2011
Canebrake Rattlesnake Conservation Plan

Virginia Department of Game and Inland Fisheries

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Canebrake Rattlesnake
Conservation Plan

Prepared by the 2011 Species Conservation Team

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Date: 2-29-2012

Disclaimer

This is the 2011 Canebrake Rattlesnake Conservation Plan for the Commonwealth of Virginia. It has been approved by the Virginia Department of Game and Inland Fisheries (VDGIF). It does not necessarily represent official positions or approvals of cooperating agencies and does not necessarily represent the views of all recovery team members who played a role in preparing this plan. This plan is subject to modification following as dictated by new findings, changes in species status, and completion of tasks described in the plan. Goals and objectives will be attained and funds expended contingent upon appropriations, priorities, and other budgetary constraints.

Cover Photo: J.D. Kleopfer

Acknowledgment:

The Canebrake Rattlesnake Conservation Plan 2011 was prepared by the Conservation Team in cooperation with VDGIF. Joseph C. Mitchell was the principal author of the original version finalized in 1994.

Conservation Plan citation should read as follows:
Virginia Department of Game and Inland Fisheries. 2011. Canebrake Rattlesnake Conservation Plan. Bureau of Wildlife Resources. VDGIF, Richmond, VA. 25 pp.

Additional copies may be obtained from:
Virginia Department of Game and Inland Fisheries
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Executive Summary

Current Species Status: The canebrake rattlesnake [(*Crotalus horridus*) Coastal Plain population] is listed as state endangered under Article 6, Title 29.1 of the Code of Virginia. There is no federal status for this species. Its range in Virginia is limited to the lower York-James peninsula (i.e. York County, cities of Newport News and Hampton), Isle of Wight County, and the cities of Chesapeake, Suffolk, and Virginia Beach.

In 1993, it was estimated that 55% of the known range (32 of 58 sites) in Virginia had been lost (Mitchell, 1993). An additional 36% was expected to be lost over the next ten to twenty years from habitat loss due to commercial and residential development. Today, the largest, contiguous areas of habitat are primarily in the cities of Suffolk, Chesapeake and Virginia Beach. Other threats include small population size due to habitat fragmentation and human persecution.

Conservation Objective: Downlisting to threatened status. Because of the lack of available habitat for establishment of historical populations for full recovery, complete delisting is unlikely.

Conservation Criteria: To establish fully protected populations in five areas in southeastern Virginia. These are the North Landing River and its tributaries, the Northwest River and its tributaries, the Great Dismal Swamp and swamplands north of U.S. Rts. 460 and 58 (including the National Wildlife Refuge), the area between Elbow Road and the Albemarle—Chesapeake canal in Virginia Beach, and the population within the Naval Support Activity Northwest Annex (NSANA) and the adjacent Cavalier Wildlife Management Area to the west.

Actions Needed:
1. Protect populations and habitats in areas designated under the Conservation Strategy.
2. Utilize existing state legislation and regulations and enhanced law enforcement to protect the species from take.
3. Monitor the status of known populations and search for additional populations.
4. Determine life history requirements of juveniles and adults.
5. Determine the full range of threats and alleviate threats to the species existence.
6. Develop and utilize education materials about this species, its habitat, and threats.
7. Investigate translocation and artificial hibernation sites as a potential recovery tool.

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Conservation Plan for the Canebrake Rattlesnake [(*Crotalus horridus*) Coastal Plain population] in Virginia

I. INTRODUCTION

A. General Species Status Overview

The canebrake rattlesnake is a large, terrestrial, venomous snake inhabiting the Coastal Plain of the southeastern United States from southeastern Virginia to eastern Texas. This species has declined in Virginia and in other states, largely because of habitat loss. Mitchell (1993) determined that 32 of 58 known canebrake rattlesnake occurrences observed and recorded in Virginia from the 1940s to the present are now extinct. This species was listed as a state endangered species on 1 January 1992 (VR 325-01-1 & 13) and is afforded official protection under Article 6, Title 29.1 of the Code of Virginia. The canebrake rattlesnake [(*Crotalus horridus*) Coastal Plain population] is not listed in any other state.

B. Taxonomy

The canebrake rattlesnake was originally described as *Crotalus atricaudatus* by Latreille (1802) based on a description of a specimen sent to him from "Carolina." The name was not recognized for over a century, as most herpetologists considered it to be a synonym of *Crotalus horridus* Gloyd (1935) resurrected *atricaudatus* demonstrating that it should be considered a subspecies of *C. horridus* This combination was followed until Pisani et al. (1973) recommended against recognizing subspecies, largely because of the extent of phenotypic variation exhibited by western populations. A later study by Brown and Ernst (1986) suggested that *atricaudatus* might be applied to lowland, southeastern populations of *C. horridus*. Brown and Ernst (1986) suggested that *atricaudatus* should be recognized because the lowland, southeastern populations are phenotypically different and possess a more uniform range of characters than upland populations.

In 2003, mtDNA analysis did not show evolutionary separations that would support a subspecific designation (Clark et al. 2003). In 2006 morphological traits were used to support the conclusion that *C. horridus* is a single widespread species with variation too extensive and complex to be reflected by formal subspecific designations since the general patterns of geographic variation are strongly clinal (Allsteadt et al. 2006). Although the subspecific designation is no longer recognized, the VDGIF does recognize the Coastal Plain population as a unique population segment. This recognition is based on distinct phenotypic and ecological differences.

C. Description

The canebrake rattlesnake is a large, robust, venomous snake reaching a maximum total length of 1892 mm (Conant and Collins, 1991). The largest specimen measured in Virginia was 1705 mm total length (Mitchell, 1994). There is no obvious sexual dimorphism, except for the fact that males on average are larger than females. In Virginia, adult female average snout to vent length (SVL) is 1046 mm and males 1141 mm (A. Savitzky, Goetz and Petersen unpublished data). Gibbons (1972) determined that adult male canebrake rattlesnakes from South Carolina were 1220-1400 mm snout to vent length (SVL) and weighed 1235-2490 grams, whereas adult females were 1170-1280 mm

SVL and weighed 1033-1546 grams. The largest known rattlesnake in Virginia was reported by Werler and McCallion (1951) to be 72 inches (1830 mm) total length.

Canebrake rattlesnakes are pinkish to light tan or brown in background color, with dark brown to black crossbands, some of which form chevrons across the dorsum. The body is variously peppered with tiny black specks. A chestnut brown to orange middorsal stripe is usually present, as is a brown oblique stripe running from the eye to the rear of the mouth (Photo 1). Both characters may, however, be faded or obscured by dark pigment in old individuals and the preocular stripe often fades to yellow. The tail is black, with a series of loose, keratinized segments that form the rattle.

Juveniles and neonates are usually lighter in color, and the preocular stripe and middorsal stripe are more distinct than in adults. Neonates possess only the prebutton of the rattle which is lost when they first shed their skin. For additional descriptive comments see Mitchell and Schwab (1991) and Mitchell (1994).

Photo 1: Canebrake rattlesnake with food bolus (Photo: Alan Savitzky).

Photo 2: Canebrake rattlesnake neonate prior to first shedding event (Photo: Scott Goetz).

