

HA File 2024.25

*Recommendations for Habitat Stewardship
and Herpetological Management at the
Hovnanian Sanctuary*



An adult female Red Corn Snake - an Endangered Species in New Jersey

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INTRODUCTION

History of the Hovnanian Sanctuary - The Hovnanian Sanctuary is owned and managed by the New Jersey Audubon Society (hereafter NJAS), and is located in western Berkeley Township, Ocean County, in the New Jersey Pine Barrens (**Figure 1**). On its western border it is connected to the New Jersey Natural Heritage Preserve known as Crossley, which was made famous by the late Carl Kauffeld in his book, *Snakes and Snake Hunting* (1957). The Hovnanian Sanctuary is approximately 513-acres in size and is considered a unique landscape for both flora and fauna. The New Jersey Natural Heritage Program designates the area as an excellent micro-site for rare species. The Hovnanian Sanctuary, and surrounding forested area is home to a number of state-listed endangered and threatened species, as well as many “species of special concern.” In recent years the Hovnanian Sanctuary has been inundated by the illegal use of all terrain vehicles, dirt bikes and other off road vehicles (ORV’s). While these ORV’s have helped keep trails and fire-cuts open, they also have a negative impact upon snakes, box turtles, and other wildlife. Herpetological Associates, Inc. (HA), was commissioned on August 29, 2024 to assist NJAS with writing a detailed Stewardship document that would guide with future habitat management and land stewardship of the Hovnanian Sanctuary. Additionally, HA would continue to document and monitor endangered and threatened snake use of the five previously made artificial snake dens on the four existing management fields.

BACKGROUND INFORMATION

The NJAS is in the process of updating a comprehensive long-term Stewardship Plan to better manage and improve the various habitat types on the Hovnanian Sanctuary. The new Stewardship Plan will cover many topics that will help keep the pine-oak forest in a productive balance that maximizes habitat features for rare plants and wildlife. Topics in the Stewardship Plan include:

- 1). Upgrading and maintaining gates and access roads.
- 2). Forest Management with Pine Creek Forestry, LLC to help improve habitat for rare snakes.
- 3). Develop a prescribed burn fire regime.
- 4). Protect the only vernal pond on site and manage the habitat.
- 5). Conduct habitat management at the four existing snake fields and dens.
- 6). Create a new snake management field and den on the western portion of the Sanctuary.
- 7). Continue to monitor endangered and threatened snake use of the management fields.

The implementation of the proposed long-term Stewardship Plan will help improve the Pine Barrens ecosystem on the sanctuary. More important it will benefit the critical nesting and overwintering habitat of the Corn Snake (*Pantherophis guttatus*), Northern Pine Snake (*Pituophis melanoleucus*), among several other rare reptiles and amphibians that naturally occur on the Hovnanian Sanctuary.



Figure 1. The red lines show the approximate property boundaries of the Hovnanian Sanctuary which is north of Route 530 (Dover Road), in Berkeley Township, Ocean County, New Jersey.

Recommendations and Topics for the Stewardship Plan

Upgrading and Maintaining Access Roads

There are many reasons to have driving access with a motor vehicle into various portions of the sanctuary. By not having driving access to the central and western portions of the sanctuary in the past greatly limited HA's ability to conduct research, monitor snake use of the habitat, and study reproduction success in these areas. Most of the sand roads are currently overgrown with encroaching vegetation and/or in poor driving conditions with a motor vehicle. HA recommends that several of the existing sand roads need to be cleared of unwanted vegetation and properly graded with a front-end loader. Grading and maintenance of the sand roads would improve access to the more remote central and western portions of the Hovnanian Preserve. NJAS may want to consider erecting and installing new locking gates at a few locations to the Sanctuary (e.g., one gate off of Davenport Road and one gate off of Dover Road - Route 530). Additionally, it may be wise to block certain fire-cut trails or old secondary sand roads that are currently being used by unwanted ORVs and motorcycles, especially the one by the vernal pond on the extreme eastern edge of the property. Only authorized personnel should have driving privileges in the sanctuary to conduct stewardship activities or scientific research and wildlife monitoring. The location of the two proposed gates are shown in **Figure 2**.



Figure 2. Approximate locations of two proposed new entrance gates. One would be off Davenport Road and the other off Dover Road (Route 530). The gates would be kept locked.

