the Turtles of Virginia. Bureau of Wildlife Resources Special Publication Number 4, Virginia Department of Game and Inland and Fisheries. Richmond, VA. 44 pp.
- Kleopfer, J.D., J.C. Mitchell, M.J. Pinder, and S.H. Watson. 2017. A Guide to the Snakes of Lizards of Virginia. Special Publication Number 6. Virginia Department of Game and Inland Fisheries. Richmond, VA. 72 pp.
- Mitchell, J.C. 1994. The Reptiles of Virginia. Smithsonian Institution Press, Washington, D.C. 352 pp.
- Mitchell, J.C., A.R. Breisch, and K.A. Buhlmann. 2006. Habitat Management Guidelines for Amphibians and Reptiles of the Northeastern United States. Partners in Amphibian and Reptile Conservation, Technical Publication HMG-3, Montgomery, Alabama. 108 pp.
- Perry, D.A. 2017. Herpetological Survey of Chickahominy Wildlife Management Area 1 May & 15 May, 2016. *Catesbeiana* 37(1) pp. 3-19.
- Steen, D.A., J.P. Gibbs. 2004. Effects of roads on the structure of freshwater turtle populations. *Conservation Biology*. Vol. 18, No. 4, pg. 1143-1148.
- Watson, S.H. 2008. Herpetofaunal Survey of Chickahominy Wildlife Management Area and New Kent Forestry Center. *Catesbeiana* 28(2) pp. 39-56.