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DEPT. OF ENVIRONMENTAL PROTECTION
COMMISSIONER'S OFFICE

Commissioner Mark N. Mauriello
New Jersey Department of Environmental Protection
401 E. State Street, 7th Floor, East Wing
P.O. Box 402
Trenton, New Jersey 08625-0402

RE: Petition to Delist the Northern Pine Snake

Dear Commissioner Mauriello:

Under the provisions of the New Jersey Administrative Procedures Act (N.J.S.A. 52:14B-4(f)) and N.J.S.A. 23:2A-4b, the New Jersey Builders Association (NJBA) petitions the New Jersey Department of Environmental Protection (Department) for rulemaking to delist the Northern Pine Snake as "threatened" from the State list of endangered and threatened species promulgated at N.J.A.C. 7:25-4.17. The NJBA is a trade association representing New Jersey builders, many of whom own land and have contractual interests in the Pinelands area. The Northern Pine Snake predominantly inhabits the Pinelands eco-region.

The NJBA hired as a consultant, Joseph C. Mitchell, Ph.D., a herpetologist with Northern Pine Snake expertise, to provide technical and scientific support in evaluating the listing of the Northern Pine Snake (*Pituophis m. melanoleucus)* as "threatened". The NJBA provides a copy of Dr. Mitchell's report, which supports our contention that the continued listing of the Northern Pine Snake as "State threatened" is unsupported by known scientific data and therefore the Pine Snake should be delisted. "Threatened" is defined in N.J.A.C. 7:25-4.1 as ". . . . species that may become endangered if conditions surrounding it begin to or continue to deteriorate." "Endangered" refers to species that require protection to avoid becoming extinct. As evidenced by Dr. Mitchell's Report, summarized below, the Pine Snake does not fit into either category. Thus, it should be delisted.

OPRA Request

NJBA submitted an Open Public Records Act (OPRA) request to the Department and the New Jersey Pinelands Commission for all available data related to the Northern Pine Snake. Although the Department denied access to many of the items requested, Dr. Mitchell's report references materials that were provided by the Department, and from which he was able to draw conclusions in support of the delisting application.

Application of the "Delphi Technique"

The New Jersey Department of Environmental Protection originally listed the Northern Pine Snake as "threatened" in 1979 based upon a 1977 report generated by R.T. Zappalorti and his company, "Herpetological Associates, Inc.". The Department had subsequently utilized the "Delphi Method" to re-evaluate the Pine Snake in two iterations (or rounds) during late 1999 through 2001. The Delphi Method seeks to establish a consensus among a variety of experts for species listing and review. Sixteen to eighteen people participated in the two rounds in which the Pine Snake was considered.

The "Instructions to Expert Panelists for Reviewing Status Assessments for Select New Jersey Reptiles and Amphibians" describes the status assessments and the associated confidence levels. (See Mitchell Report, Appendix 2.) A status assessment of "threatened" is applicable for "species that may become "Endangered" if conditions surrounding it begin to or continue to deteriorate. Thus, a "threatened" specy is one that is already vulnerable as a result of, for example, small population size, restricted range, narrow habitat affinities, significant population decline, etc." (See Mitchell Report, Appendix 2.) This definition of "threatened" is more expansive than the regulatory definition of a "threatened" species set forth in N.J.A.C. 7:25-4.1, and quoted above. A confidence level rating of "5 and 6" falls within the "reliable" category which is defined as "some risk of being wrong; willing to make a decision based on this but recognizing some chance of error". (See Mitchell Report, Appendix 2.)

Dr. Mitchell includes copies of the summary sheets for Delphi Rounds 1 and 2 in Appendix 2 of his report. He notes that a review of an Excel file containing participant response statements and confidence levels for Round 2 varied from the Summary Sheet for the round. Specifically, the fourteen individuals who listed the Pine Snake as "threatened" had a confidence level for their status assessment ranging from 4 to 8 with an average of 5.625, which is lower than the 6.4 on the Summary Sheet.