Forest Management with Pine Creek Forestry, LLC

HA will work closely with New Jersey Audubon’s forestry expert, *Pine Creek Forestry, LLC* on an “as needed basis.” The main objective would be to help improve habitat for endangered and threatened rare snakes, that would nicely dove-tail with sound forest management. In other words improve existing conditions for a healthy Pinelands forest and improve suitable habitat for the wildlife. *Pine Creek Forestry* may want to thin out dense tree growth in certain areas of the preserve. It’s important to leave the tree stumps in the ground because as they decay, they provide habitat for wildlife, especially snakes and lizards. Standing dead trees are also important in the forest landscape, especially when they become hollow from woodpecker activity and flying squirrels. A wide variety of wildlife species use standing dead hollow trees for shelter and foraging. Corn snakes will even deposit eggs in hollow dead trees, so they should be left in the forest landscape and not removed. *Pine Creek Forestry* may also want to occasionally push down unwanted large pitch pine trees so the base of the tree forms a root-ball. These fallen trees serve as shelter for many forms of wildlife, especially snakes who will eventually use them as shedding stations and winter refugia (dens). One habitat type that is lacking on the Hovnanian property is open grassy fields. There are no grassland field habitat on the Hovnanian Sanctuary. NJAS may want to consider creating a few one acre grassland fields that would provide foraging habitat for butterflies, other insects, birds, and small mammals. Grassland fields would also increase prey availability for rare snakes.

Develop a Prescribed Burn Fire Regime

Portions of the Hovnanian Sanctuary are densely overgrown by trees, underbrush, and thick mats of dry pine needles on the forest floor. During prolonged dry periods there is great danger of uncontrolled forest fire that could spread to nearby housing developments. Controlled prescribed fire is a forest management tool that is used throughout the country, especially in the southeastern coastal plain states to reduce fuel loads and refresh habitats by cleaning up older or dead vegetation buildup. Controlled prescribed fire is a tool that can lower the intensity, or even prevent wildfires on the Hovnanian Sanctuary by reducing the fuel load that may be available for consumption by wildfires. Lower intensity fires are safer and easier for firefighters to control if they become intensified by unexpected gusts of wind. Prescribed fire can be a useful and flexible forest management tool. Fire is an important natural ecological process in the Pine Barrens ecosystems. A controlled fire is ignited intentionally with a desire to control it, but cautions must be taken so the fire wont escape and became an uncontrolled wildfire. With the assistance of *Pine Creek Forestry*, NJAS should develop a prescribed burn protocol that describes 50 to 100 acre areas to be burned on a rotating biennial schedule. In order to safely burn, new firebreaks would have to be cut, or old firebreaks opened to keep the fire within the desired forest area.

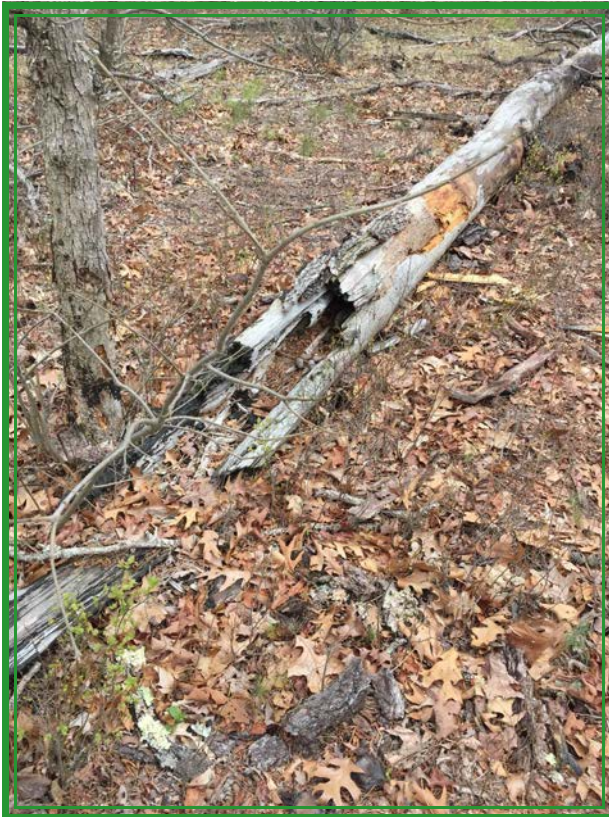


Figure 3. Fallen logs are important ground cover and habitat for rare snakes, lizards, and rodents.