D. Distribution

Crotalus horridus is found in North America from a line extending roughly from Wisconsin to eastern Texas east to the Atlantic Coast, excluding peninsula Florida (Conant and Collins, 1991). The name "canebrake" is still often used when referring to timber rattlesnakes found in the Atlantic Coastal Plain from northern Florida to southeastern Virginia where it reaches the northernmost limit of its range (Ernst and Ernst, 2003). Although canebrake rattlesnake populations are broadly distributed throughout the Atlantic Coastal Plain, its distribution is increasingly fragmented by anthropogenic activities (Savitzky pers. comm. 2011).

A 17th century record of "rattlesnakes" (most likely canebrakes) in Virginia was by Lederer (1672) who found one in present day New Kent County or King William County. William Byrd II (1728) mentioned finding several rattlesnakes along the border of Virginia and North Carolina. Wood (1954) was the first to map the distribution of canebrake rattlesnakes in Virginia. All locations noted above were included. The Prince George County location is based on an unsubstantiated medical snakebite record that occurred sometime before 1953 (Wood, 1954). A Southampton County location in Tobey (1985) was based on an unsubstantiated local newspaper report in which the snake could not be conclusively identified.

Many of the sites where canebrakes were collected or observed prior to about 1980 by Wood (1954), Goodwin and Wood (1956), and G. Williamson (pers. obs.) have been so severely altered by urban, suburban or agricultural development that they can no longer support canebrake rattlesnake populations. The current distribution of the canebrake in Virginia is limited to the cities of Chesapeake, Hampton, Newport News, Suffolk, and Virginia Beach, and York County (Appendix 2, Figure 1). Since only one observation has ever been recorded for Isle of Wight County (Schwab, 1987), the likelihood of a population occurring there is highly improbable.

E. Life History

1. Reproduction, Growth, and Development – Mate searching among male canebrakes typically peaks in July and August. During this period, males will often make large (>100 meter) daily movements in search of females. Courtship events have been observed in a variety of habitats, including clearcuts, agricultural fields and deciduous forests (Savitzky and Petersen, 2004; Savitzky and Goetz, 2009). Females routinely bask in pre-shed condition, and typically copulate shortly after shedding. Not all copulation events result in gravid females (Savitzky and Goetz, 2009). In Virginia, mating occurs in August through early September (Martin and Wood, 1955; Mitchell and Schwab, 1991; Savitzky and Petersen, 2004). After successful breeding, the following year females bear living young in late August and early September (Savitzky and Petersen, 2004). Based on the observations of Savitzky and Petersen (2004) reproductive intervals in southeastern Virginia were 3-5 years. In South Carolina, litters of 10-16 are born at 2-3 year intervals, depending on the nutrition of the female, and maturity is reached at 6 years of age and about 1000 mm SVL for females and 900 mm SVL for males (Gibbons, 1972).

Photo 3: Male canebrake rattlesnake courting female. Note opaque eyes (female) of pre-shed condition (Photo: Scott Goetz).

2. Feeding, Predators, and Sources of Mortality - The natural prey of adults consists largely of gray squirrels (*Sciurus carolinensis*) (Mitchell, 1994; Savitzky and Goetz, 2009). Savitzky and Goetz (2009) conducted a fecal analysis of 37 samples and found 45% of their diet consisted of gray squirrels. The remaining aspect of their diet is comprised of other small rodents and the occasional bird (Table 1). Martin and Wood (1955) reported a bolus of raccoon hair in the stomach of an adult canebrake from southeastern Virginia. On one occasion, a canebrake was observed eating a cottontail rabbit (C. Petersen pers. obs.). The diet of juveniles has never been documented, but it is expected they are feeding on small rodents.

Animals known to kill canebrake rattlesnakes include white-tailed deer, sheep, hogs and dogs (Klauber, 1972). Juveniles are also known to be killed by chickens and turkeys (Klauber, 1972). However, humans are presumed to be the primary predators on all age and size classes. Methods include direct killing by hand-held implements, firearms and highway mortality. Natural predators probably include red-tailed hawks, owls, eastern rat snakes, black racers and eastern kingsnakes.

Other potential sources of mortality include bioaccumulation of pesticides, collection for captive purposes, collection and removal for release elsewhere in the canebrakes range, and disease.

Prey	Number of prey items
Grey squirrel (*Sciurus carolinensis*)	20
Cotton rat (*Sigmodon hispidus*)	2
Shrew (*Sorex* and/or *Crytotis* sp)	2
Pine Vole (*Microtus pinetorum*)	1
House Mouse (*Mus musculus*)	1
Cottontail Rabbit (*Sylvilagus floridanus*)	2
Birds	5
Unidentified	7

Table 1. Prey items identified from 37 fecal samples collected from canebrake rattlesnakes in Chesapeake, Virginia (Savitzky and Goetz, 2009)

Photo 4: Female canebrake rattlesnake in an ambushing posture. Vertical ambushing is a behavior unique to the Coastal Plain population of *C. horridus* (Photo: Scott Goetz)

Photo 5: Canebrake rattlesnakes have been observed exhibiting arboreal behavior. (Photo: J.D. Kleopfer)

Photo 6: Canebrake rattlesnake eating gray squirrel (Photo: Chris Petersen).

3. Population Ecology and Survivorship - Population size, sex ratio, and population dynamics of the canebrake rattlesnake are unknown. Adult survivorship is not well known but is expected to be higher than that for juveniles (Parker and Plummer, 1987). A female canebrake was monitored intermittently for 14 years at NSANA. That individual was an adult at the time of capture and therefore at least 18 years of age.

4. Habitat Requirements - Canebrake rattlesnakes in southeastern Virginia prefer mature hardwood and mixed hardwood-pine forests, forested cane thickets and ridges adjacent to swampy areas. Hardwood forests along riverine corridors often harbor canebrakes. Snakes are known to enter wetlands often for extended periods, and they frequently cross at least small rivers (Savitzky and Savitzky, unpublished data). Savitzky and Petersen (2004) found canebrakes were located most frequently in deciduous forest (77% of observations); only 13% of observations occurred in pine forests, and another 8% occurred in clearcuts. On occasion, individuals will occupy agricultural fields and other less optimal habitats (Kleopfer pers. obs. 2011)

5. Hibernation

Unlike the communal denning behavior of the mountain populations, canebrake rattlesnakes typically hibernate solitarily in underground tunnels left by decaying roots or in hummocks created by living trees (Savitzky and Savitzky, unpublished; Kleopfer pers. obs. 2009). Although individual canebrakes are known to return to the same hibernaculum in successive years, some individuals have used up to three separate hibernation sites (Savitzky, Savitzky, and Peterson, unpublished data). The mean date of emergence from hibernation was 4 April (range: 25 March-14 April). The mean ingress date was 31 October (range: 7 October-5 December). The activity period, therefore, is approximately 4 April-31 October, or 211 days (Savitzky and Petersen, 2004). Based on data (n=8546) from thirty-four snakes, average body temperature during the active period was 21.74 ^{0}C [(S.D. 6.38 ^{0}C) Range: 0.3 - 48.07 ^{0}C]. During the hibernation period, data (N=3180) from thirty snakes showed an average body temperature of 11.21 ^{0}C [(SD 4.11 ^{0}C) Range: -2.01 – 31.68 ^{0}C] (Savitzky, Petersen and Goetz unpublished data).

Photo 7: Canebrake rattlesnake photographed 16 January, 2009 in hibernaculum. Note the extended tongue an indication of alert condition (Photo: J.D. Kleopfer).