Additionally, as discussed in Dr. Mitchell's report, commencing on page 17, the Delphi Technique was inappropriately used, rather than as recommended in a well-known study by Clark et al. (2006) on using the Delphi Technique for birds in New Jersey. Specifically, the Department did not utilize a principle investigator from outside the agency to head up the Delphi Process, but rather two Department personnel. Those agency personnel were Dr. Larry Niles, who was then Bureau Chief of the Endangered and Nongame Species Program, and then-Department employee, Eric Stiles. Moreover, many of the eighteen participants who engaged in the Delphi Process did not have experience with the Pine Snake in New Jersey. For example, six of the participants in Round 1 had experience with the Pine Snake, while the species-specific knowledge and experience of the other participants is unknown. The list of participants for Round 2 was likewise lacking in specific Pine Snake expertise.

Therefore, NJBA contends that the Department should have engaged the services of an expert with Pine Snake experience to lead as principal investigator to ensure limited agency influence on the participants. The Delphi Technique format also requires participants to provide an explanation to support the basis of their decision-making process for Pine Snake characterization. This information is to be shared with other participants, including the agency

personnel. Such a public forum may lead to reservation on the part of participants to dispute others' standpoints, particularly DEP personnel.

NJBA also believes that the Department should have ensured that **all** of the participants in the Delphi Process had the requisite knowledge and expertise with the particular species at hand for characterization (i.e. Pine Snake). Presumably, the Department had characterized a number of species during the four iterations in 1999-2001, rather than focusing only on those species that were the subject matter expertise of the participants.

Alternative Methods to Determine Species Characterization

Dr. Mitchell points to the availability of other appropriate methodology to characterize the Pine Snake as well as to evaluate the population status of the species that the Department could have utilized in addition to the Delphi Method. Use of these methods would have resulted in a more precise evaluation of the species current status.

"Population Viability Analysis" (PVA) "is a process that evaluates data and models for a population in anticipation that it will persist for some specified time into the future." (See Mitchell Report at page 20). PVA relies on extensive population and demographic information, such as growth rates, age at maturity, and survivorship, to provide quantitative estimates of the status of the species. Dr. Mitchell's reports lists a number of population and demographic parameters that would be necessary to develop models estimating the effect on the Pine Snake population in response to changes to these parameters. (See Mitchell Report at page 20). However, recognizing the limited availability of information for these parameters, Dr. Mitchell notes that "the only way to anticipate any changes in the Pine Snake population in New Jersey in the face of landscape changes is to speculate." (See Mitchell Report at page 20.)

"Occupancy Models" are another process to estimate the species' detectability (present or not-detected) based upon repeated observations at each study site. The same sites are visited repeatedly at different times and seasons, both within the same year and over a number of years. The accumulated detection records are converted into mathematical statements, which then are incorporated into a software package (MARK or PRESENCE available on the internet).

By monitoring occupancy at many sites and in different habitats, the Department would have a better sense of the changes in the status of the Pine Snake in New Jersey, particularly with respect to maintaining its viability. As discussed below, application of this model would be particularly appropriate given the apparent lack of effort by the Department to determine a quantitative estimate of the population size of the Pine Snake.

Population Size of Pine Snake

The Department provided a map identifying 387 known locations where the Pine Snake had been observed in thirteen land use categories. (See Mitchell Report, Figures 1-3; Table 1.) Although this provides some data on the number of sightings, Dr. Mitchell's report highlights that "there are no quantitative estimates of the number of Pine Snakes in New Jersey." (See Mitchell Report, at page 13.) Such data is not available either in the reports provided by the Department

pursuant to NJBA's OPRA request or in the scientific literature. Dr. Mitchell also points out that there is "no estimated population size estimate for the Pine Snake in New Jersey based on average population sizes in different parts of the region." (See Mitchell Report, pages 14 and 22.) Similarly, as discussed above, the Department has not demonstrated that the Pine Snake population has declined in New Jersey.

The absence of quantitative data specifying the actual number of Pine Snakes raises the serious question of how the Department can substantiate the need to maintain the current status of "threatened" for the Pine Snake. In fact, the number of sightings of the Pine Snake may indicate that the species itself is not in jeopardy of becoming endangered, but rather is maintaining a robust population.

Moreover, the Pine Snake is protected by the fact that virtually no development is permitted in the "preservation area" of the Pinelands Area, the snakes' primary habitat. Much of that land has also come under public or non-profit conservation ownership. Given the extent of publicly and privately owned conservation lands, and the conservation areas and wildlife corridors, NJBA is of the belief that the Pine Snakes species will be sustained in the natural conditions and environment in which it lives. The Pinelands are greatly protected and are not likely to deteriorate. Thus, the Pine Snake's habitat is unlikely to deteriorate as required by the definition of "threatened".

