Some Rare Reptiles and Amphibians of the New Jersey Pine Barrens

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The Corn Snake or Red Rat Snake is an Endangered Species in New Jersey

An e-Book By Robert T. Zappalorti

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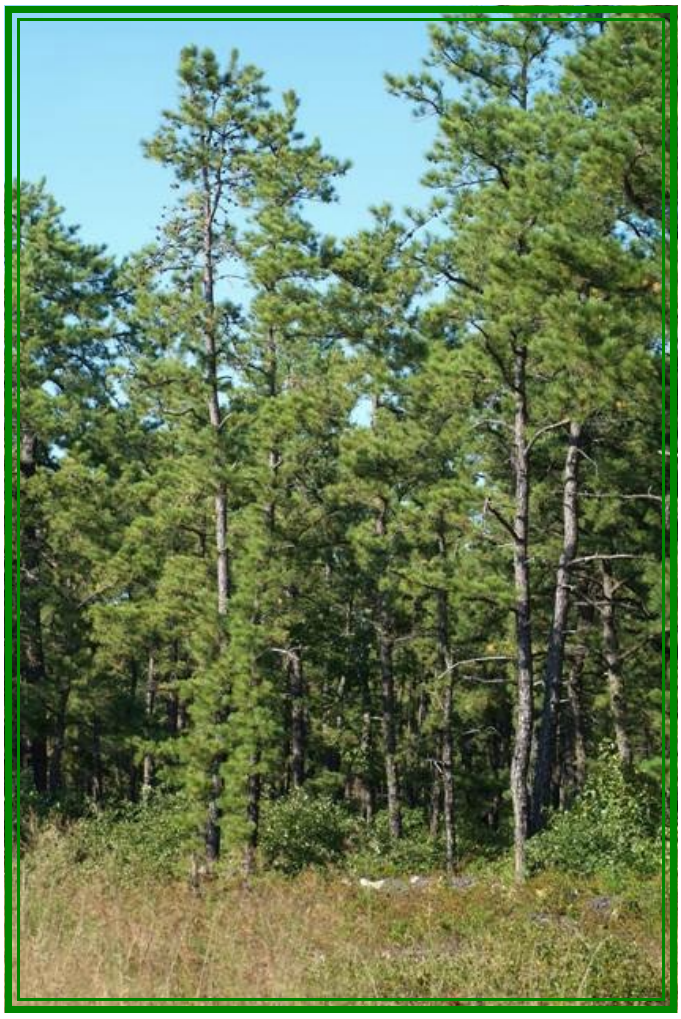
By Robert T. Zappalorti

Introduction

I recall with fondness my first trip to the New Jersey Pine Barrens, back in June of 1961. I was with my childhood friend and long time buddy, Jim Bockowski. We were looking for an old clay mining town called Crossley, in Ocean County, but could not find it. Out of desperation we stopped at a gas station in Whiting to ask for directions. We spoke with an elderly man dressed in overalls and a straw hat, and asked if he knew where Crossley was? The local man (known as a "Piney," a person who lives in the Pine Barrens), was kind enough to say, "follow me, I'm going that way. I'll show you Crossley Road." So, Jim and I followed the man in his pickup truck Eastward from Whiting. After about 1.4 miles he slowed down and pointed North towards a non-decrypt sand road, then waived good bye as he continued on his way. We turned left and followed the winding sand road through an extensive pine-oak forest. The over-story trees consisted of pitch pine, short-leaf pine, scrub oak, black-jack oak and sassafras, while the under-story was mostly huckleberry, lowbush blueberry, inkberry and bracken fern.

We came to a sandy flat section of the road and had trouble driving in soft white sand, but managed to keep going with some extra speed. After traveling about 0.75 of a mile, we came upon an opening in the forest and an abandoned railroad track that ran from East to West through the pine forest. We crossed over the tracks to the North side and could now see an open grassy field to the West. As we approached the field we could see an old shack and the concrete walls and foundations of some old buildings. This was it... the old clay mining town of Crossley. The place that Carl Kauffeld wrote about in his 1957 book, "Snakes and Snake Hunting."



The open edge of the pine forest at the Crossley Preserve.

An adult male northern fence lizards (*Sceloporus undulatus hyacinthinus*), basking on a pitch pine branch. Notice the brick colored dorsal scales and the blue and black flash colors on its ventral. Photo by the author.

We parked the car in the shade of an enormous sycamore tree, grabbed our home-made snake hooks and began our search for reptiles and amphibians in general and pine and corn snakes in particular. As we walked towards the old ruins the sweet pungent aroma of honey-suckle, sheep-laurel, mountain-laurel and pitch pine filled our nostrils, while a large red-tailed hawk gave it's territorial cry as it circled in the sky high above us. The first reptiles seen were some northern fence lizards (*Sceloporus undulatus hyacinthinus*), that were scurrying up the side of the falling-down wooden shack. Then we flipped some flat plywood and found a large black racer (*Coluber constrictor*), that coiled defensively and vibrated its tail at us before disappearing into the tall switch grass. We found a female box turtle (*Terrapene carolina*), with a sunburst orange, yellow and tan shell walking across the path. We admired its beauty for a moment and continued our search of the field, old building foundations and walls, only to find a few more northern fence lizards. We doubled back along a sand road towards the railroad tracks and started to turn discarded railroad ties in hopes of uncovering a snake. As we walked along the railroad tracks, we found a shed snake skin coming out of a hollow railroad tie. Jim picked up the skin to examine it as I looked on. Then some movement inside the hollow tie caught our attention. We could see the red and orange blotches of a snake crawling inside the tie. Using our snake hooks to force open the rotten tie, we were able to pull the snake out from its retreat. It was an adult female corn snake (*Pantherophis guttata*,) heavy with eggs. We were overjoyed that we had actually captured a corn snake on our first trip to Crossley.

A robust northern red salamander (*Pseudotriton ruber*) that was found hidden under a board. Notice the end of its tail where about two inches are discolored and regenerated. Photo by the author.

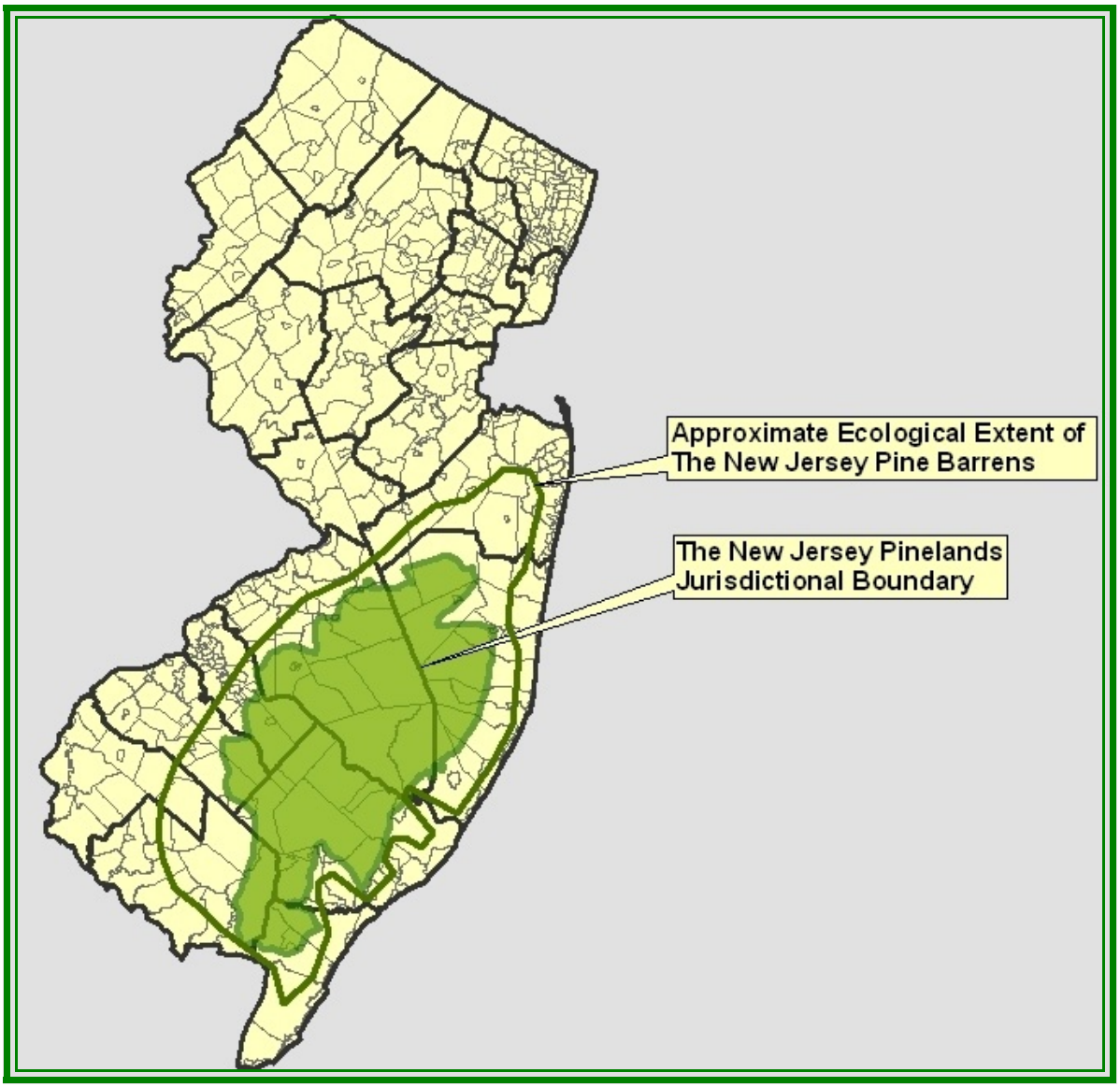
We walked East on the railroad tracks, all the way to a small bridge over a tea colored stream. A spotted turtle dropped off a fallen log laying in the stream. Along the grassy edge both green frogs and southern leopard frogs hopped into the water and disappeared in the swaying aquatic vegetation. The repeated "quonking" call of a Pine Barrens tree frog could be heard in the distance. White cedar trees grew tall and close along the edge of the stream and the floor of the swamp was covered in a bright green carpet of *Sphagnum* moss.