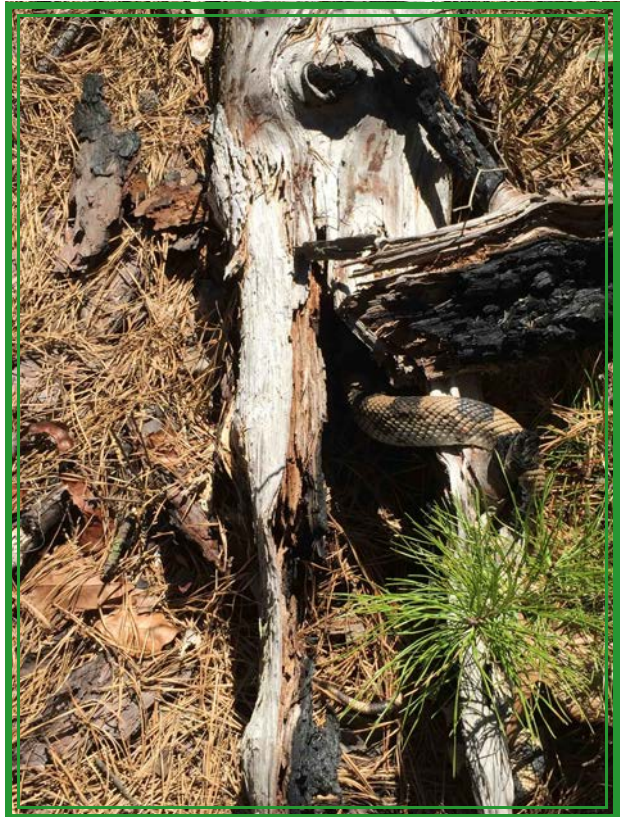


Figure 4. An adult Pine Snake crawling into a hollow log on the forest floor.



Figure 5. An illustration of a prescribed burn of a Pine-Oak forest at a site in Ocean County, New Jersey.

Prescribed burns should only be conducted during acceptable weather conditions (e.g., low wind speed, wind direction, relative humidity, smoke dispersion, acceptable soil moisture). *Pine Creek Forestry* would be responsible for all equipment needed, contacting Berkeley Township civil authority, and neighbor notifications protocols.

Properly planned and implemented prescribed burns provide several benefits while mitigating or avoiding an uncontrolled wildfire. In the Pine Barrens fire on the landscape can restore the important ecological process (several plants and ecosystems are fire dependent). Prescribed burns would increase plant diversity, which usually increases wildlife diversity and ecosystem health. Fire also increases legumes in plant communities and increases herbaceous production (e.g., grasses, forbs, and sedges) in the pine-oak forests. Fire also increases plant palatability, nutrient content, and availability for herbivores (white-tailed deer and rodents), commonly for 3-6 months post-burn. Fire decreases wildfire risk by removing accumulated fuels, commonly for

1-2 years post-burn. Reduces plant thatch for many wildlife species that require some patches of bare ground such as northern bobwhite quail, mourning dove, killdeer, fence lizards, nesting habitat for pine snakes and corn snakes, and helps rare plant species such as sickle-leaved golden aster and other wildflower species.

In order to protect endangered and threatened snake species along with ground nesting birds and butterflies, controlled burns should only be done in the winter between November 15th and March 15th of each year. Historically, smaller fires occurred in forests at regular intervals. When these fires are suppressed, flammable materials accumulate, insect infestations increase, forests become more crowded with trees and underbrush, and invasive plant species move in. Controlled burns seek to accomplish the benefits that regular fires historically provided to an environment while also preventing the wildfires from burning out of control and threatening life and property.

Protect the Only Vernal Pond on the Hovnanian Sanctuary

In order to recognize a vernal pond in late winter or early spring, one must look for certain landscape characteristics. They get their name from the Latin word “vernalis,” which means spring. Vernal ponds are formed seasonally in shallow ground depressions from spring snow melt, precipitation, and rising water tables. Generally drying up in late summer, these ponds are only temporary woodland reservoirs. They are slightly harder to identify during the summer and fall months; however, there are several clues to look for. Blackened, compressed leaf litter; gray soil; watermarks on surrounding tree trunks; and the presence of moisture-tolerant vegetation all suggest an area that collects water part of the year. Red maple, sweetgum, blackgum, highbush blueberry, and button-bush all commonly grow at these locations. Vernal ponds themselves are generally less than 30 to 40 yards in diameter and no more than 3 to 4 feet deep, although they receive run-off sheet flow water from a larger surrounding landscape.

Why are vernal pools important?

Vernal ponds are extraordinary wetlands fascinating to observe and essential to the lives of many wildlife species. With the rapid population declines of so many amphibian species, it's crucial that these often unnoticed habitats be recognized and protected. Vernal pools are critical wetland environments for an assortment of biologically specialized aquatic and semi-aquatic life forms which include vertebrates, invertebrates, and plants. They serve as important habitat in the life cycles of several obligate and facultative vernal pool species such as Pine Barrens treefrogs, gray treefrogs, and other local amphibians. Since there are no nearby wetlands within a half mile of the existing vernal pond, facultative species often use the pool for the completion of their life cycles. There are no streams, bogs, ponds, or lakes nearby. Facultative species are not dependent on vernal pools to complete their life cycles, but use them when no other suitable wetlands are available. Some examples of facultative vernal pool species include Fowler's toads, spadefoot toads, spring peepers, southern leopard frogs, green frogs, and several insect species such as caddisflies and dragonflies.