6. Movement Patterns and Activity Areas – The average sizes of activity areas differ greatly between males (87.66 ha), gravid females (17.71 ha), and nongravid females (31.89 ha) (Savitzky and Goetz, 2009). During the active summer months, canebrake rattlesnakes will often remain in the same location for several days to ambush prey, gestate or digest. Daily long distance movement patterns are infrequent and are influenced by seasonal and ecological variables.

The average annual movements for males are 5.77 km/yr (max. = 6.62 km/yr) and 3.91 km/yr (max. = 5.36 km/yr) for nongravid females. Average daily movement patterns for males were 87.66 m/day, 72.39 m/day for nongravid females, and 54.11 m/day for gravid females. Linear movements were greatest when leaving and returning from hibernaculum and during the mate-searching season of July and August (Savitzky and Goetz, 2009). See Appendix 2, Fig. 2, 3 and 4 for illustrations of typical movement pattern.

Activity areas, however, can be influenced by anthropogenic (i.e. agricultural fields and clearcuts) and natural disturbances. Canebrake rattlesnakes often use these areas for purposes that require an elevated body temperature such as gestation, digestion, shedding and courtship (Savitzky and Goetz, 2009). At NSANA, Savitzky and Goetz (2009) found a common response to the rapid and dramatic loss of canopy cover was a reduced size in the activity area and a marked shift from the use of anthropomorphic openings to natural openings located within the forest itself. These findings are consistent with other research addressing the effect of canopy cover on rattlesnakes (Fitch and Pisani, 2006). However, these findings should be interpreted with some understanding. Natural disturbances are typically smaller in size and provide down woody debris as protective cover for thermal regulation and habitat for prey species. In contrast, anthropomorphic clearings typically increase exposure to predators and lack down wood debris. Although clearcuts do provide large amounts of down woody debris, they do not provide sufficient cover from predators or habitat for their primary prey, gray squirrels.

F. Limiting Factors and the Causes of Population Decline

The primary limiting factor for canebrake rattlesnake populations in southeastern Virginia is the extent of mature forested habitats. The destruction of such habitat is due to agricultural, forestry, and urban and suburban development. The primary cause of the decline of canebrake rattlesnakes in Virginia presumably is habitat loss and fragmentation. Other likely causes of population decline include collecting adults for captivity and willful killing of snakes by people.

County/City	1992 (acres)	2001 (acres)	2006 (acres)	% Decline
Chesapeake	66313	56506	9807	85
Hampton	5943	4588	1355	77
Newport News	19239	11886	7353	62
Suffolk	168133	102992	65141	61
Virginia Beach	34849	26429	8420	76
York	71498	41326	30173	58

Table 2. 15 year trend analysis of upland forested habitat (deciduous, evergreen, mixed) in southeastern Virginia. The "housing boom" of the late 1990's and early 2000's exponentially increased the rate of habitat loss. (Virginia Fish and Wildlife Information Service, 2011).

> **Deciduous forest**—Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
> **Evergreen forest**—Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
> **Mixed forest**—Areas dominated by trees generally greater than 5 meters tall, and greater than 20% of total vegetation cover. Neither deciduous nor evergreen species are greater than 75% of total tree cover.

Although highways are a direct source of canebrake rattlesnake mortality (Kleopfer per. obs. 2011), habitat fragmentation resulting from highways also effectively fragments canebrake rattlesnake populations in Virginia. U.S.17 in southern Chesapeake has effectively separated populations in the Great Dismal Swamp from populations to the east. U.S. 13/58/460 on the northern edge of the Great Dismal Swamp has also effectively fragmented this population into north and south of the highway (Appendix 2, Fig. 5). Continued development along Ballahack and Blackwater roads will also most likely result in population fragmentation and increased highway mortality of canebrakes in these areas. Small populations can also be seriously affected by changes in sex ratio, survivorship of adults, disease, inbreeding and environmental disasters (Soule, 1986).

G. Conservation Status

The canebrake rattlesnake was state-listed as an endangered species on 1 January 1992 under Article 6, Title 29.1 of the Code of Virginia. It is not afforded protected status anywhere else in its range. Mitchell and Schwab (1991) and Mitchell (1993) predicted that urban development and other causes of habitat loss will restrict canebrake rattlesnakes in southeastern Virginia to the following locations: the North Landing River and its tributaries, the Northwest River and its tributaries, the Great Dismal Swamp National Wildlife Refuge (GDSNWR) and swamplands north of U.S. Rts. 460 and 58 (including the GDSNWR), the area between Elbow Road and the Albemarle Chesapeake canal in Virginia Beach, and the population within the Naval Supply Activity Norfolk,

Northwest Annex (NSANW) and the adjacent Cavalier WMA to the west. Although populations north of the James River were predicted to be extirpated by the year 2000 (Mitchell and Schwab, 1991), canebrakes still persist (Kleopfer pers. comm. 2011). In May 2007, two adult canebrake rattlesnakes were found in the City of Hampton near the intersection of Armistead Avenue and Hampton Roads Center Parkway (Kleopfer pers. obs. 2009). In 2008, observations include Sandy Bottom Nature Park (Currier pers. obs. 2008) and an area adjacent to Hardwood Mills Reservoir near Rt. 17.

H. Protection and Management

Canebrake rattlesnakes are protected from collection, sale, or possession under the Commonwealth of Virginia's Endangered Species Act. They are also protected from wanton killing by humans, but enforcement is difficult and problematic.

Protected public lands within the canebrake rattlesnake's current distribution include: Sandy Bottom Nature Park, Great Dismal Swamp National Wildlife Refuge, Northwest River Park, Cavalier Wildlife Management Area, NSANA and lands owned by the DCR-Heritage Program. Protected private lands include areas under conservation easements, wetland mitigation banks and lands owned by The Nature Conservancy.

II. CONSERVATION STRATEGY

A. Objectives

The ultimate objective of this conservation plan is to conserve and maintain viable populations of canebrake rattlesnakes in a significant portion of its historic range. The Conservation Team has deemed it impossible, under current and projected land use in southeastern Virginia, to restore the canebrake rattlesnake to its historic range and has determined that it is unlikely that this species can be removed from Virginia's endangered and threatened species list in the foreseeable future. Based on this conclusion, the primary objective of this Plan is to prevent the extirpation of canebrake rattlesnakes from Virginia and provide guidance for its conservation in Virginia in perpetuity.

Zones of Protection

The Conservation Team has identified five Zones of Protection as being critical to secure the conservation of the canebrake rattlesnake in Virginia in perpetuity: (1a) North Landing River and its tributaries, (1b) Northwest River and its tributaries, (1c) Great Dismal Swamp National Wildlife Refuge and swamplands north of U.S. 13/58/460, (1d) area between Elbow Road and the Albemarle-Chesapeake canal in Virginia Beach, and (1e) population within the NSANA and the Cavalier Wildlife Management Area to the west (See Appendix, Figure 5). These Zones of Protection were identified based on the presences of existing populations of canebrake rattlesnakes and lands already purchased for conservation. These zones should also be the primary focal areas for any land acquisitions that include canebrake rattlesnakes as a conservation objective and for any research objectives identified in the Conservation Plan Outline.

The idea of maintaining a population on the York-James peninsula is problematic, but should not be abandoned. Except for Sandy Bottom Nature Park, no population is known to still exist. However based on recent and historic observations (see section G. Conservation Status), a population (or individuals) may inhabit the Hardwood Mills Reservoir watershed and nearby areas. Therefore, mitigation for impacts to canebrake rattlesnake on the York-James peninsula is warranted.