Wherever patches of sunlight hit the ground, carnivorous sundew and pitcher plants grew sporadically from the moss. Jimmy, turned a board laying across the path and uncovered an elegant northern red salamander (*Pseudotriton ruber*). About an inch of the end of its tail was discolored because it had regenerated. Salamanders have the amazing ability to regrow lost digits, limbs or their tail when attacked by a predator.

We made our way back up onto the railroad tracks walking eastward while turning dozens of ties. After two hours of searching the railroad tracks and the surrounding forest edge we only found another shed skin, but no more snakes. The heat of the afternoon sun was stifling, so we returned to the car to get a cold drink. As we stood by the edge of the grassy field drinking we saw that same red-tailed hawk swoop down and land in the tall grass about 75-feet in front of us. As the hawk landed, hissing and thrashing sounds irrupted. Curious to see what the bird had attacked, we walked towards the hawk's location. As we approached, we flushed the hawk up into flight. To our dismay, it had a dead three-foot pine snake (*Pituophis melanoleucus*), clutched in its talons as it flew away from us. The hawk disappeared over the top of the pine trees into the forest to eat its meal.

Jim and I were annoyed that the hawk had captured the pine snake and not us. Nevertheless, we had the opportunity to witness a predation event in the wild, which is something that is not often seen. I remember that trip as if it were yesterday, not only because of the wildlife we observed that day, but because of the peace and serenity of the pitch pine forest, white cedar swamps and *Sphagnum* bogs instilled upon me. I became fascinated with the unique array of plants and wildlife that occurs in the "Barrens," and my interest in the area has not diminished in the 50-years since. In fact, I purchased my home in the Pine Barrens (Ocean County), in 1986 where I still live today. I summarize here some of my many years of reptile and amphibian observations in this region.

A gravid female northern pine snake (*Pituophis melanoleucus*), basking under a blackberry bush. Photo by the author.



The location of the Pine Barrens in the coastal plain of New Jersey. Source: Matt McCort, Herpetological Associates, Inc.

Where is the Pine Barrens? Located halfway between such populated areas as New York and Philadelphia, the Pine Barrens of New Jersey encompasses approximately one million acres (445,164 hectares). Even though New Jersey has the highest human population density (436 individuals per km^2) in the United States, most of the Pine Barrens has remained a wilderness area that supports many rare forms of plants and wildlife (see location map). Commercial and residential development was a constant threat to the Pinelands back in the 1960 and 1970 eras with a high rate of sprawl.

A typical pitch pine dominated forest with switch grass and Pennsylvania sedge grass growing on the forest floor. These open grassy areas support many small mammals and birds. Photo by the author.

Plant and wildlife habitat loss was reduced and controlled by the creation of the New Jersey Pinelands Commission (NJPC) which now strictly regulates development through legal measures by its Comprehensive Management Plan in cooperation with local, state and federal governments (NJPC 1979, 1980). The Pinelands is the first U.S. National Reserve and a U.S. Biosphere Reserve of the United Nations Educational, Scientific and Cultural Organization.

A biosphere reserve is a unique kind of protected area that differs from a national park, wilderness area, national forest, or wildlife refuge in having three different, yet equal goals. These are: 1). The conservation of genetic resources, species and ecosystems, 2). Scientific research and monitoring, 3). Promoting sustainable development in communities of the surrounding region. All three of these objectives are equally important in a United Nations Biosphere Reserve. National parks and other kinds of protected natural areas usually are primarily concerned with conservation, and only secondarily with research and sustainable development.

Another impressive statistic is that the Pine Barrens ecological region occupies 22% of New Jersey's total land area with 700,000 persons living and working in Pinelands communities. Wilderness, rural farmland and residential urban gradients occur throughout the Pinelands landscape which offer opportunities to observe snakes and other wildlife use in these areas.

The Pine Barrens encompasses several southern New Jersey counties which include portions of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, Ocean and Salem Counties. There are 8 listed species of reptiles and amphibians which are legally protected by the New Jersey Department of Environmental Protection, Division of Fish and Wildlife. These are: Timber Rattlesnake (*Crotalus horridus*) - State Endangered, Corn Snake (*Pantherophis guttata*) - State Endangered, Northern Pine Snake (*Pituophis melanoleucus*) - State Threatened, Bog Turtle (*Glyptemys muhlenbergii*) - State Endangered and Federally Threatened, Wood Turtle (*Glyptemys insculpta*) - State Threatened, Tiger Salamander (*Ambystoma tigrinum*) - State Endangered, Cope's or Southern Gray Treefrog (*Hyla chrysoscelis*) - State Endangered, Pine Barrens Treefrog (*Hyla andersonii*) - State Threatened.

There are also several reptiles and amphibians that are listed as "Species of Special Concern," of which some are highlighted below. One needs a *Scientific Collecting Permit* to capture and/or handle specimens. Photography of specimens without handling or harassment is allowed, but it is illegal to collect and remove herptiles from the wild without a permit. A scientific collecting permit may be obtained if one has justification for obtaining it by contacting the New Jersey Division of Fish and Wildlife permit office at 908-735-5450, Monday - Friday 8:30 a.m. to 4:00 p.m. or E-mail them at ExoticPermits@dep.state.nj.

A female Marbled Salamander with her eggs.

Methods for Finding Reptiles and Amphibians

In his 1957 book *Snakes and Snake Hunting*, the late Carl F. Kauffeld stated: "the Pine Barrens does not yield it's snakes easily." Anyone who has tried to consistently find snakes in the Pinelands knows how true Kauffeld's statement was. Finding and monitoring fossorial reptiles presents a unique set of challenges. Because snakes are secretive and spend much of their life hidden, large gaps exist in our knowledge and understanding of their behavior and ecology. Sampling methods must be efficient at finding the target species while causing little disruption to their habitat. A knowledge of the life history, thermal requirements and activity patterns of the herp species to be studied is essential. Knowledge such as the type of habitat a particular reptile species selects on an hourly, daily, or seasonal basis is important information for a herpetologist.