On the other hand, obligate vernal pond species are dependent on using these pools. Certain species have evolved accelerated reproductive strategies that allow them to use vernal pools more effectively than permanent water bodies for mating and egg laying activities. In the Pine Barrens of southern New Jersey, three mole salamanders, treefrogs, toads, wood frogs, and fairy shrimp all use both vernal ponds and old burrow pits for reproduction. There are many fewer vernal pool obligate species than facultative species. The ecology and biology of the obligate species is what drives vernal pool conservation laws and protection strategies; because they are vernal pool indicator species. Vernal ponds are temporary wetlands that fill after rainstorms or snow-melt each spring. They become the seasonal breeding and feeding grounds for many intriguing amphibians and insects, as well as the reptiles, birds, and mammals that depend on them for food. In late March or April the unmistakable vocal sounds of spring peepers, other frogs and toads can be heard calling for a mate.

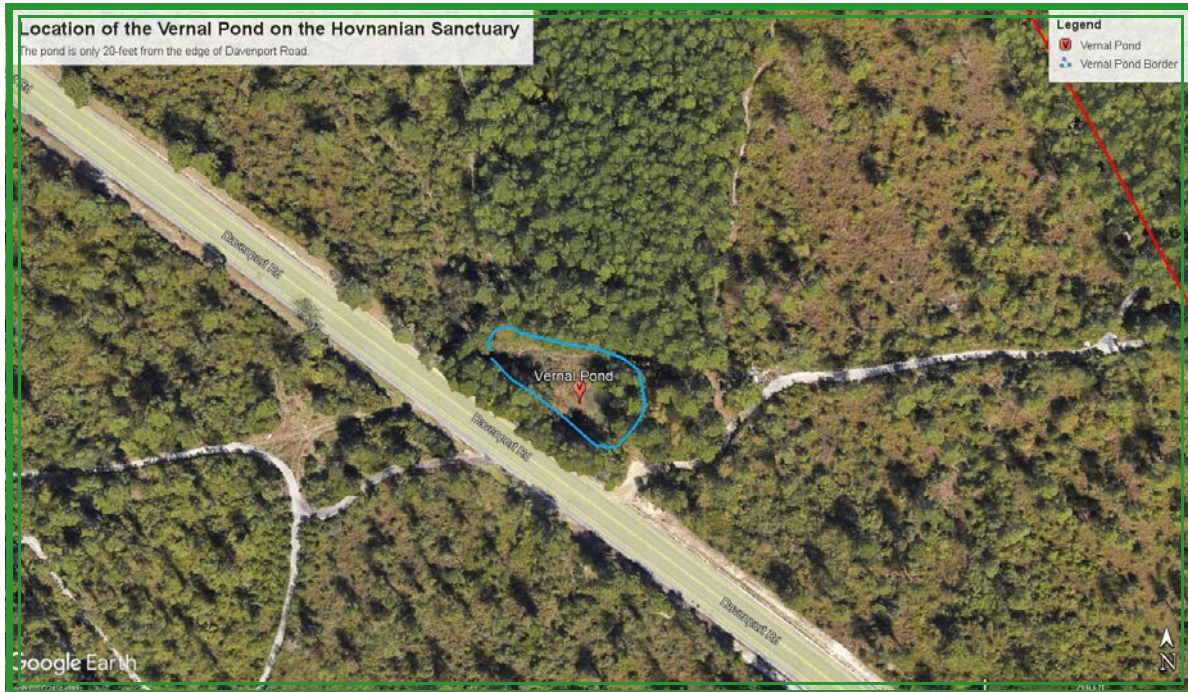


Figure 6. The only Vernal Pond on the Hovnanian Sanctuary is located on the north side of Davenport Road. Notice the sand road right near the eastern end of the pond that is used by ORV's.

Ecological Importance - If a vernal pond's physical landscape features are not apparent, the wildlife living there will certainly give away its location. Vernal ponds are home for a diversity of amphibians that count on them for the spring breeding season. The seasonal nature of vernal ponds means that they are not uninhabited by fish. This makes them the perfect habitat for a variety of amphibians and invertebrates to breed and develop with less chance of predation. Species like spring peepers and fairy shrimp depend exclusively on vernal ponds for this part of their life cycles. Often a vernal pond is the ancestral home of an amphibian community that resides nearby in the forest each winter, then migrates to the same pond each spring to lay its eggs. The first creatures to arrive each season are spring peepers, which spend most of their lives in the surround pine-oak forest. On rainy nights from mid-March through May, spring peepers travel through the forest floor to reach their chosen vernal pond. There they mate and lay a small eggs on branches and other vegetation submerged in the pond. The other amphibians that soon arrive are southern leopard frogs and Fowler's toads, which migrate in late April and May to lay their eggs on pond vegetation. Many other species use vernal ponds in spring. The spring peeper is one of the Hovnanian Sanctuary's smallest frog species, but has one of the animal kingdom's loudest voices for its size. Choruses of its high-pitched, birdlike peeps can sound like sleigh bells from a distance. Pine Barrens treefrogs, gray treefrogs, and green frogs are among the many other creatures that may come to breed (**Figures 8 to 11**). By the end of the breeding season, ponds are filled with egg clusters that appear as jellylike masses containing small, round eggs.