B. Conservation Plan Outline

1. Protection of canebrake rattlesnake populations in Virginia.
    - 1.1 Delineate habitat/population boundaries.
    - 1.2 Contact landowners and hunt clubs.
    - 1.3 Coordinate efforts with agencies in North Carolina.
    - 1.4 Enhance law enforcement.
    - 1.5 Pursue a mitigation/conservation banking system.
    - 1.6 Acquisition of lands within the Zones of Protection (Figure 5)

2 Monitoring of specified populations.
    - 2.1 Snake population monitoring.
    - 2.2 Habitat characteristics.
    - 2.3 Population genetics.

3 Population dynamics and life histories of populations in designated study sites.
    - 3.1 Population ecology.
    - 3.2 Life history characteristics.
    - 3.3 Movement patterns and activity areas of neonates and juveniles.

4 Consequences of snake translocations.
    - 4.1 Investigate snake translocations as a management tool.
    - 4.2 Ecology, genetics, and diseases.

5 Prepare and maintain a management profile for each defined population.

6 Develop and maintain public support for species protection.
    - 6.1 Landowners.
    - 6.2 General public.

7 Conservation Team meetings.

C. Conservation Plan Outline Narrative

1 Protection of canebrake rattlesnake populations in Virginia.

The populations of canebrake rattlesnakes in southeastern Virginia have not been adequately identified or characterized. Probable habitat boundaries need to be determined for all areas that are likely to possess viable populations so that protection measures can be initiated.

Note: We are currently unable to quantify a “viable population” and that the use of this term is an intuitive reference to large, contiguous tracts of suitable habitat that are occupied by canebrake rattlesnakes.

1.1 Delineate habitat/population boundaries.

Using available distributional data and appropriate maps, boundaries of potentially viable populations should be mapped and identified. Conduct ground and aerial surveys of all sites that may harbor populations and the corridors between them. A computerized information database (e.g., GIS) should be established to incorporate all geographic data so that changes can be entered quickly and so that this database can be used to track changes in landuse.

1.2 Contact landowners.

All appropriate landowners within these protection boundaries should be identified. Each should be contacted in the manner that will best ensure cooperation. Landowners should be made aware of the sensitivity of the endangered canebrake rattlesnake and of the value of maintaining natural habitat. They should be made aware of the available conservation options. All efforts should be made by conservation agencies and organizations to ensure the protection of these sites.

1.3 Coordinate efforts with agencies in North Carolina.

Conservation efforts should be coordinated with agencies in North Carolina when populations occupy both Virginia and North Carolina.

1.4 Enhance law enforcement.

DGIF and local law enforcement officers need to be trained in canebrake rattlesnake identification, handling of snakes, and in strategies for dealing with people who have taken them illegally. Existing agency goals and objectives place high priority on protection of endangered species. DGIF field personnel should be made aware of the special attention required of this species.

1.5 Pursue a mitigation/conservation banking system

Although mitigation banks specifically set-up to mitigate impacts to canebrake rattlesnakes are currently unavailable, canebrake rattlesnake credits in association with wetland credits are available at some wetland mitigation banks. Developing a mitigation/conservation bank system specifically for canebrake rattlesnakes should be pursued by the Virginia Department of Game and Inland Fisheries.

1.6 Acquisition of lands within the Zones of Protection

The single greatest objective to protect existing populations of canebrake rattlesnakes will be the continued acquisition of land for conservation. All potential land acquisitions within the Zones of Protection (See Appendix, Figure 5) should be strongly considered.

2 Monitoring populations.

It will be necessary to regularly monitor selected populations for trends in structure and size, and for changes in the habitat. Although the research being conducted at NSANA has provided much data on the ecology of this species, we do not have data on several key factors of its life history. For example, it is not clear how long the snakes live or how often females reproduce. These data can only be obtained through long-term (>15 years) monitoring of a single or multiple populations.

2.1 Snake populations.

Small populations are known to fluctuate because of random events, such as removal of one to a few breeding adults by humans, which in turn may affect the effective sex ratio and cause important changes in population structure. Because populations fluctuate over time, the size of canebrake populations should be continuously monitored. Population

studies should include a mark-recapture program using Passive Integrative Transponder (PIT) tags on adults and juveniles and radio-telemetry.

2.2 Habitat changes

The habitat of each of the populations selected for study should be monitored every five years for the following parameters: extent of the forest habitat, changes in area and forest composition. All habitat parameters must be recorded on permanent data sheets and copies filed with the DGIF; a copy should be maintained in a separate location. All data should be entered into a computerized database (e.g., GIS) specifically designed for this species and analyzed periodically.

2.3 Population Genetics

Continue to obtain genetic samples from road-kill and live individuals. These samples should be stored at the Canebrake Rattlesnake Conservation Center at NSANA.

3 Determine the ecology and life history

A concerted effort is needed to obtain additional ecological and life history data for each population selected for monitoring purposes.

3.1 Ecology

Ecological information needed for management purposes includes population density, predators, movement corridors, activity areas (adults and juveniles), habitat, etc.

3.2 Life history characteristics.

Life history information needed for management purposes includes size and age at maturity, survivorship of juveniles and adults, recruitment rate, growth patterns of juveniles and adults, and relationship of litter size and litter frequency to parental body size. A life table is needed.

3.3 Movement patterns and activity areas of neonates and juveniles.

Little is known about the ecology of neonates and juvenile canebrake rattlesnake. Investigations are needed to better understand their ecological needs and survivorship. Historically, lack of methodology has been a limiting factor. Recent advances in radio-telemetry, however, may allow investigators the ability to study movement patterns and activity areas.

4 Investigations of translocations as a recovery tool.

4.1 Investigate snake translocations as a management tool.

Translocation of snakes from their original home population into another area may be a useful tool to supplement extant populations and/or dealing with snakes that cannot be returned to their original habitat. However, evidence suggests that translocated snakes often fail to thrive, or even survive, following translocation, and this approach should be considered a poor alternative to protection of existing habitat and resident populations. Controlled experiments should be designed to test the effectiveness of such management techniques for canebrake rattlesnake conservation. Consequences of translocating a snake from its original home population to another area include disruption or alteration of the receiving population’s social system or local ecological food web, disorientation, inability to find a suitable hibernation site and introduction of a deleterious gene or disease organism.

4.2 Ecology, genetics, and diseases.

Each translocated snake should be radio-tracked for at least 3 years. Its movements, ecological and social interactions should be recorded and evaluated. Each translocated snake should be checked for genetics and disease before release and study.

5 Prepare and maintain a site profile for each monitoring site.

Each monitored site should have an information database containing the following information. Each site should then be evaluated on a regular basis for changes in any aspect of the above parameters. A management profile could include:

a. site number and location on the appropriate topographic map

b. description of the habitat

c. all pertinent physical measurements (e.g., temperature, rainfall)

d. name, address, and phone numbers of all appropriate land owners

e. photographs of the site

f. site specific historical and contemporary information on population levels

g. results of periodic monitoring surveys

h. data files on ecological and life history parameters of the snake population

i. habitat maintenance/enhancement programs and schedule

j. a copy of the cooperative agreements with landowners

k. records of incidents of predation or other natural disturbances

1. records of incidents of vandalism and other unnatural disturbances

m. records of individuals captured or encountered including morphometric data, photographic record and PIT identification number

6 Develop and maintain public support for species protection.

6.1 Landowners

In order to encourage cooperation of landowners, they should be informed of the value of canebrake rattlesnakes as part of Virginia's natural and cultural heritage. They should receive special instructions (i.e. brochure) on how they can protect the habitat of this species and prevent the loss and alteration of forest habitat.