Being able to predict when to search for and find a target species may greatly enhance one's observational and photographical results. Complications affecting capture success include: weather conditions (e.g., temperature and humidity), avoidance behavior by the target species, daily and seasonal activity patterns, and the experience and skill of the person(s) in the field. Unsuitable weather conditions may lead to decreased terrestrial behavior, markedly reduced activity, shifts in habitat type used and/or estivation. I found that repeated random sampling efforts or drift fence trapping programs in suitable habitat over a full activity season resulted in the most accurate species composition and abundance estimates. Random Opportunistic Sampling can be employed while performing other sampling techniques on a study site. This involves searching various areas that have potential habitat for a species of interest. Locations on-site which do not fall into any specific habitat classification (e.g., disturbed areas, discarded lumber or sheet metal, car hoods and doors, etc.) may generate previously undiscovered species that would not have been found. All reptiles and amphibians encountered are recorded to supplement the species list generated by other field methods. This method is effective if there are no time constraints on the survey and the survey area is visited often. Qualitative impressions can be developed as to the relative abundance and habitat use of certain species.

Discarded metal or plywood on the forest floor are good places to look for snakes and other wildlife. Photo by the author.

Forest edge or ecotone grassland habitat provides basking and foraging opportunities for many kinds of reptiles and amphibians. Open grassy, sandy fields are often selected by gravid female pine snakes as nesting areas. Photo by the author.

Road cruising can be used passively, such as while driving to and from a site. This method involves driving a vehicle at slow speed or walking along paved roads or sand trails at various times of the day or night. Road cruising is often highly productive on warm, humid or rainy spring nights, or during other high activity times of the year (depending on the species). Animals moving across roads can be easily identified and/or captured. In addition, roads which border potential habitat often yield dead reptiles or amphibians or other animals, killed as they attempt to cross. These "road-killed" animals can be identified and provide useful information on migration routes, activity patterns, and habitat utilization/partitioning. The basic presence or absence of a species in a particular area can also be determined by the identification of their remains.

The suitability of an area for one or more of the target snake species can be determined by evaluating existing habitat structure. Components that should be considered are: forest type, vegetative types, hydrological conditions, elevation topography, soil type, and surrounding terrestrial habitat are most commonly used to evaluate upland forest as potential habitat for timber rattlesnakes, corn snakes, and/or pine snakes. Typical vegetation in un-developed forest is mainly large pitch pine trees along with various oak species such as scarlet, chestnut, post, white, scrub, and the abundant black-jack oak.

Vegetation along wetland corridors or flood plains consists of large red maple, sour gum, sweet gum, gray birch, holly and pitch pine. Dangleberry often occurs with a dense thicket of common greenbrier, bearberry and teaberry. Interspersed between pine-oak forest, oak-pine forest, or old field habitat is often a dense area of low bush blueberry, huckleberry and greenbrier. Over story trees that form the canopy are mostly oaks and pines, but the edges of the forest, or old fields are often dominated solely by grasses such as Pennsylvania sedge, broom sedge, or switch grass.

Marking Techniques and Data Collection on Snakes

Electronically-read, glass-encapsulated AVID Identification tags are used to mark all state-listed snakes along with several other species. Each tag has a unique 9-digit number, allowing quick, easy, accurate identification of any injected snake. The AVID ID tags are small, measuring 14 mm x 2.1 mm (.55 in. x .08 in.) and weighing 0.08 grams (0.0028 oz.), which allows their use even in large neonate snakes (such as pine snakes and timber rattlesnakes). The ID tags are hermetically sealed in biocompatible glass and have an anti-migratory coating of parylene, enabling them to be injected subcutaneously using a 3/4 inch 12 gauge needle. The power requirements of the tags are passive, meaning that they are activated by the electromagnetic field of the portable AVID reader.

Body measurements are taken upon the initial capture or subsequent recapture of any state-listed species using a squeeze box and cartometer or manipulation along a meter stick. Weight is determined using an Ohaus triple beam balance scale. Sex is determined by probing, counting subcaudal scales, or by noting sexually dimorphic characteristics. The reproductive condition of adult female snakes can be assessed visually or by palpation of the posterior ventral region of the body for bulging eggs.

A portrait of a female Spotted Turtle. Photo by the author.

Species Studied and Natural History Accounts

Timber Rattlesnake - In New Jersey there are two geographically separated populations of the *Crotalus horridus*. The typical Appalachian form occurs in the northern portion of the state, mainly along the Kittatiny Mountain ridge, whereas the isolated Atlantic Coastal Plain rattlesnake population is restricted to portions of Atlantic, Burlington, Camden, Cumberland and Ocean Counties in the Pine Barrens. The focus of this account is on southern New Jersey populations. Because of habitat loss and past human persecution and wanton killing, many timber rattlesnake populations have been extirpated in the Pinelands and throughout the state. Its scientific name *horridus* refers to its rough body scales and not to a horrible or aggressive disposition as some poorly informed people may think. Some Pinelands residents are quite surprised to learn that rattlesnakes actually occur in southern New Jersey. Although rattlesnakes are venomous, they are not aggressive towards humans. Instead, they are shy and secretive and attempt to avoid humans. The venom is used to subdue and kill their prey which consists of warm-blooded birds, rodents and other small mammals. Timber rattlesnakes do not attack or chase people, or their pets. Although bites are rare, most people who are bitten are trying to kill or catch rattlesnakes. In New Jersey, there are no recent records of a human death from the bite of a rattlesnake.

An adult male Timber Rattlesnake in ambush posture. They are sit-and-wait predators and position themselves where rodents will pass. Mice and chipmunks run along the top of fallen logs. Photo by the author.

The hibernation strategy of *C. horridus* in the Pine Barrens creates an exception to the more typical habitat requirements associated the Appalachian mountain timber rattlesnakes. Den sites in the Barrens are generally along major or secondary tributary streams with Atlantic white cedar trees along its edges. The water must be clean and moderately-flowing. The stream is usually surrounded by large tracts of undeveloped forest with few or no roads through it. Unlike Appalachian timbers, Pine Barrens rattlesnakes use shallow underground rodent burrows and natural spaces under the root-systems of Atlantic white cedar, sour gum and red maple trees along stream edges for winter refuge.