Figure 7. An eastern view of the vernal pond when it is full of rain and ground water. The photo was taken on April 15, 2024. This is when Spring Peepers, Fowler’s Toads, Northern Gray Treefrogs, Pine Barrens Treefrogs, and Southern Leopard Frogs begin calling.

As young amphibian larvae hatch and develop, they feed on invertebrate species that have emerged from their eggs at the same time. Fairy shrimp, dragonflies, damselflies, caddisflies, mosquitoes, daphnia, and other invertebrates drop egg cases in vernal ponds each year. The egg cases lie dormant over winter and hatch the following spring. While amphibian larvae feast on these delights, insect predators like fishflies, diving beetles, and backswimmers also look for amphibian larvae to feed upon. As activity inside the pond increases each spring, it attracts other animals to the vernal community. Some turtle species like painted and spotted turtles may visit the ponds to feed on egg masses, while snakes and raccoons may feed on tadpoles and frogs. Birds like the green heron and red-shouldered hawk also visit ponds to feed.

Protecting the Vernal Pond

As far as we know, there is only one vernal pond on the 513 acre Hovnanian Sanctuary, so it is a unique and important habitat type that needs protection and monitoring. The pond is 140 feet long by 70 feet wide, and is about 3 feet in depth at its deepest point. Unfortunately the pond is on the north side, and within only 20 feet of Davenport Road (**Figures 6 and 7**). This means that frogs and toads must cross the road to access the pond if they are coming from the forest to the south during the spring and early summer breeding season. This causes considerable road mortality to migrating frogs and toads, because of the amount of increased auto traffic on Davenport Road. One of the concerns is year-round disturbance from recreational off-road vehicles in the surrounding area. It is essential that the pond bed and perimeter remain undisturbed even during the dry season. There is a sand road on the southeastern edge of the vernal pond that is frequently used by ATV's. HA recommends that a fence should be erected on the southeast side of the vernal pond to keep the ATV's away from the pond's edge. Compaction or disruption of the sandy soil can change water flow and upset the drainage flow. Tire ruts along the edge of the pond can also promote early drainage at a time when amphibian eggs have not yet hatched. A large educational sign should be placed near the pond to inform Hovnanian Sanctuary visitors and the public about the importance of the pond and the animals that depend upon it.



Figure 8. Pine Barrens Treefrogs in amplexus.



Figure 9. Adult male Northern Spring Peeper.



Figure 10. Adult female Southern Leopard Frog.



Figure 11. A pair of Fowler's Toads in amplexus.

Habitat Management at the Four Existing Snake Fields and Dens

Herpetological Associates was hired as a consultant by Hovnanian Industries to conduct presence or absence surveys for endangered and threatened Pine Barrens Treefrogs, Corn Snakes and Pine Snakes back in 1983. All three species were found during our surveys on the 500 acre property known as Holiday Heights. The Pinelands Commission and the NJDEP reviewed HA's report and conservation recommendations and subsequently approved the plan.

As mitigation to protect these rare species, 250 acres were proposed for development and 250 acres were set aside as conservation land and a wildlife sanctuary. HA recommended that the 250 acres should be donated to the NJAS, which it eventually was. As part of the mitigation program, HA created four snake management fields that were approximately 300 feet long by 125 feet wide. One artificial snake hibernacula was also constructed on each field. These dens have proven to be very successful as winter refugia and have continued to be used by rare snakes as hibernation sites for the past 40 years.

Unfortunately, through natural succession the four management fields at the Hovnanian Sanctuary have become densely overgrown with underbrush, oak trees, and pitch pine trees which shades out much of the formerly open sunny areas that encouraged snake mating, nesting, and egg laying. While the few remaining open areas are still occasionally used by Pine Snakes, clearing the fields again would make the habitat much more suitable for snake basking and nesting. Likewise, the artificial dens are somewhat overgrown with vegetation as well and some selective thinning of trees and shrubs is needed as well.

HA recommends that each management field should be selectively thinned of unwanted trees and shrubs. While this task is labor intensive, this action will provide better basking habitat and expand nesting areas for the snakes and lizards. HA staff will do these tasks over the winter of 2024 and 2025. We will use chain saws, and weed whackers to cut down the trees and vegetation. The tree trunks and logs will be stacked-up into neat brush piles along the edges of the fields. This work will be done as part of our existing contract with NJAS over the next two years.