Conclusion

NJBA petitions the Department to delist the Northern Pine Snake as being "threatened" from the official state endangered and threatened species list. The decision to list the Pine Snake was based only on the opinions of Delphi Method participants - many of whom were not deemed to be experts of the Pine Snake species. There was also no quantitative analysis of the Pine Snake population and assessment of "the deterioration of its habitat". Further, the Department has not substantiated the need to continue the threatened status through recent empirical analysis of the actual presence of the Pine Snake in New Jersey. In fact, the number of sightings suggests that the Pine Snake population is not in jeopardy nor has it experienced significant population decline. NJBA contends that there was a lack of sound scientific basis for the initial listing and its continuation as "threatened" is also dubious.

For the reasons discussed above, the New Jersey Builders Association recommends that the Department delist the Northern Pine Snake. Should you have any questions, please contact me at (609) 570-2156.

Sincerely,

Elizabeth George-Cheniara, Esq.
Director of Environmental Affairs

Assessment of the Listing of the Northern Pine Snake (*Pituophis melanoleucus*) in New Jersey as State Threatened

for

Giordano, Halleran & Ciesla
Attorneys at Law
125 Half Mile Road
Red Bank, NJ 07701

Photo by R.T. Zappalorti (from NJ Division of Fish and Wildlife home page)

Joseph C. Mitchell, Ph.D.
Mitchell Ecological Research Services, LLC
10404 Patterson Ave., Suite 208
Richmond, VA 23238

4 April 2009

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Introduction

The New Jersey Department of Environmental Protection's Division of Fish and Wildlife listed the Northern Pine Snake (*Pituophis melanoleucus melanoleucus*) as state Threatened in 1979. This species occurs primarily in the Pinelands ecoregion located in the southern portion of the state. It was listed due to its apparent rarity and the threats to its existence in the region (see below for a review of the basis for listing). The land on which this snake is located is also land that has been and is targeted for a variety of other uses, including construction of housing developments and associated infrastructures. Application of the state endangered species law by the New Jersey Department of Environmental Protection has created conflicts between the stakeholders who need the land for a variety of usually opposing reasons. This report summarizes the ecology of this threatened species with an emphasis on its land use, evaluates the information used to justify its listing as state threatened, reviews the Delphi method used to make the Threatened determination, and seeks to determine whether delisting of the Northern Pine Snake is warranted.

Materials

A wide variety of information was used as background information for this report. It includes the published scientific literature in journals, unpublished reports, comments from "experts" regarding the status and threats to this species provided by the NJ Department of Environmental Protection, and a map of known locations where the snake has been observed in relation to other current land uses. A full list of reports and publications consulted in the construction of this report is in the Literature Cited and Resources Used section.

Distribution and Status of the Northern Pine Snake in the United States

The distributional range of the Northern Pine Snake extends from southern New Jersey southward in a very fragmented pattern through the Blue Ridge and Appalachian Mountains to eastern Tennessee and northern Georgia. It also occurs in the Sand Hills in the south-central portion of North Carolina, the upper portion of South Carolina, and portions of western Kentucky, Tennessee, and central Alabama. The known locations in the mountains are widely scattered and based on old records. Pine Snakes apparently occurred historically in Delaware and Maryland on the Eastern Shore (Delmarva) and a small portion of mountainous West Virginia, but no populations are known to exist today in these areas. Thus, the entire range of this snake is highly fragmented. The population in New Jersey is isolated from all other populations.

The Northern Pine Snake is protected by state endangered and threatened species laws as Threatened in New Jersey, Special Concern in North Carolina and Virginia, and High Conservation Concern in Alabama. The Northern Pine Snake is not listed as endangered or threatened in other states within its range.

Distribution in New Jersey

The Pinelands comprise approximately 1.1 million acres within Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester, and Ocean counties in New Jersey. The U.S.