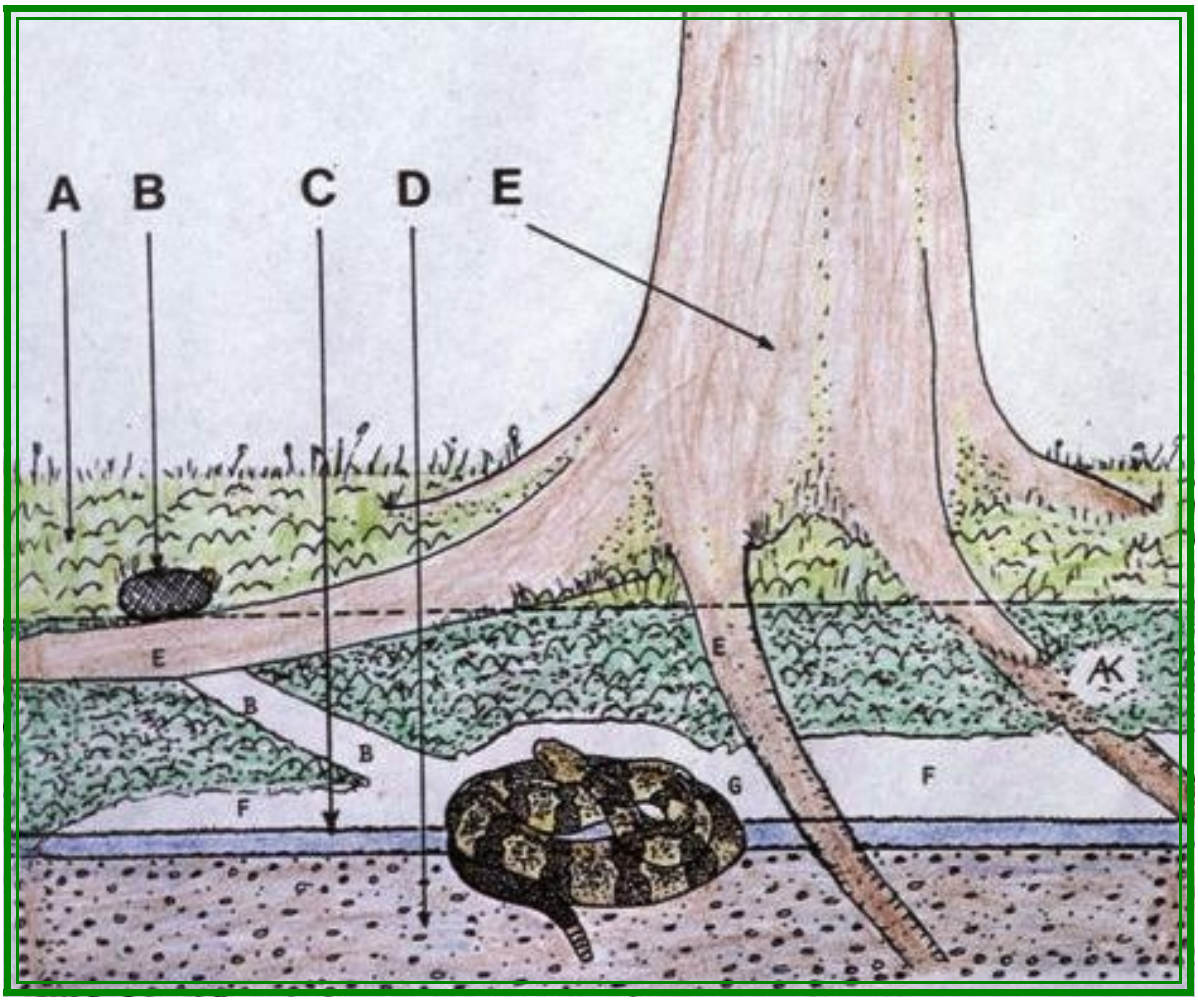
Stream edges and White Cedar swamps are where Timber Rattlesnake and Eastern King Snakes hibernate in the Pine Barrens. The moving water and insulation from roots and moss prevents them from freezing. Photo by the author.

The ground surface is often covered with a thick carpet of green and red *Sphagnum* moss, in densely vegetated white cedar or hardwood stands. The photo below shows a timber rattlesnake entering its winter hibernaculum under a large red maple tree and the drawing illustrates what the underground tunnel looks like based upon personal observations. Gravid female timber rattlesnakes select canopy-free openings that are created by a forest fire, or a human-made edge (an ecotone area), such as a sand road, railroad bed, or transmission line right-of-way, they will remain in these areas until parturition. Natural forest openings are lacking in the Pine Barrens, and thus gravid females often use the edges of sand roads as basking sites. Rookeries are usually 0.3 to 1.0 mile from a winter denning stream. Their summer home-range or primary habitat for *C. horridus* focuses within a 1.5 to 2.5 mile radius around the den stream. One radio-tracked male had an activity range-length of 7,027 feet (2,142 meters), and a summer home-range of 305.6-acres (123.46 hectares). More recently, between July 31 and September 24, 2010, a large male radio-tracked timber moved 7.1 miles from its summer foraging habitat to its winter den (no paved roads were crossed on its journey). This large movement included the August mating season when males are more active.

A radio-tracked adult male Timber Rattlesnake entering its winter hibernaculum under a large Red Maple tree along the edge of a Pine Barrens stream. The underground root systems of White Cedar and Black Gum trees are also used by the Rattlesnakes as entrances to get below the frost line. Photo by the author.

Timber rattlesnake's typical habitat is pine-oak upland forest which is dominated by pitch pine and mixed with various oaks (post, scarlet, blackjack, scrub, white and chestnut oaks). These upland forests often have intermittent stream corridors, *Sphagnum* bogs, or grassy savannahs interspersed within them. Pitch-pine lowland forest surrounding the overwintering stream or in adjacent wetlands is also used. The vegetation in these transition areas between upland and wetland is dominated by pitch pine and red maple, with an understory of highbush blueberry, dangleberry, sheep laurel, sweet pepperbush, and other shrubs. Much of the Pine Barrens contains relatively uniform pine-oak forest habitat, thus suitable brooding or rookery areas occur in low frequency.

Areas that provide appropriate basking conditions for gravid snakes are often human-made, which include old farm fields, clearings around infrequently used hunting cabins, abandoned buildings, and the edges of sand roads. The "edge effect" created by sand roads which pass through the Pine Barrens offers an ideal basking site for gravid females or other snakes that are migrating to and from their summer foraging grounds.



A diagrammatic cross-section of a Timber Rattlesnake hibernaculum based upon personal observations of the author. A = Sphagnum and humus surface layer. B = Entrance to the den. C = Underground water level from nearby stream. D = Sand and gravel hardpan substrate. E = Red Maple Tree. F = Hibernation Chamber. G = Timber Rattlesnake resting in water. Drawing by Alec Knight and Howard Reinert.

Depending upon climate and the location of a population in eastern United States, female timber rattlesnakes take from 9 to 11 years to reach sexual maturity. They bear young only every 2 , 3, or 4 years and may only breed 3 to 5 times in their lifetimes. Gravid females have a tendency to remain in open, sunny areas with few or no trees, which helps them thermoregulate, usually in the vicinity of the brooding site (rookery). The edge or ecotone caused by old fields and sand roads which pass through the Pine Barrens offers ideal basking sites for gravid females, or other snakes that are migrating to and from their summer foraging habitat. Gravid female snakes are particularly prone to lie at the edge of forest openings, including sand roads, in order to incubate their young with the aid of the sun's warmth. This habit makes the snakes highly vulnerable to accidental or intentional killing by motorists.

A gravid female Timber Rattlesnake basking on the side of a sand road. This behavior makes them vulnerable to wanton killing by poorly informed people. Photo by the author.

Since *C. horridus* gives birth every 2 - 3 years, non-gravid females use different migratory routes and habitat types than in years when they are gravid. Additionally, their summer activity range in years they are not gravid, may be much greater, due to the need to forage. Radio-tracking studies I conducted with Dr. Howard Reinert showed that gravid females were relatively sedentary using only 15 to 25-acres during the summer, whereas non-gravid females moved farther and used between 75 to 150-acres. Comparison of the movements of gravid versus non-gravid females exhibited a significantly shorter activity-range for gravid rattlesnakes.

Timber rattlesnakes are viviparous (the young are maintained in the mother's ovary and are nourished by an exchange of materials from the placenta). Adult female timber rattlesnakes give birth in late summer or early fall. The average litter size is 9 snakes each about 12-inches long and slim at birth. The mother timber rattlesnake selects a protected place such as a hollow log or stump, or beneath an old railroad tie, or an abandoned fox burrow, or even along the edge of a right-of-way or sand road deep in the forest. The gestation period for timber rattlesnakes takes two years. Individual baby rattlesnakes are formed in an embryonic sac or membrane (the remnant of an egg shell) within the female's body. The young are individually born live and cut through the sac with an egg-tooth on their snout.

A gravid female Timber Rattlesnake giving birth to a neonate still wrapped in the embryonic sac. The average litter size is 9 snakes for Pine Barrens Timbers. One large female gave birth to 16 neonates. Photo by Zig Leszczynski.

They are miniature replicas of the adults, but lack the full rattle. Instead they only have the first segment or the button. Each time they shed their skin, they add another segment to their rattle. They shed once or twice before entering hibernation. Neonate rattlesnakes remain with their mother until their first shedding. After a few days, they begin to wander further away from the mother, but remain in her vicinity.

The mother will begin hunting for food to regain her strength for the long winter ahead, since she loses 50% of her body weight giving birth. Once the babies leave the seclusion of the rookery they follow the mother while she's foraging for white-footed mice, voles, or other small birds or mammals. Baby rattlesnakes have many predators and must remain hidden if they are to survive. When they cross an opening in the forest, a circling red-tailed hawk can swoop down and quickly snatch one in its talons, or a large king snake can constrict and eat them in a few minutes.