6.2 General public

Education of the general public should be advanced through written articles and brochures, newspaper articles, and other media. The development and updating of a fact sheet for general distribution is especially important. School children in the region should be encouraged to conduct projects on the canebrake rattlesnake. Those efforts will inform the public of the endangered status of canebrake rattlesnake, the value of the animals, and the problems encountered by the animals in contemporary Virginia. Other actions may be taken, such as working with natural resource personnel in maintaining forest habitat. Public awareness often yields new locality information and could reduce the frequency with which canebrakes are killed.

7 Conservation Team meetings.

The Conservation Team will meet every five years to review and update the Plan if necessary.

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Appendix

1. Nuisance Rattlesnakes.

The Conservation Team expects that individual canebrake rattlesnakes will occasionally need to be removed from private property. The following procedure is recommended:

1. Each snake will be measured and weighed, sex determined, and photographed. A passive integrative transponder (PIT) tag will be inserted. When possible, a blood sample should be taken.
2. Return the snake to its original population and habitat when possible.
3. Do not release any of these snakes on any ongoing monitoring/research sites, unless it came from that site.
4. Snakes caught in the James River watershed will be released on the same side of the river, as close as possible to the capture site. The sites selected must be publicly owned or other protected lands.

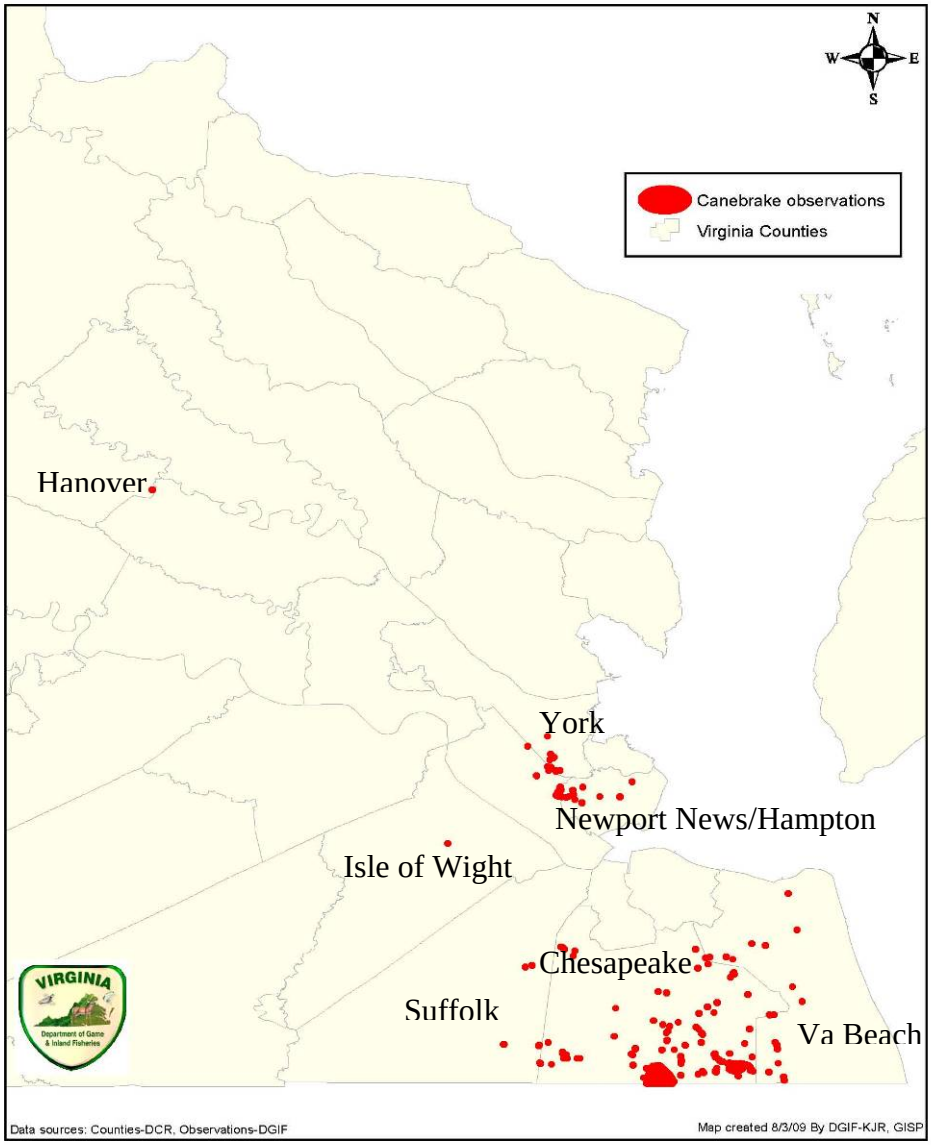

Figure 1. Observations of canebrake rattlesnakes (Virginia Fish and Wildlife Information Service, 2009). The Hanover County observation was determined not to be legitimate, but most likely a released pet.