Congress designated the Pinelands National Reserve under the National Parks and Recreation Act in 1978. In 1979, the state of New Jersey enacted the Pinelands Protection Act that established the Pinelands Commission to oversee the management of the Protection Area of some 565,000 acres and the Core Preservation Area of 368,000 acres. The United Nations Educational, Scientific, and Cultural Organization (UNESCO) designated the Pinelands National Reserve as a Biosphere Reserve in 1983.

The Northern Pine Snake inhabits the Pinelands of southern New Jersey. This is the northern-most known region that supports this species. The Pinelands are well suited for this large burrowing snake because it offers soil types that support a fire-adapted pine, pine-oak, and oak-pine forest and is soft enough to allow burrow and hibernacula construction by Pine Snakes. Three primary soils overlap the range of the Pine Snake, Lakehurst, Lakewood, and Evesboro. Secondary soils that also support pine forests and can be used by Pine Snakes are Klej sands, Klej loamy sands, Hammonton loamy sands, Woodmansie sands, and abandoned sand mines.

The Lakehurst-Lakewood-Evesboro soil association and the secondary soils combined occur in on 12.9% (155,822 acres) of a five county region in southern New Jersey (Atlantic, Burlington, Camden, Cumberland, Ocean). The NJ Division of Fish and Wildlife used digital GIS (Geographical Information System) applications with soil and vegetation maps to estimate potential Pine Snake habitat in several counties. Specific county areas known to support Pine Snake habitat include 136,070.6 acres for Burlington County (26% of county land area), 6824.9 acres for Cape May County (4.1%), and 149,193.5 acres for Ocean County (30.7%). Most of the remaining Pine Snake habitat occurs in scattered pockets. The only large area of contiguous habitat is in Cumberland County (documentation for this county was not provided).

Public lands with extensive areas known to support Pine Snakes include Lakehurst Naval Air Engineering Center; Fort Dix Military Reservation; Colliers Mills, Greenwood, Manchester, Stafford Forge, Pasadena, and Whiting Wildlife Management Areas; and Bass River, Double Trouble, and Lebanon State Forests. Private lands with Pine Snakes are held by the New Jersey Natural Lands Trust, New Jersey Audubon Society, and The Nature Conservancy.

Landscape Use by Pine Snakes in New Jersey

The New Jersey Department of Environmental Protection provided a hard-copy map with 387 known locations where Pine Snakes have been observed. These locations were plotted on a plain map within county boundary lines (Figure 1). Using the county boundary intersections, a GIS specialist was able to determine coordinates of each of these 387 sites. Description of this process and how the maps included in this report were produced are included in Appendix 1. He created a map of these sites once the site locations were digitized, the coordinates determined, and a file of these coordinates was produced (Figure 2). We next overlaid these locations on a Landsat map from the public domain files provided by the U.S. Geological Survey of the area encompassing the range of the Pine Snake. The on-the-ground resolution was estimated to be within 50 feet of the actual site, well within the known movement range of Pine Snakes. We assumed that the points on the map provided by the New Jersey Department of Environmental Protection were not altered or changed from their original coordinates. The combination of the digital map of the Pine Snake locations with vegetation and land use maps (see Appendix 1) allowed us to determine the type of land use where each snake had been found. The resulting map is in Figure 3. The data derived from the land use map allowed us to determine 13 general land use categories for these Pine Snake locations. Table 1 provides a list of the 13 NLCD land use categories and the number of Pine Snake sightings within each type.

The results clearly show that Pine Snakes prefer pine forests (= evergreen) and to a lesser extent deciduous forest over other types of vegetation and land use (Table 1). Pine Snakes are not uncommonly seen in Open Space Developed areas, Low intensity Developed areas, some Barren Land, fields of Cultivated Crops, and Woody Wetlands. They are rarely seen in Open Water (they are known to swim), Medium and High Intensity Developed lands, Mixed Forest, and Pasture (with livestock).

Table 1. Distribution of known Pine Snake locations in 13 land use categories in the New Jersey Pinelands.