Neonate rattlers find suitable over wintering sites (dens) by following scent-trails of their mother, or any other adult rattlesnakes in the population. They enter borrows dug by red squirrels along the edge of a moving stream in a cedar swamp. They crawl down into the burrow and sit partially submerged in the moving water. Their heads are above the moving water whose constant temperature prevents them from freezing throughout the long winter.

The following spring, the baby snakes emerge from their hibernaculum beside the stream. They are on their own and venture into the forested upland where they will spend the summer and fall foraging and growing. They grow about 8 to 10 inches a year and reach sexual maturity in 9 or 10 years. During this time they learn about their habitat and where to find prey. They learn migration routes by following cent-trails, set down by the adult rattlesnakes who moved through the forest over generations before them. They use all the suitable Pinelands habitat that is available to them and have been know to travel 3 to 7-miles from their den during the course of their summer active season.

A juvenile Timber Rattlesnake eating a White-footed Mouse it had just killed with its venomous bite. Photo by the author.

Red Rat or Corn Snake

Corn snakes are listed as an endangered species in New Jersey. Their distribution is sporadic and population centers or colonies are widely separated in some areas of the Barrens. There are only three major populations of corn snakes know from southern New Jersey. These are located in Burlington, Cumberland and Ocean Counties.

There is one historic record of a corn snake, with a voucher specimen, from Hammonton in Atlantic County, that was found in 1938. The identification was verified by the late Carl F. Kauffeld. The specimen is now stored at the American Museum of Natural History (Don Johnson and Hyde, AMNH specimen number R-28947). No other records of corn snakes exist from Atlantic County and none have been found by intensive field surveys by Herpetological Associates over a 10 year period between 1995 to 2005.

An adult male Red Rat Snake draped over the top of a pine stump. These snakes are quite variable in coloration and blotch pattern and some have lots of red while other are more drab in coloration. Photo by the author.

In New Jersey, the corn snake inhabits upland pine/oak forests dominated by pitch pine, shortleaf pine, Virginia pine, scrub oak, blackjack oak, chestnut oak, white oak, post oak, greenbrier, lowbush blueberry, highbush blueberry, turkey beard grass, bracken fern, golden heather, Pine Barrens sandwort and Pennsylvania sedge grass to name the more dominant plant species.

An adult male corn snake basking in oak leaves under a pitch pine tree. This fossorial species spends much of its time under leaf litter, in vole or mole tunnels, or in hollow logs on the forest floor. Photo by the author.

Corn snakes may hibernate in communal dens with pine snakes and black racers, or singly in stump hole dens. They appear to have less fidelity to a particular hibernaculum than pine snakes. Emergence from hibernation occurs in late March or early April. Mating occurs in late April and throughout May. Eggs are laid approximately three weeks to one month after copulation, generally in late June or early July.

Nesting sites are usually located along the forest edge, in an area that receives maximum exposure from the sun. By monitoring gravid female corn snakes with radio-telemetry, I have documented them nesting in mole tunnels, old pine stump holes, under hollow railroad ties or in decaying standing trees or in fallen logs. The young hatch approximately two months later, and are typically lighter in color than the adults. Hatchling corn snakes are shy and secretive and not often seen. I have found them under loose bark of pine trees, under discarded plywood or on rare occasions, just crawling on the forest floor.

Although red rat snakes will hiss, strike and bite when first captured, they will eventually calm down after gentile handling. This is a non-venomous constrictor, feeding primarily on warm-blooded prey including mice, voles, masked shrews, young moles, rats, bird eggs and birds. I once found an adult male corn snake eating quail eggs. Palpation revealed six eggs in its stomach. Juvenile corn snakes also eat frogs, skinks and fence lizards.

A hatchling Red Rat Snake found crawling next to a fallen pine log and stump hole. Fence Lizards, Ground Skinks and Masked Shrews are in the diet of young Corn Snakes. Photo by the author.

A hatchling Corn Snake from Ocean County, New Jersey. This specimen was found in May 2011, not far from Crossley. Photo by the author.

Natural predators include many mammals (*e.g.*, coyote, fox, skunk, weasel, raccoon, opossum and shrews), hawks, owls, and other snakes (primarily eastern king snake and black racer) in New Jersey. Defense is largely restricted to tail vibration, hissing and rapid striking. Despite being very common in some areas of their range (e.g., South Carolina, Georgia and Florida), very little is known of their ecology, seasonal movements, home range size and secretive behavior.

Based upon Herpetological Associates' limited radio-tracking data for adult corn snakes (N = 9), the mean activity range is 43.91-acres (15.77-hectares). The range of the nine free-roaming snakes was between16.86-acres for an adult female to 145.96-acres for an adult male corn snake. Home ranges were calculated using the Convex Polygon Method.

Northern Pine Snake

P. melanoleucus is a large, powerful constrictor reaching a length of 48-66 inches (maximum length of 83 inches). The pattern is variable, but generally consists of 20 to 30 large black or brown blotches leading down the back on a white ground color. The blotches tend to be darker and less defined near the head. The ventral scales may be immaculate white, flecked with varying quantities of black, or patterned with differing amounts of orange or pink; combinations of black and pink are also encountered. Scales are strongly keeled and the anal plate is single. There are 4 prefrontal scales and a pointed rostral scale on the snout for digging. The snake is often gentle, although it may give a loud hiss when startled. They may occasionally bite when first handled.

An adult male Northern Pine Snake basking as it was found about four feet from its den entrance. Photo by the author.

The range in New Jersey is spotty, with isolated populations restricted to the Pine Barrens; the next nearest historic populations occur in Maryland and north-central Virginia. Other populations are found in eastern North Carolina, South Carolina, Georgia; and west to northern Alabama, western Tennessee and Kentucky. The distribution is spotty over much of their range in eastern United States. The Black Pine Snake is found in portions of Mississippi and Alabama and the Florida Pine Snake occurs throughout most of the state.

These large, powerful constrictors are confined to the Pine Barrens. A true lover of the dry uplands, pine snakes inhabit the pitch pine and oak forest areas, or sometimes forage along the edges of creeks, streams and cedar swamps that are also found in this unique ecosystem. In mid April, pine snakes begin emerging from hibernation. Pine snakes den communally, not only with conspecifics, but with other species of snakes such as coastal plain milk snake, black racer, hognose snake and corn snake. Dens are dug at the bases of old decaying stumps or in abandoned mammal burrows. The snakes follow the paths of rotted tap roots down to a safe, frost-free depth (at least three feet), where they create hibernation chambers. In the spring the snakes remain around the den for a short period, until air temperatures begin to remain consistently above the soil temperature.

A pair of adult Northern Pine Snakes that were radio-tracked, in the process of mating. The male bites the female on the neck (just behind her head), while he copulates with her. This photo was taken under natural conditions by HA Staff member Dave Burkett in souther Ocean County.

Mating may occur during this time or throughout the month of May. Later in the spring and even into early summer, males may actively seek out females that are still giving off pheromone trails and will attempt to mate with them. In mid June and early July, gravid female pine snakes find open sunny areas where they proceed to dig meter-long horizontal tunnels ending in a chamber. The female lays from 3 to 15 eggs in the nest chamber, but 8 is the average clutch. After resting, the female leaves her nest and crawls off into the forest in search of prey.

Pine snake eggs are similar in size to chicken eggs though they are somewhat more elongated and soft-shelled, as are most reptile eggs. The eggs hatch in about 2 months and reveal 14- to 20-inch-long vibrantly patterned replicas of the parents. These neonates quickly begin foraging for small warm blooded prey. During early fall, pine snakes follow scent trails back to their original hibernation sites. New born of the year also follow these trails and will hibernate with the adults at the dens. Cold weather in mid October or early November will promote the descent of the snakes into the hibernation chambers, where they will remain all winter until the spring thaw.

Close-up of copulating Pine Snakes. Photo by Dave Burkett, HA Staff.

A gravid female Pine Snake searching for her annual nest site. Photo by the author.