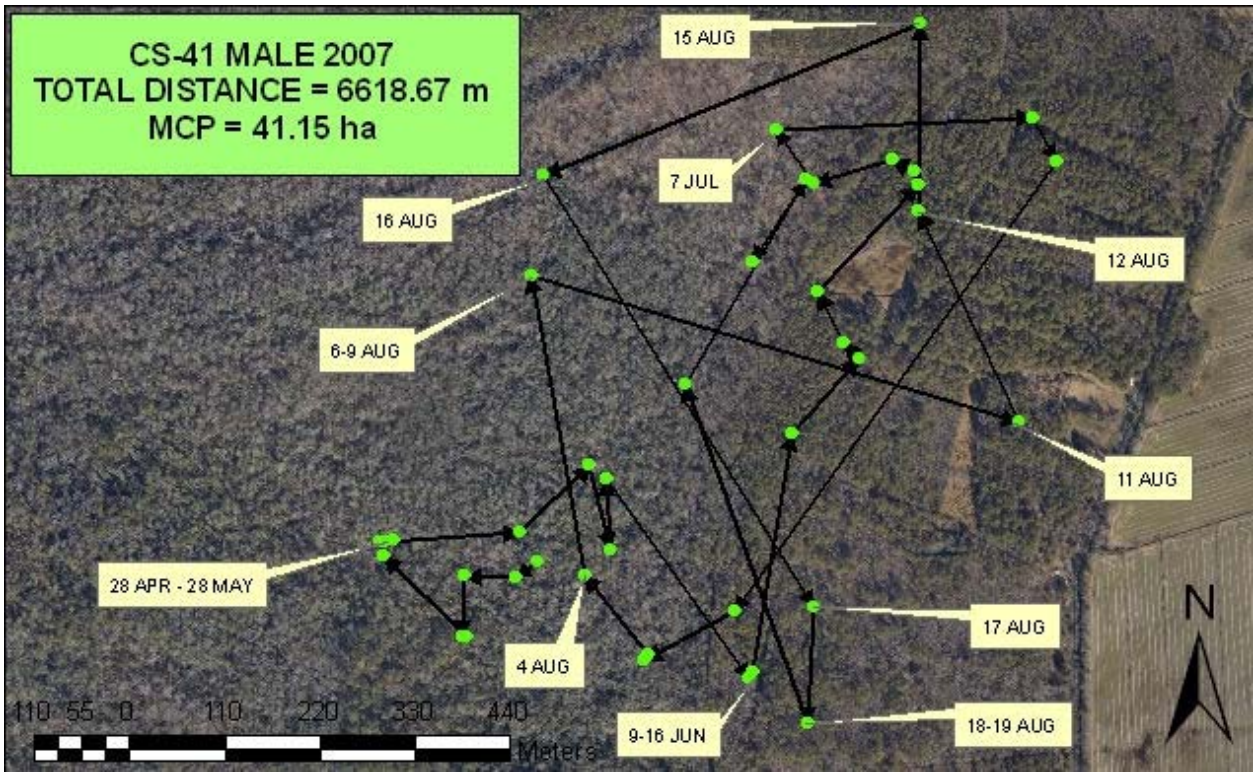

Figure 2: Typical movement pattern of a male canebrake rattlesnake. Note presumed mate-searching movements of 4-19 August (Savitzky and Goetz, 2009).

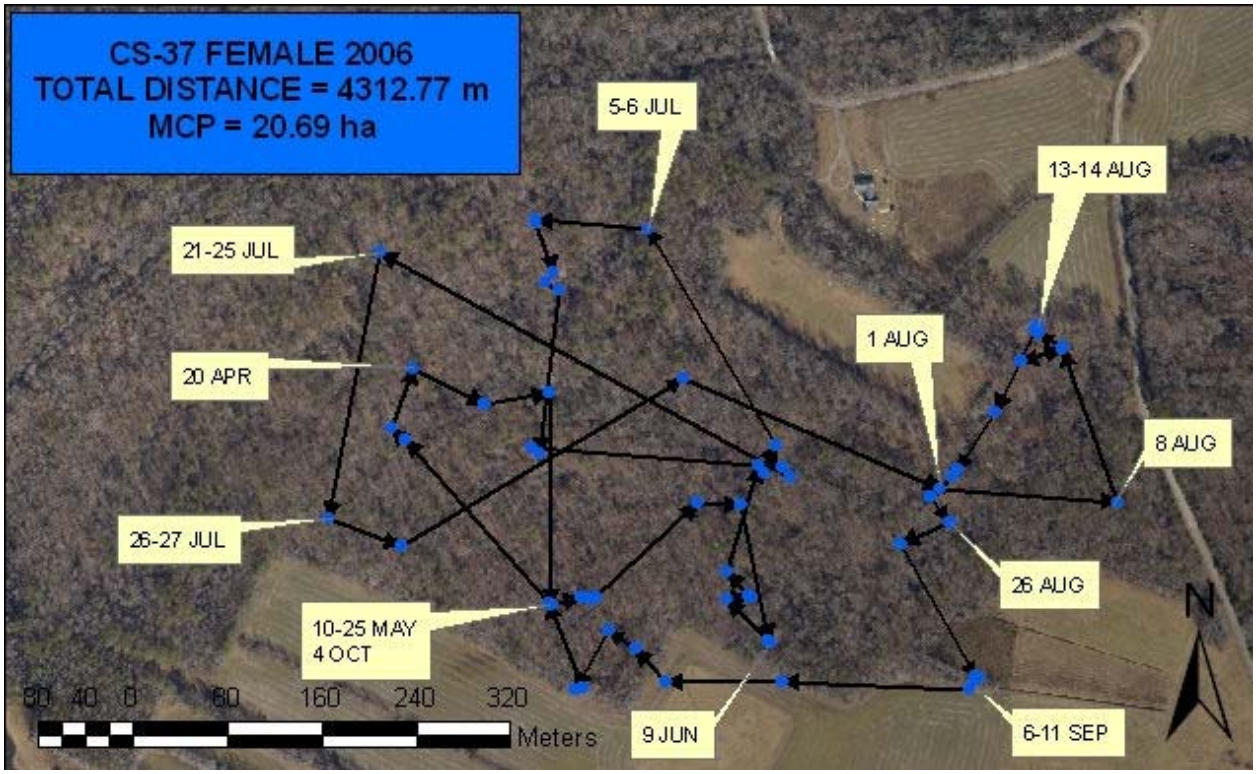

Figure 3: Typical movement pattern of nongravid female (Savitzky and Goetz, 2009).

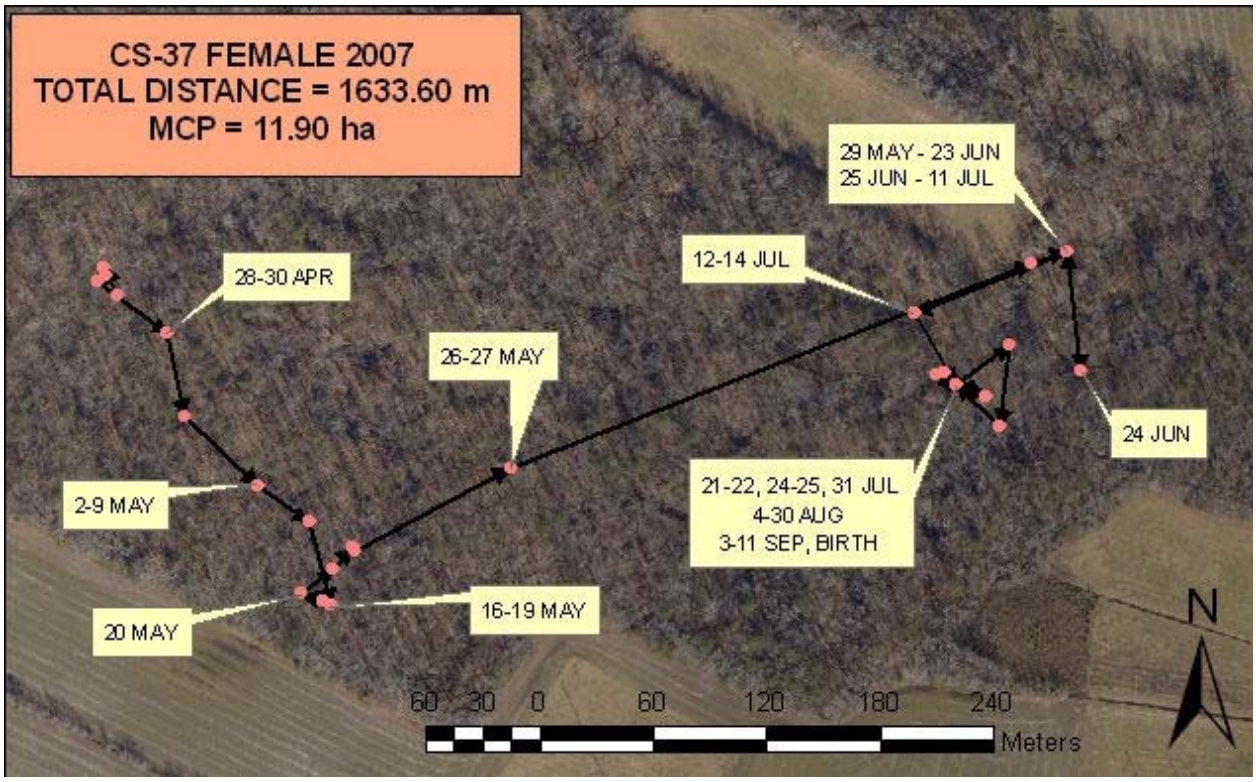

Figure 4: Movement pattern of gravid female. Compare to movements in 2006 (Figure 3); note highly restricted movement pattern (Savitzky and Goetz, 2009).