Land Use Category	Number of Sites	Percent of Total Sample
Open Water	4	1.0
Open Space Developed	28	7.2
Low Intensity Developed	34	8.8
Medium Intensity Developed	6	1.6
High Intensity Developed	2	1.6
Barren Land	24	0.5
Deciduous Forest	59	15.2
Evergreen (Pine) Forest	151	39.0
Mixed Forest	6	1.6
Pasture	4	1.0
Cultivated Crops	30	7.8
Woody Wetland	35	9.0
Emergent Herbaceous Wetland	4	1.0
Totals	387	99.9

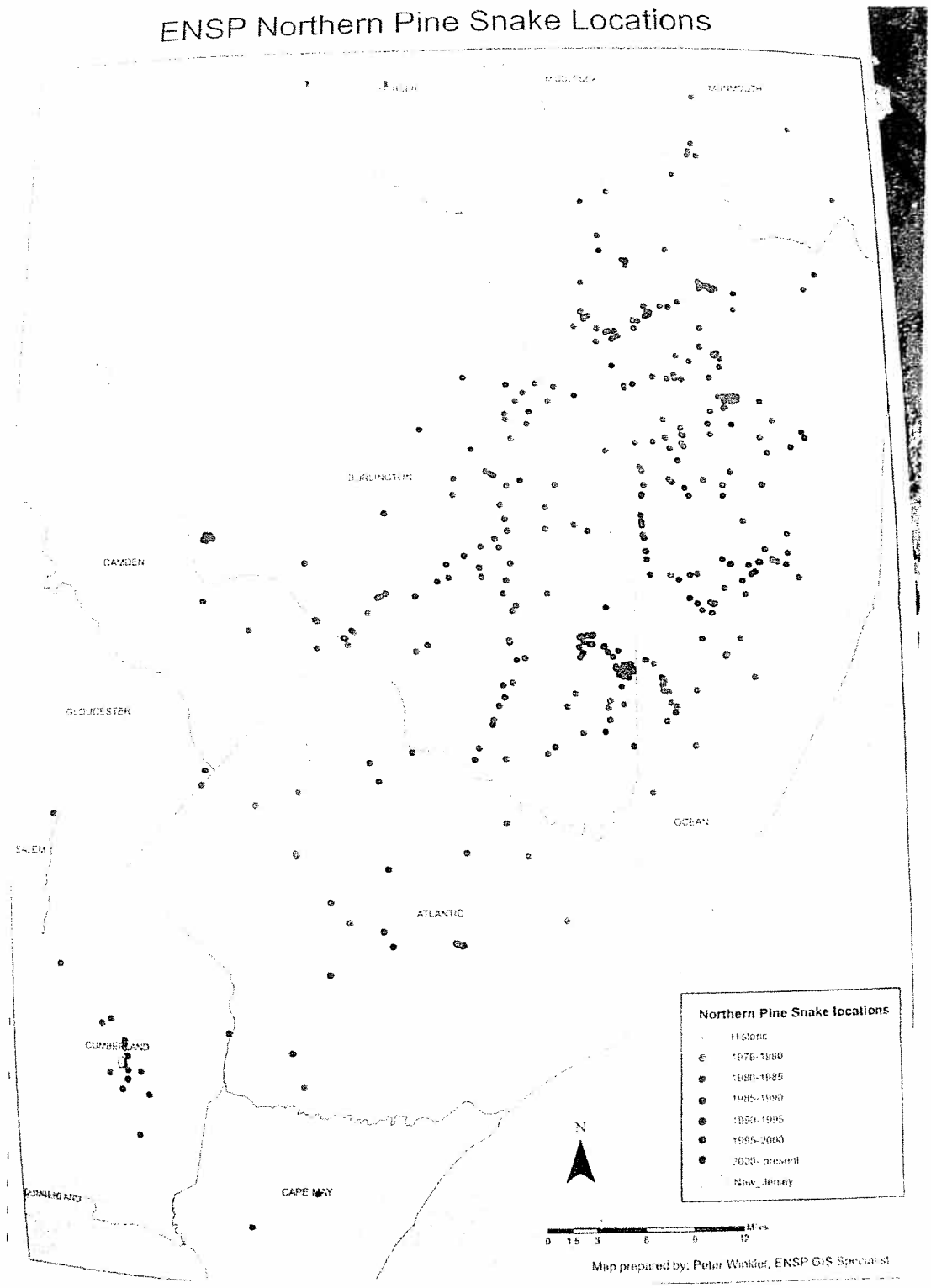

Figure 1. Map of the locations known for the Pine Snake provided by the New Jersey Department of Environmental Protection.