In conjunction with Dr. Joanna Burger from Rutgers University, we have pioneered original research on nesting behavior, nest site selection and hibernation strategies of pine snakes in the New Jersey Pine Barrens. Observations on the nesting behavior of pine snakes were made quite accidentally by me and my friend, Zig Leszczynski as is often the case in science, beginning in 1977. At that time, pine snakes were occasionally found partially exposed on the ground, with the anterior portion of the snakes' body concealed in a tunnel. Early assumptions attributed these observations to feeding behavior, with the snake attempting to obtain small, burrowing mammals. However, as more snakes were captured and detailed observations made, it was noticed that all of the snakes burrowing into these "rodent burrows" were gravid females. It was also discovered that the snakes would be seen only during a three-week period and always at the same time of the year (~ June 20 through about July 4). These early observations led to intensive research, which eventually unlocked the mystery of pine snake nesting behavior and nest site selection.

A gravid female Pine Snake excavating her nest tunnel in an open grassy field. Photo by the author.

Pine snake eggs require warm conditions provided by the heat of the sun in order to incubate successfully. The adult female pine snake finds these conditions by selecting open, sunny locations in the forest and then digs a tunnel and nest-chamber. Similar to other members of the genus *Pituophis*, northern pine snakes are well-equipped for this task, possessing a large, pointed, shield-like rostral scale on the tip of the snout. In order to loosen the often compacted sand, the snake uses its powerful neck muscles to dig its head into the earth. It then turns its head to one side and draws backward, forming a "primitive scoop" with its neck to excavate the loosened sand. A completed nest opening has a large dump-pile that is formed by the dragging actions of the female pine snake and is quite characteristic and noticeable by the trained observer.

A typical Pine Snake dump pile and sand-fan with the entrance hole in the center. Notice the fresh tracks made by the gravid female while she was digging. Until the tunnel is long enough to accommodate the full body of the snake, they seek shelter under nearby vegetation to avoid the hot sun and predators. Photo by the author.

A female Pine Snake laying eggs in her nest chamber. Photo by the author.

A female Pine Snake resting in her nest chamber while laying eggs. Photo by the author.

The average pine snake tunnel and nesting chamber is about one meter (3-feet) in length, but some were measured as long as 7-feet. Many of the nest tunnels curve to either the left or right. Often, it is speculated that the curve are the result of the snake encountering an obstacle such as a root or some hardpan gravel which they must dig around. They seek the softest sand to dig their tunnel. If not successful, she may abandon the tunnel (known as a test hole), and start another tunnel nearby. The average depth of the nesting chamber from the surface is four to five inches, although some have been found almost a foot or more deep. Another curious feature is that all the tunnels make a downward dip six to twelve inches from the entrance. This low spot may act as a catch basin for water, preventing the nesting chamber from becoming flooded in times of heavy rain.

Through mark-recapture studies, HA has discovered that a large percentage of female pine snakes return to the same general area to dig their nests. On several occasions, freshly laid eggs and the empty shells of eggs that hatched in previous years were found in the same burrow. In addition, up to five clutches of pine snake eggs were found in the same burrow. Females nesting later were found to dig their own chambers off of the main tunnel. The risk of communal nesting is if a fox or coyote finds the nest, all the eggs will be predated. I have personally seen this happen on three occasions.

This is a wild albino female Pine Snake caught by the author on August 13, 1986, in Ocean County, New Jersey. The snake lived in captivity until July of 1999, when it died of old age. It is now in the preserve collection at Dr. Joanna Burger's laboratory at Rutgers University. Photo by the author.

This behavior may be attributed to decreasing the risk of predation by reducing the amount of time later nesting females spend exposed on the open surface. A second hypothesis for communal nesting is that siblings may nest together, and possibly with their mother. This second hypothesis is supported by the observation that individually marked hatchling female pine snakes imprint on the nesting area from which they hatched, returning to this nesting area after reaching sexual maturity and preparing to lay their own eggs.

Adult females have been shown to return year after year to the same nesting area, and often to the exact location where eggs were laid in previous years; fidelity to particular sites have been shown to last as long as 14 years. Although unknown at the present time, olfactory cues left by the old egg shells or the snakes themselves, chemical cues in the soil, magnetic orientation, visual orientation, or some combination of these may aid the snakes in finding original nest sites over long periods. While strong nesting fidelity has been observed with many of the marked snakes, there is of course some deviation, and this is necessary if the snakes are to expand their range and use all of the available habitat.

An adult male Pine Snake basking in the morning sun. Pine Snakes are diurnal and are never active after dark. They forage and move about within their home range during the day. Photo by the author.

The abandonment of long-term or parental nesting areas may be attributed to a loss of orientation, disturbance of the original nest site, natural succession of vegetation leading to excessive shading of the nesting area, or simple natural pioneering by some females.

Preliminary one or two season radio-tracking studies of 21 adult pine snakes from Ocean and Cumberland Counties (8 males and 13 females), revealed a mean activity home range of 125.5-acres. These were only short-term studies with limited funding.

Whereas a current seven-year radio-tracking study funded by the *Walters Development Group,* of 16 adult pine snakes (6 males and 10 females), has shown much larger home range sizes. Of the 16 snakes, only three individuals had an activity range less than 90-acres, three had home ranges between 201.5 to 299.6-acres, four of the snakes had home ranges between 302.2 and 350.1-acres, another four snakes had home ranges between 473.4 to 684.2-acres, and two male pine snakes had home ranges that were 1104.9-acres and 114.8-acres in size. This demonstrates the need for long-term studies in order to fully understand the movement patters, habitat use and activity range size of large terrestrial snakes. Home ranges were calculated using the Convex Polygon Method. Northern pine snakes are a fascinating species with many unique behaviors and is one of the few North American snakes that excavates its own nesting burrow.

A female Northern Scarlet Snake from Cumberland County, New Jersey. Notice the pointed snout. Photo by the author.

Northern Scarlet Snake

The northern scarlet snake (*Cemophora coccinea copei*), typically obtains a length of 36-51 cm (14-20 inches), with the record size being 32.5 inches (82.8 cm). The dorsal and tail coloration consists of a series of bright red blotches, bordered by black, specifically, on the anterior and posterior edges. The ground coloration between the blotches may vary from white to yellow. The snout is pointed and red. The ventral surface is patternless and may be cream or white in coloration.

This snake ranges from Maryland to the Florida Keys, west into Louisiana and East Texas. Disjunct populations occur in Missouri and in the Pine Barrens of New Jersey. In New Jersey, scarlet snakes are historically known from Atlantic, Burlington, Camden, Cumberland, and Gloucester Counties. There are no NJDEP confirmed HERP Atlas records or museum voucher specimens from Cape May, Monmouth, Ocean, or Salem Counties. The NJDEP has placed the scarlet snake in the "Species of Special Concern" category.

Scarlet snakes are oviparous (egg laying) and the young average 61/2" - 71/4" (168-183 mm) when they hatch from the egg. I have never found a clutch of scarlet snake eggs in the wild, but have had a gravid female lay eggs in the laboratory of which all four eggs hatched in 7 weeks. This fossorial snake species is extremely secretive and rarely seen. They are found in areas with loose sandy soil, in which the snake uses its pointed snout to burrow or "sand swim." Most of the scarlet snakes I found were under logs or railroad ties. In Cumberland County, New Jersey I found one adult male specimen crawling on a railroad track at 11:00 PM at night.

They also dig in the soil and search for its favorite food, reptile eggs. This includes the eggs of turtles, lizards, and snakes. When a clutch of eggs are found, the scarlet snake grabs an egg by its mouth and begins to chew. They possess enlarged posterior teeth which they use to slit the flexible shells of the eggs. Then they place a body coil over or around the egg and apply pressure.

The scarlet snake uses a vigorous side to side chewing motion that will eventually pierce the shell of the egg. It then punctures the shell with its pointed snout, thus squeezing out and drinking the contents. A hungry scarlet snake can devour an entire clutch of reptile eggs. I once found a shed skin of a scarlet snake near the entrance of a pine snake nest. After excavating the burrow, the scarlet snake was found under the clutch of pine snake eggs, with its head inside an egg drinking the contents.

This Scarlet Snake was found concealed under a railroad tie. Photo by the author.

Southern Ring-neck Snakes are a common species in the Pine Barrens. Photo by the author.

Rare Treefrogs of the Pine Barrens

Gray Treefrog Complex

A Northern Gray Treefrog resting on an oak leaf. Morphologically, they look just like the Cope's Gray Treefrog. Photo by the author.