Create a new Snake Management Field and Den on the Western Portion of the Sanctuary

Because of poor sand road conditions and lack of access, the western portion of the Hovnanian Sanctuary has been somewhat neglected towards herpetological surveys. While in the past we established two sampling stations along the western edge of the property (we placed 12 plywood cover boards on the forest floor), infrequent checking has not yielded any Pine or Corn snakes. Improved road access would allow HA's researchers to regularly enter the central and western sections of the Hovnanian Sanctuary. More important, the creation of a new snake management field would provide an improved habitat type that would encourage snakes to congregate for basking, shedding, mating, and hibernation. HA would also set-up a series of sampling stations with 25 additional cover boards throughout the central and western sections of the Hovnanian Sanctuary. HA recommends the construction of a new field that would be approximately 400 feet long by 125 feet wide. The field would be cleared of all canopy trees and underbrush, so that about 80% of the understory is removed. The removed trees, logs, stumps, shrubs, and surface litter would be pushed along the edges of the field to form elongated mounds. Some logs would be scattered about on the open ground as basking sites for lizards and cover for snakes. An attempt would be made to bring in some Pennsylvania Sedge Grass, *Hudsonia*, and Pine Barrens Sand Wort, which are plants that are associated with Pine Snake nesting habitat. These plants are available at other sections of the Hovnanian Sanctuary, and would be transplanted. Additionally, one artificial hibernaculum would be constructed in the center of the new field. HA would take the lead on supervising the creation of the field and artificial den. HA would provide all the material (cement blocks, PVC entrance pipes, railroad ties), to build the artificial den. However, NJAS would pay for the rental fee of a front-end loader and backhoe machinery to accomplish this habitat management task. This work will be done as part of our existing contract with NJAS over the next two years.



Figure 12. Approximate location of a proposed new snake management field in the western portion of the Hovnanian Sanctuary.

Continue to Monitor Endangered and Threatened Snake Use on the Hovnanian Sanctuary

Reptile and Amphibian Survey Techniques

The ideal situation for research is to find snakes in the wild as often as possible, and in substantial numbers. Furthermore, obtaining a large sample size is necessary for meaningful statistical data analysis. When dealing with secretive, fossorial snakes finding enough specimens on a regular basis is not always easy to achieve, or may not even be an option. Protected species listed as endangered or threatened are the forms most often in greatest need of ecological studies. Information gathered from field studies aids in the development of smart conservation and management programs for their continued survival.

Reptiles and amphibians are often difficult to census due to their highly secretive nature and ability to remain hidden for long periods of time. Environmental conditions such as ambient temperature, precipitation, soil moisture, relative humidity, light intensity, wind, and season have strong influences on reptile and amphibian activity patterns (Vogt and Hine 1982). Unsuitable weather conditions may lead to increased fossorial behavior (burrowing), markedly reduced activity, shifts in habitat usage, and/or estivation (dormancy during hot and dry conditions, Greene 1997). Therefore, the use of several sampling techniques on the Hovnanian Sanctuary which take into account the various aspects of an animal's biology will often result in the best assessment of the target species relative abundance (Zappalorti and Torocco 2002). The following search methods were used.

Monitoring Spring and Fall Emergence from Dens

HA staff spent a minimum of 8 to 16-hours a week in the spring and fall seasons monitoring the 4 artificial snake hibernacula (winter dens), at each management field on the Hovnanian Sanctuary. This involved a person walking slowly up to a den and visually scanning the entrance pipes and a 10-meter area around the den for emerging or basking snakes. Sometimes only the head and a small portion of the snake's body was exposed. We often had to wait motionless until the entire snake crawled out in order to safely capture it. Corn and Pine Snakes were taken to HA's laboratory for processing, then released back to their original capture location.

Diurnal and Nocturnal Road Cruising

Sand roads that pass through, and paved roads which surround the border the Hovnanian Sanctuary, habitat often yield both living and road-killed reptiles, amphibians and other animals (referred to as Dead On Road or DOR). Identification of species found while "road cruising" can provide useful information on migration routes, activity patterns, and habitat utilization. The basic presence or absence of a species in a particular area can also be determined by the identification of their remains on the Hovnanian Sanctuary.

Road cruising was used passively, such as while driving to and from the site or while driving/walking to and from areas on the Hovnanian Sanctuary. Road cruising was initiated as an additional surveying technique while on the property. This method involved driving a vehicle at slow speed along sand trails and paved roads at various times of the day and/or night. Road cruising is often highly productive on warm, humid or rainy spring nights, or during other periods of high activity. Animals moving across roads, or those killed were collected and/or identified which increased our knowledge of species on the Hovnanian Sanctuary (Campbell and Christman, 1982; Karns, 1986; Zappalorti and Torocco, 2002).

Results of Pine Snake Nest Surveys

Surveys for pine snake nests were conducted visually. Typical pine snake nesting habitat consists of sandy uplands with few shrubs or tree cover and characteristic plants such as Pennsylvania sedge (*Carex pennsylvanica*) and golden heather (*Hudsonia ericoides* - Burger and Zappalorti, 1986). Pine snake nests can be located by the characteristic sand dump pile left by the female after nesting (Burger and Zappalorti, 1991). Additionally, pine snake nesting areas can be found by locating the hatchlings (or their fresh shed skins) in late August or early September when the effects of weather makes the sand dump piles difficult to find (Burger and Zappalorti, 1991; Burger and Zappalorti, 2011) (Zappalorti, personal observations). The primary goal of these surveys was to delineate critical pine snake nesting habitat. All potential pine snake nesting habitat was carefully walked by HA staff members. Surveys were conducted during the known nesting period (June 15 to July 15). We found two Pine Snake nest sites in 2024. One at Field 2 and one in a small clearing in the forest, off the main entrance road.