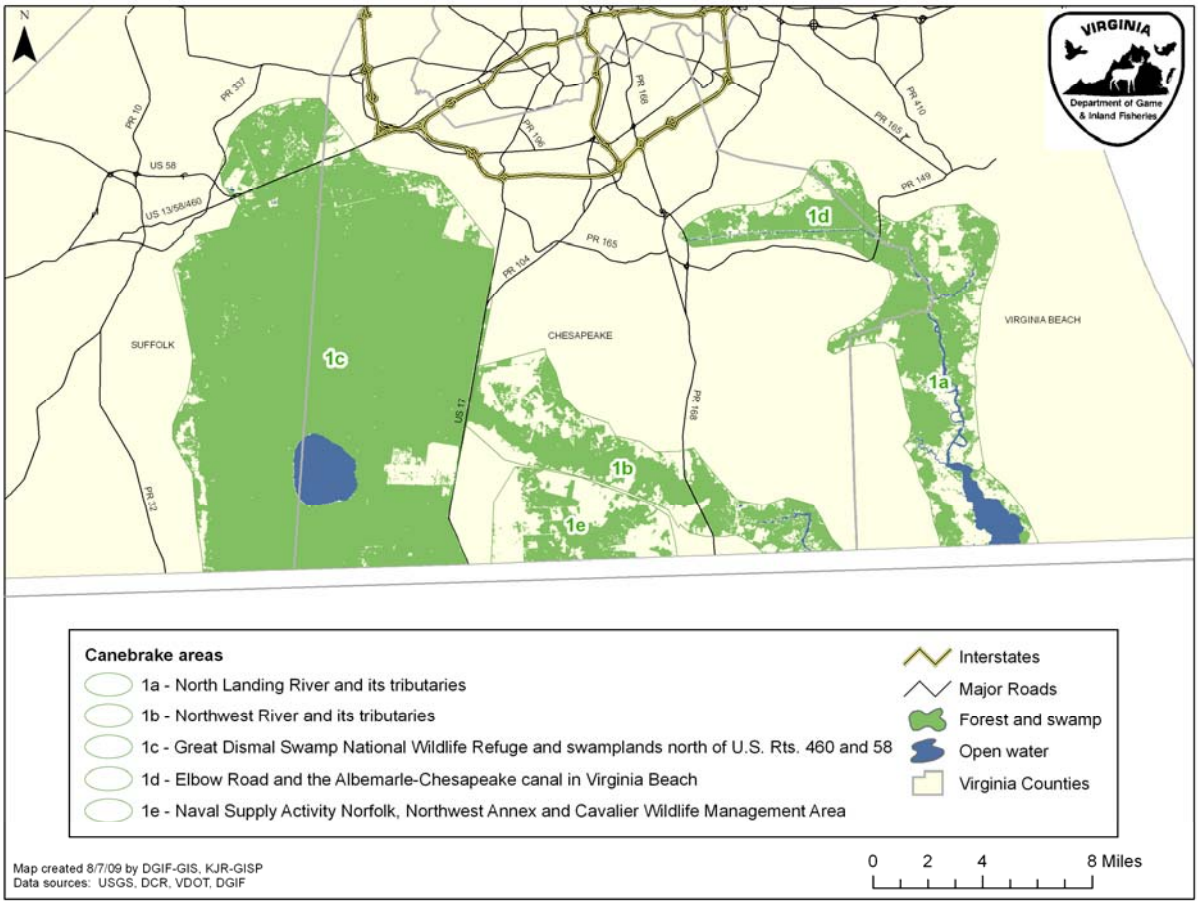

Figure 5: Zones of Protection (Virginia Fish and Wildlife Information Service, 2009)

Canebrake Rattlesnake Mitigation Guidance:

VDGIF Internal Guidance

November 2010

This report may be cited as follows:

Virginia Department of Game and Inland Fisheries. 2010. Canebrake Rattlesnake Mitigation Guidance: *VDGIF Internal Guidance*, Virginia Department of Game and Inland Fisheries, Bureau of Wildlife Resources, Environmental Services Section. Richmond, VA. 8 pp.

This report was completed with funds provided by the U.S. Fish and Wildlife Services through a State Wildlife Grant.

Canebrake Rattlesnake Mitigation Guidance

VDGIF Internal Guidance

Background

The purpose of this document is to guide internal development of mitigation recommendations for projects that may impact the *State Endangered* canebrake rattlesnake.

Taxonomy: Canebrake (=Timber) Rattlesnake [*Crotalus horridus* (Coastal Plain population)] Based on genetic analysis, the canebrake rattlesnake is no longer considered a subspecies of the timber rattlesnake. However there are morphological and ecological differences between the Coastal Plain and mountain populations. Because of these differences, the Department recognizes the Coastal Plain population as a unique population.

Characteristics: In Virginia, this large, venomous snake reaches a maximum length of about 182 cm. (72 inches). It is the only species of rattlesnake native to southeastern Virginia. The body color is usually pinkish, gray, yellow or light brown with brown to black chevrons and a black tail. A rust-colored mid-dorsal stripe is usually present as is a yellow-gold to brown stripe from the eye to the back of the jaw.

Food habits: This species feeds primarily on gray squirrels and typically only feeds once or twice per year. This snake also may capture and eat other rodents, rabbits and birds.

Range and Status: In Virginia, the canebrake rattlesnake primarily occurs on the lower York-James Peninsula and east of the Suffolk Escarpment. The southeastern Virginia population is designated as *State Endangered*.

Preferred Habitat: Canebrake rattlesnakes prefer mature hardwood forests, mixed hardwood-pine forests, cane thickets, and in the ridges and glades of swampy areas. Areas with numerous logs, significant leaf litter and humus also provide suitable habitat. This species overwinters in the bases of hollow trees and stumps, and in the underground tunnels resulting from stump and root decomposition. . This species has also been known to occupy disturbed areas, such as farm fields and cut-overs.

Reproduction: Canebrake rattlesnakes mature at 4-6 years of age and reproduce every 2-3 years. Mating occurs primarily in late summer and litters of 7-18 young are born the following August or September.

Permit Review Process

JPA Review (project with stream/wetland impacts):
For project sites in York County, Hampton, and Newport News, only those projects located within the boundaries of the designated Canebrake Rattlesnake Peninsula Core Habitat Area (see attached map) should be evaluated for the potential of canebrake rattlesnakes to occur onsite.

For projects south of the James River (i.e., Suffolk, Chesapeake, and Virginia Beach), projects impacting blocks of habitat 50 acres or more in size (i.e., suitable habitat being impacted on the project site is greater or equal to 50 acres or the impacted habitat on the project site plus contiguous habitat equals 50 acres or more) should be evaluated for potential canebrake rattlesnake occurrence.

If a proposed project being reviewed falls within the known range of the canebrake rattlesnake (using parameters described above) and is within 3.2 kilometers (2 miles) of a documented occurrence of the species, the following mitigation recommendation guidance should be followed in the absence of performing a survey on site (i.e., applicant prefers to assume presence). This guidance also may apply in situations where the applicant has had a habitat assessment performed and we have reviewed that assessment.