Both species of gray treefrogs can be described together due to the extreme similarity of external characteristics. These frogs have warty skin and prominent adhesive pads on the tips of their fingers and toes. Their dorsal color varies from green lo light greenish-gray, all gray, brown, or dark brown. Except for very light individuals, a few large, irregular dark blotches are usually present on the back. A large white spot is always present below each eye. The belly is white. The inside of the hind legs is yellow or orange-yellow. Although both species of gray treefrogs found in New Jersey are morphologically identical, the Cope's gray treefrog *(Hyla chrysoscelis)* has a tendency to be slightly smaller in size and is more often green in color than the eastern gray treefrog (*Hyla versicolor*). During the breeding season, females usually appear more heavy bodied, while males leave dark throats. Adult gray treefrogs range in snout vent length from 32 to 51 mm (1 and 1/14 to 2 inches). According to Roger Conant and Joe Collins (1994), the largest specimen recorded is 60 mm (2 and 3/8 inches).

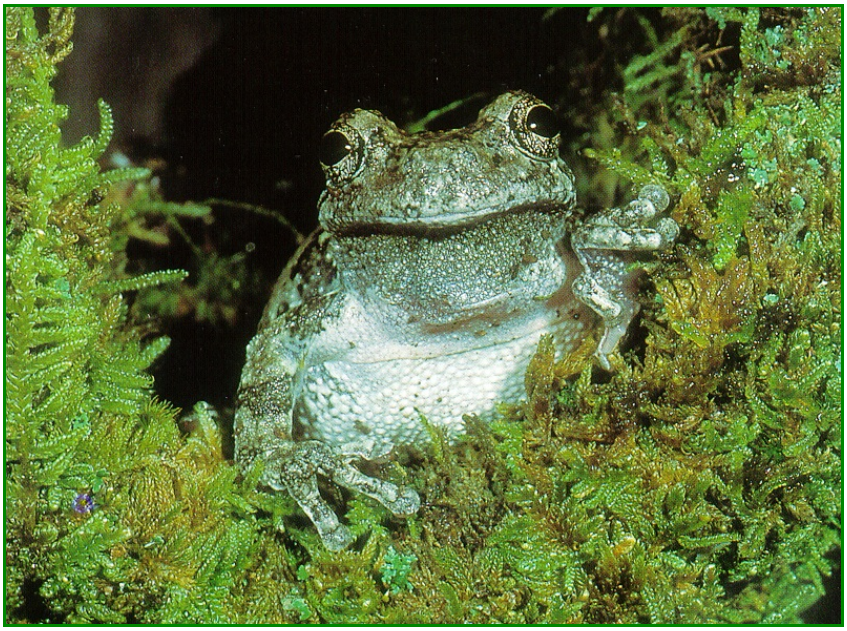
A Southern Gray Treefrog resting on a pine stump. Photo by the author.

These look-alike species of treefrogs appear to have the same habits and habitat preferences. Gray treefrogs may be found in small wood lots or high in hollow trees along woodland streams, in large tracks of mixed hardwood forest, and in bottomland forests along rivers and swamps. These frogs can also be observed hiding in nooks and crannies of farm buildings and on porches or decks of homes.

The two specimens on the left are Southern Gray Treefrogs, while the individual on the right is a Northern Gray Treefrog. They can be distinguished by the pitch and rapidity of their vocal call. Photo by the author.

In New Jersey, gray treefrogs are normally active between April and October. I have noticed that males start calling when flowering dogwood trees are in bloom. Gray treefrogs breed from early April to mid-June. Males gather and begin calling at breeding sites when night air temperature is above 16 degrees C (60 degrees F). Preferred breeding sites include fishless farm ponds, woodland ponds, vernal ponds, hardwood swamps and human made retention basin or drainage ditches. While calling, vocalizing males may sit at the water's edge or station themselves on a log or branch above the water.

A male will grasp a female with his front legs when she comes in contact with him. They hop into the water and find a secure place to deposit eggs. As they float in the water, the female will begin laying eggs. The male fertilizes the eggs while they are being laid. Each female is capable of producing up to 1,800 eggs, which are attached to floating vegetation in clumps of 30 to 40 eggs. Each egg is a little over 1 mm (1/25 inch) in diameter and is light brown in color. The protective jelly-covering is weak and indistinct.



An adult male southern gray treefrog (*Hyla chrysoscelis*) emerging from a moss-covered hollow log. Males have dark throats whereas females have white throats. Photo by the author.

Hatching takes place in about 4 or 5 days. Gray treefrog tadpoles have a wide tail membrane which may be red or orange, and bordered with black blotches. The tadpoles transform into froglets in about two months. The newly transformed gray treefrogs average 13 mm (½ inch) in length and are usually green with the identifying white spot beneath their eyes. They spend most of the remainder of the summer in low vegetation near the breeding pond or in the surrounding forest. Calls of the two gray treefrogs species are very different and described below. On humid days, males can be heard calling away from breeding sites throughout the summer and into the fall. During the breeding season they may be seen on the ground at night on-route to a breeding pond. During the day gray treefrogs hide on or beneath rough tree bark, in hollow trees, or rest between live leaves. Gray treefrogs have large toe pads which enable them to climb or rest on vertical surfaces. Treefrog toe pads are "sticky" because of surface tension between a mucous layer on the toe pad cells and the ground surface.

The feeding response is visual and is triggered by motion of any small insect. Both flying and walking insects are captured with the frog's sticky tongue. The prey is forced into the mouth with their front limbs, and swallowed with the help of the blinking eyes which pushes the food down the throat. Some spiders and other invertebrates are also eaten by gray treefrogs.

The northern gray treefrog *(Hyla versicolor)* and Cope's gray treefrog *(Hyla chrysoscelis),* can be distinguished in the field by comparing the pitch of the males vocal call. In the northern gray, the call is a musical, bird-like trill, which may vary from 17 to 35 pulses per second (depending on the frog's temperature). The call of *Hyla chrysoscelis* can be described as a high pitched buzzing trill, with 34 to 69 pulses per second depending on the frog's temperature.

Some people cannot distinguish between the two species with the naked ear, so for proper identification of gray treefrog calls, a tape recording must be analyzed in the laboratory using sophisticated audio-spectrogram equipment. One must take air temperature when the recording is made. The results must be correlated with the pulse rate of the treefrog's call and the temperature when recorded.

These two treefrogs also differ in the number of chromosomes: tetraploid in *Hyla versicolor* and diploid in *Hyla chrysoscelis.* In addition, the red blood cells of *Hyla versicolor* are larger than those of Hyla chrysoscelis. Evidently, the two gray treefrog species are genetically incompatible throughout their range. I have heard both species calling from the same breeding pond on several occasions along with several other frog and toad species. Green frogs, leopard frogs, spring peepers, cricket frogs, Fowler's toads and spadefoot toads all share the same breeding ponds.

A dorsal view of a Cope's Gray Treefrog resting on a cattail reed. Photo by the author.

An Eastern Spadefoot Toad at the edge of its breeding pool. Photo by the author.

A female Green Frog moving across a Sphagnum bog. Photo by the author.

Pine Barrens Treefrogs are known for their rich array of colors. Lavender stripes and orange flash colors on the undersides of their legs. Photo by the author.

Pine Barrens Treefrog

The Pine Barrens treefrog (*Hyla andersonii*), is a small treefrog that averages 1.0 to 1.75 inches (2.8-4.4 cm) in length, with a record size of 2 inches (5.1 cm). Dorsally, the frogs are an emerald green. Bold lavender stripes bordered by white run laterally along the body from the eye to the groin. A considerable amount of orange is found on the concealed surfaces of the thigh and legs. The underside is white and the throat of the male is dark purplish-gray. The limbs have a light line between the legs and feet, which gives the impression that the frog is wearing gloves. The adhesive toe pads are well developed.

The range of the Pine Barrens treefrog is fragmented, with three distinct populations occurring from New Jersey to Florida. The northern-most population in the range of this species occurs in the Pine Barrens of southern New Jersey. A second population occurs from southern North Carolina into South Carolina. The southern-most population is found in the Florida panhandle, and west into extreme southern Alabama.