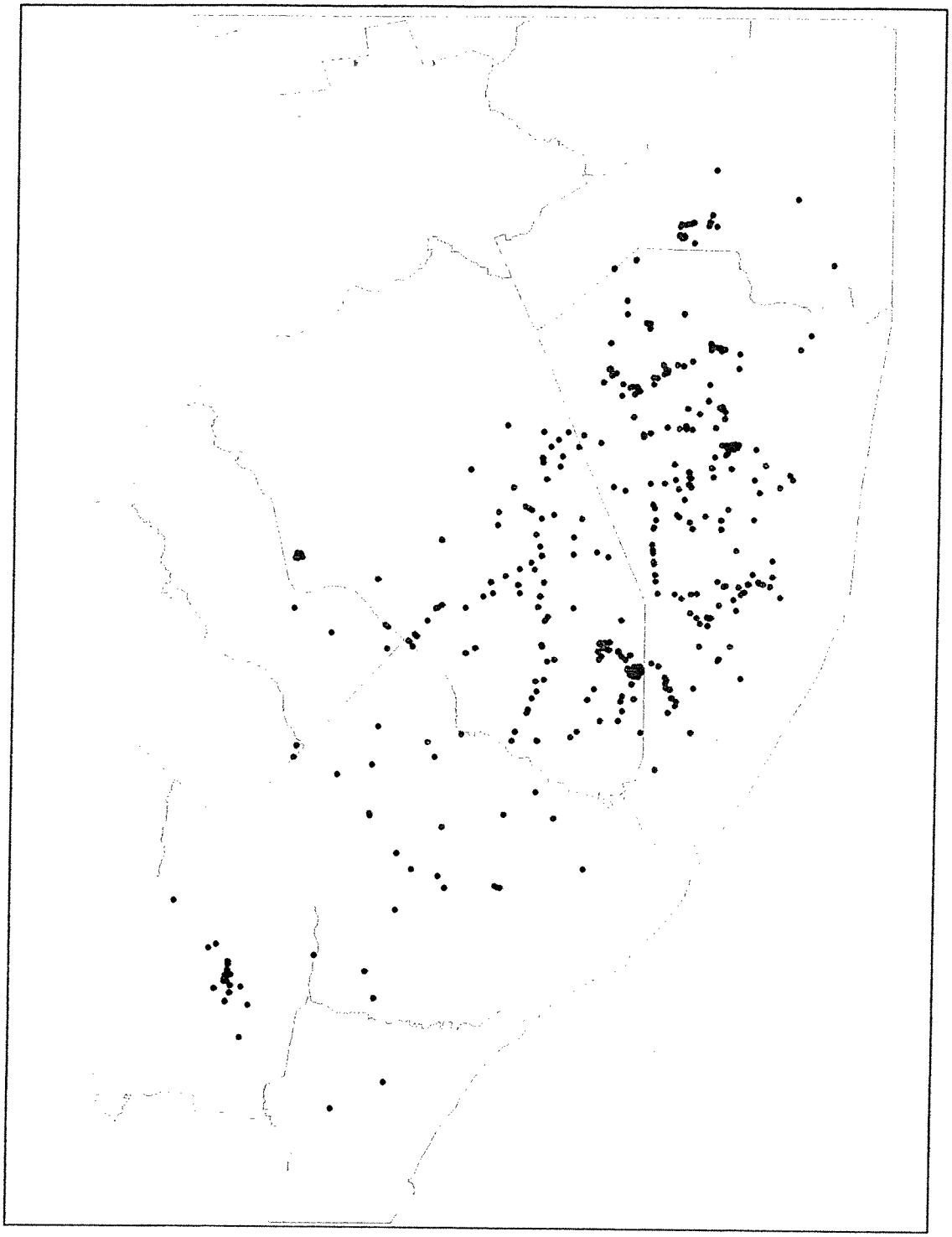

Figure 2. Map generated after digitizing the locations on the map in Figure 1.