Figure 13. Northern Pine Snake, is a state “threatened” species.

Table 1. Reptile and Amphibian Species Captured, Observed, or Heard on the Hovnanian Sanctuary between March 15th and September 30th, 2024.

No. of Species	Common Name	Scientific Name	Comments and Field Notes
1	Eastern Box Turtle	<i>(Terrapene c. carolina)</i>	Crossing roads
2	Northern Fence Lizard	<i>(Sceloporus undulatus hyacinthinus)</i>	Basking
3	Northern Redbelly Snake	<i>(Storeria o. occipitamaculata)</i>	Under debris
4	Eastern Garter Snake	<i>(Thamnophis s. sirtalis)</i>	At den
5	Southern Ringneck Snake	<i>(Diadophis punctatus)</i>	Under debris
6	Coastal Plain Milk Snake	<i>(Lampropeltis triangulum)</i>	Under RR Ties
7	Rough Green Snake	<i>(Ophedrys aestivus)</i>	Crossing roads
8	Eastern Hognose Snake	<i>(Heterodon platirhinos)</i>	On road and nesting
9	Northern Black Racer	<i>(Coluber constrictor)</i>	At dens and on roads
10	Northern Pine Snake	<i>(Pituophis melanoleucus)</i>	At dens or nesting
11	Red Corn Snake	<i>(Pantherophis guttatus)</i>	At dens and on road
12	Northern Redback Salamander	<i>(Plethodon cinereus)</i>	Under logs
13	Fowler's Toad	<i>(Anaxyrus fowleri)</i>	On roads and Calling
14	Northern Spring Peeper	<i>(Pseudacris c. crucifer)</i>	In Vernal Pond Calling
15	Pine Barrens Treefrog	<i>(Hyla andersonii)</i>	In Vernal Pond Calling
16	Northern Gray Treefrog	<i>(Hyla versicolor)</i>	In Vernal Pond Calling
17	Southern Leopard Frog	<i>(Lithobates utricularia)</i>	In Vernal Pond Calling
18	Green Frog	<i>(Lithobates clamitans melanota)</i>	In Vernal Pond Calling
19	Bull Frog	<i>(Lithobates catesbeiana)</i>	In Vernal Pond



Figure 14. An adult Rough Green Snake that was found crawling on a sand road.

Results of Road Cruising

HA staff found both live and dead snakes (DOR) on both paved and sand roads during our 2024 investigation, including an adult male Corn Snake. This snake was a recapture that was radio-tracked back in the 2017 field season. We also found an adult male Rough Green Snake on a sand road in September 2024 on the western portion of the Sanctuary. Many other forms of wildlife were also found DOR. We found one DOR box turtle, a black racer snake and one rough green snake on Davenport Road. We also observed numerous fence lizards and Fowler's toads on both Dover and Davenport Roads. This is a good example showing that even if the target species of snakes occur on a study site they are not always easy to capture.

Results of Monitoring Pine Snake Nests

HA staff only found two Pine Snake nests in open sandy areas of the management fields (Burger and Zappalorti, 1985; 1991). Gravid females nested in open grassy areas on fields 1, 2 and 4. The "nesting area" usually has Pennsylvania sedge grass (*Carex pennsylvaticus*), and other heat tolerant grasses with soil that is easy to excavate. Dry sugar sand is too soft and causes the tunnel and nest cavity to collapse when she is digging (or once the eggs are laid). Thus there is a delicate balance between sand soft enough for the snake to dig, but hard enough to support the roof of the tunnel. The roots of various grasses and Pennsylvania sedge provide soil stability and some slight moisture for the incubating eggs (Burger and Zappalorti, 1991). The average clutch is nine eggs (Burger and Zappalorti, 1991).

Shelter or Cover Boards

HA recommends using cover boards or flat metal sheets to increase the chances of finding snakes. We typically use plywood or metal rectangle or square sheets (2 or 3-feet wide by 4-feet long), that are placed on cleared ground to create an inviting place for snakes and other reptiles to retreat under (Sutton, Mushinsky, and McCoy, 1999; Tietje and Vreeland, 1997). We plan on setting-up several new sampling stations in the central and western portions of the Hovnanian Sanctuary in order to capture snakes at new locations. The cover objects that we currently have on the management fields have yielded many rare snakes as well as recaptures, so additional sampling stations should increase our chances of finding snakes in areas where they previously have not been found.