1. Recommend additional compensation for wetland impacts at a ratio from 1:1 to 3:1. This range of compensation ratios should be used when some combination of the following descriptors applies to the site/review:

- the project area (not only water impact area) is relatively small (<10 acres in total);
- the area is contiguous with other areas of suitable habitat, but there is some impediment to movement between the project site and other areas of suitable habitat (roads, water bodies, etc.) or contiguous habitat does not surround the project site
- the canebrake rattlesnake documentation is old (>20 years) and/or located greater than 1 mile from the project site;
- the habitat is suitable, but not ideal

2. Recommend additional compensation for wetland impacts at a ratio from 4:1 to 6:1. This range of compensation ratios should be used when some combination of the following descriptors applies to the site/review:

- the project area (not only water impact area) is of medium size (10-25 acres in total);
- the project site is contiguous to other areas of suitable habitat with movement corridors between them, but perhaps not on all sides;
- the canebrake rattlesnake documentation is recent (<20 years) and/or is located within 1 mile of the project site;
- the habitat appears to be suitable and of good quality leading one to believe that although there are no survey records for the site, it is highly likely the species would be found there

3. Recommend additional compensation for wetland impacts at a ratio from 7:1 to 10:1. This range of compensation ratios should be used when some combination of the following descriptors applies to the site/review:

- the project area (not only water impact area) is large (>25 acres in total);
- the impact area is contiguous with other areas of suitable habitat – especially if these areas are already preserved/protected/public lands;
- the canebrake rattlesnake documentation is recent and within 0.5 mile of the project area (in the contiguous habitat areas) and/or we have survey records for the project area itself that document the existence of canebrake rattlesnakes onsite.
- the habitat is considered of high quality

Other project reviews:
If the project does not fall under any water impact permitting requirements, rather than recommend mitigation ratios based on wetland/stream impacts, it is more appropriate to recommend that areas of like habitat be preserved to compensate for lost habitat. Projects impacting habitat blocks of less that one acre do not require mitigation.

Mitigation Options (in order of preference)

1. Preservation of suitable habitat adjacent to already preserved, occupied habitat. Preservation should be in perpetuity through a third party conservation easement/agreement. Such agreement should preserve the land in its current state or an enhanced state. No building/timbering/trail development should be allowed in such areas, unless first reviewed by our agency to address possible impacts upon canebrake rattlesnakes or the overall health of the preservation area. Future vegetation management of the site should be to the benefit of canebrake rattlesnakes. Canebrake rattlesnake habitat adjacent to Davis Mitigation Bank and located within Dover Farm Mitigation Bank is available for the purposes of mitigating impacts upon canebrake rattlesnakes and their habitat. Davis Consulting may be contacted at 757-456-9331. Dover Farm may be contacted (Katherine Birnie) at 773-921-9441.

2. Purchase of credits at a wetland mitigation bank that falls within the natural range of canebrake rattlesnakes and is known to include suitable habitat for the species. This should include the purchase of a combination of upland and wetland credits, if available. Banks known to support canebrake rattlesnakes include: Lewis Farm and Edge Farm mitigation banks (Great Dismal Swamp Restoration Bank - 757-487-3441); and Dover Farm Mitigation Bank (Katherine Birnie - 443-921-9441).

3. We recommend payment into the Aquatic Resources Trust Fund.

Species Surveys

Because this species is cryptic, making detection very difficult even for the mostly highly trained biologist, we do not consider species surveys a viable option for determining presence or absence of canebrake rattlesnakes at any particular project site.

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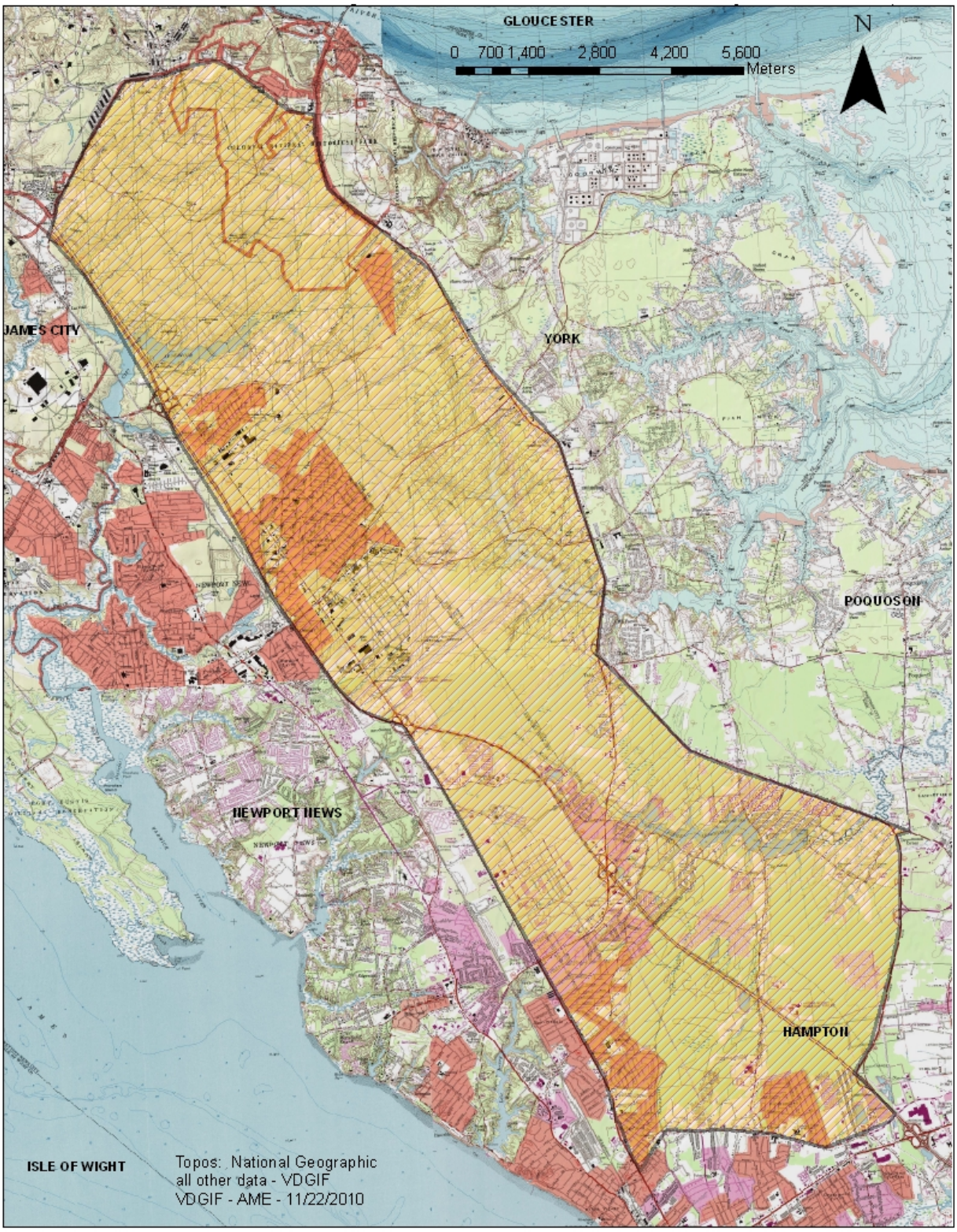
Canebrake Rattlesnake Peninsula Core Habitat Area