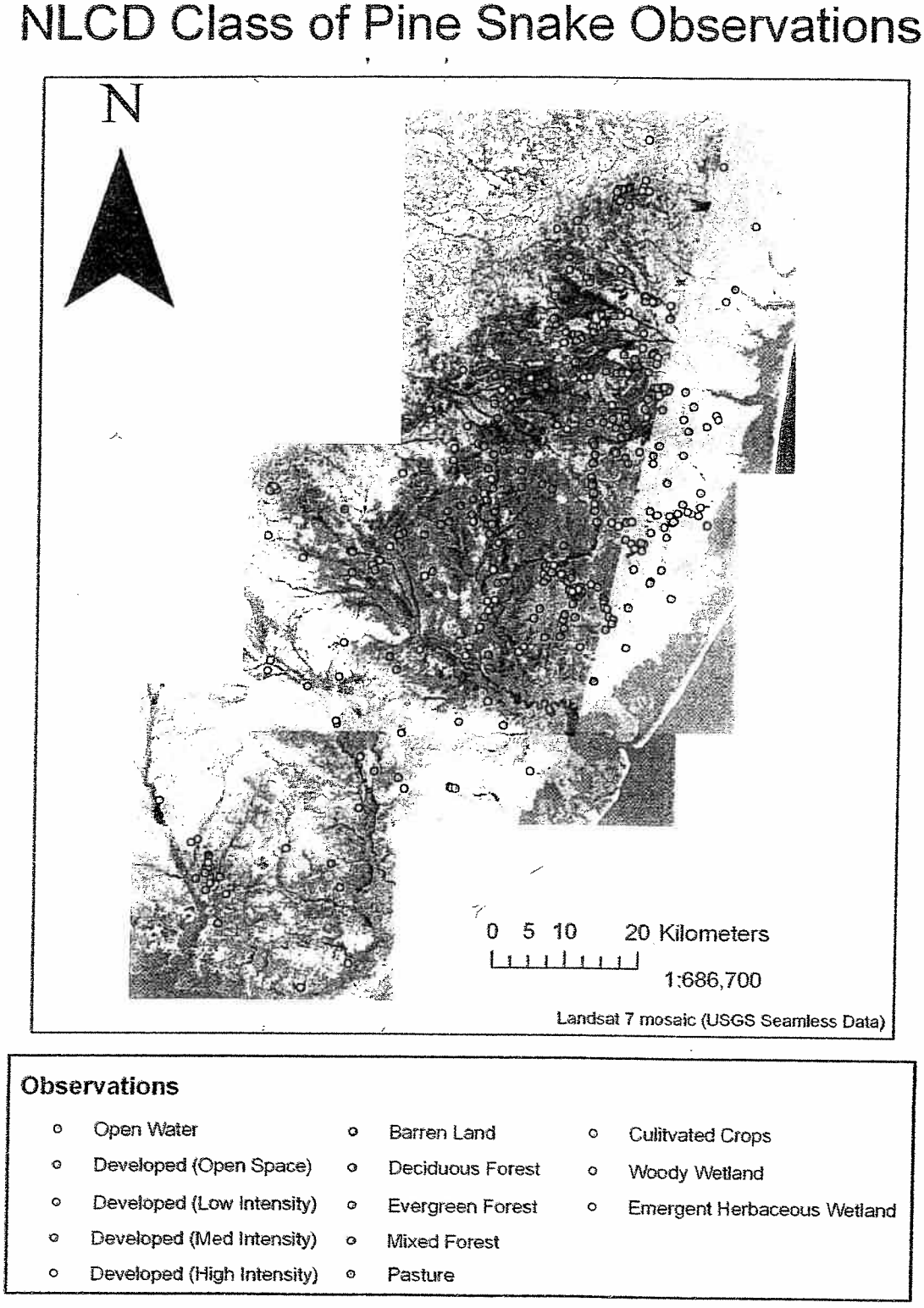

Figure 3. The USGS LandSat map with the site locations for the Pine Snake in New Jersey. Dot colors correspond with land use category.

Description and Ecology

Description

Northern Pine Snakes are large and robust, reaching 48-68 inches in total length. This is a generally a black and white snake as adults and juveniles. All ages have black, irregularly-shaped blotches along the back that tend to change in color to brown toward the tail. Body background color is usually white but may be yellowish. The head is somewhat blunt with black pigment along the edges of most of the scales. The top of the head is usually black. The belly is white. These snakes are among the few snakes in North America that hiss loudly when disturbed by humans or relatively large animals.