Warren (2000) placed 61-cm (2-feet) by 61-cm (2-feet) plywood boards atop wooden legs 5-cm (2-inches) by 5-cm (2-inches) by 10-cm (4-inches). The boards were then covered with 61-cm (2-feet) of grass clippings, which due to grass fermentation and radiant heat collection, created a "snake magnet" (Warren, 2000). All the snake species surveyed in this study in Wisconsin were found by carefully lifting the cover boards and identifying them.

A Pennsylvania study of riparian zones found that although cover boards captured fewer total species than funnel traps, they did yield some species not found with other methods (Homyack and Giuliano 2000). Using cover boards in conjunction with random searching increases the number of specimens seen during a mark-recapture study, this higher sample allows an estimate of the size of a population (Catenazzi 2001). Parmelee and Fitch (1995) conducted a long-term cover board experiment which compared the use of metal versus plywood, age of cover boards (seven years old versus new), and surface preparation (vegetation under the boards versus bare ground with vegetation removed). The investigators captured 105 snakes of eight species during their experiment, as well as two lizards (*Ophisaurus attenuatus* and *Scincella lateralis*) and one turtle (*Terrapene ornata*). There was no overall significant differences between the six shelter types, however metal shelters were avoided during the heat of mid-day because of high temperatures. The plywood boards were used during the heat of day because they did not absorb as much heat and were somewhat cooler (Parmelee and Fitch 1995). Henry Fitch used an assortment of methods to find and capture snakes at the University of Kansas' Natural History Reservation between 1948 and 1997. His best results were with the use of wire funnel traps (that he made himself) and artificial shelters (both plywood and metal) which yielded the best capture results. Eighteen different snake species were captured in his long-term (50+ years) study of a Kansas snake community (Fitch 1999).

This current rare snake study is similar to other snake studies published in the literature such as Kauffeld (1957), Zappalorti et al, (1985), Burger and Zappalorti (1986, 1987, 1988, 1989, 1991 and 1992), Burger et al, (2000), Burger et al, (2007), Himes et al, (2006), Gerald, Bailey and Holmes (2006a and 2006b), and Golden et al, (2009), and this study will compliment and enhance our knowledge of these secretive snake species.

DISCUSSION

Collecting and monitoring fossorial and terrestrial snakes presents a unique set of challenges, because so much of their life is hidden. Large gaps exist in our knowledge and understanding of the behavior and ecology of these secretive species (Mattison, 1995). Sampling methods must be efficient at finding the target species while producing as little disruption in their habitat(s) as possible. A working knowledge of the life history, thermal requirements, and activity patterns of the species to be studied is essential (Davis et al., 1998). Knowledge such as the type of habitat a particular snake species selects on an hourly, daily, or seasonal basis is extremely important. Being able to predict when and how to search or trap for the target snake species may greatly enhance one's capture results (Zappalorti and Torocco, 2002). A snake crossing a sand road or basking in an open field is easy to see, and thus easily captured by the average herpetologist. However, most snakes remain hidden for 50% of their lives and therefore are difficult to find and capture. When searching for snakes, the partially concealed reptile with its cryptic coloration will only be seen by an experienced herpetologist. Therefore, a visual search image and basic understanding of the life history and behavior of the reptiles being sought is very important. HA will use all standard sampling methods to find and capture rare snakes on the Hovnanian Sanctuary.

Conclusion and Recommendations

Snakes are drawn to grassland habitat because of the abundant prey species they find there. That is why HA recommends that NJAS should consider crating some two acre grassland fields on the Hovnanian Sanctuary. Creating some field habitat would greatly benefit birds and other wildlife by increasing insect and small mammal populations. This in turn would provide an increase in prey availability for rare snakes and lizards. Local bird populations would also benefit by having a variety of habitat types to choose from on the property.

HA recommends that the management fields should be thinned of trees and vegetation during the fall and winter of 2024 and 2025. A new management field should be constructed in the western portion of the Sanctuary with a new artificial den in its center. The artificial snake dens should continue to be monitored in the fall and spring of 2024 and 2025. Many of the resident Corn and Pine Snakes now have PIT Tags in them. Recapturing these snakes will demonstrate survivorship and fidelity to winter dens. More important, it shows that the past forest management practices undertaken by NJAS has not negatively impacted the rare snake species which occur naturally on the Hovnanian Sanctuary. In other words, the wildlife in general, and snake populations in particular are thriving under the existing forest conditions. The rare snakes are finding sufficient prey animals, basking opportunities, suitable habitat and winter hibernacula on the Hovnanian Sanctuary.

Understanding the life history and ecology of fossorial and terrestrial snakes will greatly enhance scientific research. Once one knows how, when, and where to capture these secretive reptiles, better capture results should and can be achieved. By considering and perhaps combining some of the methods suggested in this report, such as: Random Opportunistic Sampling, Road Cruising, Cover Boards, Radio-tracking, and Marking with PIT Tags, one's chances are greatly increased to capture and better study these secretive reptiles.

Respectfully submitted,

Herpetological Associates, Inc.

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Northern Pine Snake (*Pituophis melanoleucus*)



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