A Pine Barrens Treefrog showing the ventral portion of its body with the bright undersides of the legs. Their sticky toe pads allow them to cling onto the rough bark of shrubs and trees. Photo by the author.

If you drive through the New Jersey Pine Barrens with the windows open during warm, wet evenings in spring and early summer, you may hear a strange "quonk-quonk-quonk" sound emanating from wetland ponds. This eerie sound is not the legendary "Jersey Devil," it's mating call of the Pine Barrens treefrog. They select wetland areas such as *Sphagnum* bogs, hardwood swamps, cranberry irrigation ditches, pitch pine lowland ponds, and wet burrow pits for depositing their eggs. The male treefrogs produce this call, attempting to attract a receptive female to the breeding pond. The calling usually begins in late April or early May and continues sporadically until mid-July. By mid-July, the breeding choruses have tapered off to only a few individuals. Humidity and temperature seem to be important factors in influencing the number of frogs that can be expected to be calling on a particular evening, with frogs preferring evenings when the humidity is high and temperatures above 20.0 C. Rain is another important stimulant which will induce this species to vigorously call for potential mates.

The vocal call of the Pine Barrens treefrog is best described as a nasal "quonk-quonk-quonk-quonk", repeated rapidly at a rate of 15 to 20 times within a 20 second period. Their honking call is rapid on warmer nights (above 28.0 C), slower on cooler nights. A full chorus sounds quite different than a single individual. The calls from the multiple frogs overlap and the chorus that is produced is a continuous, sometimes deafening "a-quonk-a-quonk-a-quonk." The vocal pouch is shaped like a rounded balloon and extends to be quite large, almost half the size of the frog itself. When a receptive female approaches a male, the treefrogs engage in amplexus, with the male holding onto the back of the female with his front legs. During amplexus the female lays 500-1000 eggs that are singly deposited. When each egg is extruded, it strikes the male's ventral surface just below the cloaca, at which point he fertilizes it.

An adult male Pine Barrens treefrog (*Hyla andersonii*) calling while perched on a dead oak branch. During May and June dozens of these frogs can be heard singing for their mates. Photo by R.T. Zappalorti.

Then the egg is released into the water where it will adhere to vegetation or simply rest on the pond bottom. Each spherical egg is surrounded by a jelly-like coating that swells in the water. Depending on the temperature of the water in which the eggs are laid, hatching occurs in 7 to 14 days. The small swimming tadpoles that hatch from these eggs begin to feed on algae, microscopic invertebrates, and tiny bits of plant matter found in their wetland habitat.

The tadpoles grow rapidly and within 80 to 100 days they have completed their transformation into froglets, emerging from the water between late July and early September. The young frogs quickly seek out moist hiding places where they remain during the day. At night they come out and feed on small invertebrates, such as insects and spiders. After 2-years (males) and 3-years (females), they reach sexual maturity and enter the breeding choruses with other adults.

Summary

The corn snake, northern pine snake, northern scarlet snake, rough green snake (*Opheodrys aestivus*), and eastern king snake (*Lampropeltis getula*) reach the northern limit of their range in southern New Jersey. Whereas the timber rattlesnake, northern black racer, eastern hognose snake (*Heterodon platirhinos*), northern redbelly snake (*Storeria occipitomaculata*), eastern worm snake (*Carphophis amoenus*) are within the eastern core of their range in the Pine Barrens.

Some of these snake species have developed different strategies to cope with harsh winter temperatures. Radio-telemetry was used to study the ecology, home range and seasonal movement patterns of pine snakes, corn snakes, king snakes and timber rattlesnakes along with locating winter hibernacula. Once dens were discovered, circular drift fences with traps were used to determine dates of emergence and dates of ingress. Past trapping studies of winter hibernacula resulted in capturing 113 pine snakes in 6 dens, 66 black racers in 5 dens, 61 corn snakes in 6 dens, and 4 king snakes in 1 den.

Physical characteristics of the underground den structure and the depth at which the snakes hibernated was observed by excavating 3 timber rattlesnakes (2 dens), 1 king snake (1 den), 12 corn snakes (3 dens), 196 pine snakes (8 dens), and 41 black racers (6 dens). Rattlesnakes ($N = 45$) and king snakes ($N = 6$) were observed to hibernate in shallow, water-filled cavities and tunnels along the edge of stream corridors. The snakes were found beneath the roots of Atlantic white cedar, black gum, or red maple trees under *Sphagnum* mats, at an average depth of 30 cm, and were partially submerged in water. Corn snakes, pine snakes, black racers, and hognose snakes often share the same upland hibernacula, which are generally located in stump holes or abandoned mammal burrows at an average depth of 1.0 meter.

The earliest dates for emergence and latest dates for ingress back into dens were as follows: pine snake emergence = March 25, return = November 27; corn snake emergence = March 14, return = November 16; black racer emergence = March 20, return = November 11; timber rattlesnake emergence = April 20, return = November 25; and eastern kingsnake emergence = April 1, return = October 22. When climatic weather data are compared with snake egress, years with warmer March temperature triggers early emergence. On the other hand, cooler longer spring temperature causes late egress. On a few occasions some pine snakes and timber rattlesnakes did not emerge until late May, but mid-April is the normal emergence for most Pine Barrens snakes.

Timber rattlesnakes, corn snakes and pine snakes are on the NJDEP's endangered or threatened species list because their survival in New Jersey is in immediate danger due the fragmentation, destruction or alteration of some Pinelands habitat. Add to this the all-too-frequent killing of individual snakes on roads or by ignorant people and it is apparent why their numbers continue to decline. These snakes could become extinct in New Jersey if protection of remaining populations and their critical habitats are not increased in the Pinelands. The NJDEP, the Pinelands Commission and several NGO conservation groups are the first and most important line of defense for the protection of these rare snake species. It is illegal and unnecessary to kill snakes in New Jersey. They are important predators in the Pinelands ecosystem and are at the top of the food chain. They perform a service to humans by controlling disease carrying rodents and more important, they are part of our natural heritage. They are a natural part of the Pinelands natural fauna and need no special reason or excuse for conservation.

The New Jersey Pine Barrens is a wonderful place for herpetologist to visit. The flora and fauna are diverse and interesting, but some species are difficult to observe. May and June are good months to come, but not July and August, because the daytime temperatures are very warm and may reach 95 to 100 degrees F. September and October are also nice times to visit because of the change in season. One should bring and use lots of insect repellant when you come to the Barrens, because there are plenty of ticks, chiggers and biting flies to annoy you. That aside, the Pine Barrens can be a rewarding place to visit that will offer ample photography opportunities and a chance to see herpetofauna in its natural habitat.

An adult male Eastern Tiger Salamander from Cape May Coulty. Photo by the author.

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Robert T. Zappalorti, worked as a herpetologist at the Staten Island Zoo for 14-years, before starting his environmental consulting company. He's the founder and Executive Director of Herpetological Associates, Inc. and the Zappalorti Institute for Pinelands Research. Robert has worked with bog turtles, Pine Barrens snakes and other reptiles and amphibians for over 55-years. His main research and conservation interests involve the biology of threatened and endangered reptiles and amphibians. With his colleagues at HA, they conduct presence or absence surveys, population estimates, adverse impact analysis and assessment of development projects. He specializes on amphibians and reptiles of the New Jersey Pine Barrens, although he also works throughout New York, New Jersey, Pennsylvania, Maryland, North Carolina, South Carolina, Georgia and Florida. He has served as an expert consultant to the Endangered and Nongame Species Program of the New Jersey Department of Environmental Protection, the Division of Coastal Resources, the New Jersey Pinelands Commission, The Pinelands Preservation Alliance, the Trust for Public Land, The New Jersey Conservation Foundation and the Nature Conservancy. He has given presentations and provided expertise to numerous universities, including New York University, University of Georgia and Rutgers University, as well as zoological institutions, such as Staten Island Zoo, Philadelphia Zoo, Atlanta Zoo, Smithsonian National Zoo, Taipei Zoo, and the Taiwan Forestry Bureau, Republic of China. He is a life member of the Society for the study of Amphibians and Reptiles and the Gopher Tortoise Council.