Pine Snakes are almost entirely predators of mice and other rodents. Young ones may eat lizards occasionally. Females of this species are egg-layers and often use the same sites repeatedly for years. During June, females dig underground nest chambers in open sandy areas to lay 3-14 large, white eggs. Nest sites are in soft sand in open, unvegetated areas within large clearings with less than 10% tree cover. Once she has laid her clutch of eggs, the female will cover the nest and try to conceal it from nest predators. Females will often use the same nesting area year after year. The eggs incubate in the warm sand for at least 60 days before hatching in late August to September. The hatchlings are about 11-15 inches in total length and often remain in the vicinity of the nest until they shed their natal skin. Afterwards, they disperse into the surrounding forest to seek at least one meal before hibernation. They follow the scent trails of adults to the den sites. Hatchling growth rates depends on prey availability and the success that each individual has in catching them, but they generally grow about 20-30 cm in their first three years. Adults maturity is reached at a length of about 100 cm in their fourth year of age. Length of life is unknown for natural conditions but Pine Snakes live for as long as 15 years in captivity.

Pine Snakes are active periodically from about mid-April to October, with peak surface activity in June and July. Cool weather in mid- to late-October triggers them to seek hibernation sites, which are underground dens within mounds of sandy soil that support grasses, pines, and other vegetation on the surface. Entrances are small and usually difficult to see by humans. Hibernation lasts as long as six months. Although active for at least a half-year, these snakes spend much of their time underground or under the cover of thick vegetation. They are thus

difficult to find by visual searching. Their color and pattern provide them with effective camouflage.

Ecology

Habitat: Northern Pine Snakes occupy the various mixtures of pine-oak forest throughout the New Jersey Pinelands usually at an elevation of 40 feet or more. The soil in this region is primarily Lakehurst and Lakewood sand. Historically, fire was an essential element in the maintenance of Pinelands vegetation. The occasional fires opened gaps in the forest that allowed full sunlight penetration. It kept the understory of mixed hardwoods relatively small and the ground vegetation limited to fire-tolerant and fast growing plants like blueberry. The pines are adapted to fire, and indeed the cones usually require heat to open thoroughly so that the seeds can be dispersed. Forest gaps provided places for basking and warm temperatures on the ground for proper egg incubation. Thus, a mosaic of forest types dominated by pine, irregular spacing of forest gaps, and the sandy substrate provided appropriate habitat for Northern Pine Snakes, as well as several other species of snakes.

Pine Snakes spend roughly an equal portion of their above-ground active time in thickly wooded areas, especially after mating and laying eggs when they forage for prey, and along the edges of woods, roads, railroad tracks, and other open, cleared areas covered in various amounts of grassy and herbaceous vegetation. The latter openings are used primarily for basking to raise body temperatures to aid in digestion and egg development. Combinations of pitch pine (Pinus rigida) and low bush blueberry (*Vaccinium vacillans*) are preferred over other habitat types but areas with heather (*Hudsonia* spp.), Pennsylvania sedge (*Carex pennsylvanica*), and scruboak (*Quercus marylandica*) are also used. They avoid areas with white cedar (*Thuja occidentalis*), saw-briar (*Smilax glauca*), and lowland pine areas.

Movements and home range: Pine Snakes require large tracts of land to obtain resources to meet their needs for food, nesting areas, and overwintering sites. Hatchlings have been documented to

move as far as 1,650 feet over a 7 week period after initial release. *Seeking movement distances of adults.*

Pine Snakes do not defend territories but occupy home ranges, a region within which each snake spends it active periods in various parts of the landscape and includes its hibernaculum. These areas are connected by snake movements among them. Known home range size for males is 44-399 acres, whereas home range size for females is 54-296 acres. Males generally move over more of the landscape than females because they seek to mate with more than one female each year. Home ranges of males and females overlap. Pine Snakes occupy large areas of land because of the scattered locations of the various resources it uses during their lifetimes, such as small mammal prey populations, water sources, appropriate hibernation sites, appropriate nesting areas, and mates that have their own home ranges.

Predators: Natural predators are primarily raccoons, coyotes, foxes, skunks, opossums, and shrews. Each of these mammals dig up or dig into nests of eggs and hatchlings and eat them. These predators, as well as several species of hawks and possibly Great Horned Owls will kill and eat small individuals, however, full-grown adults have few predators, although large hawks will catch them when they can. Introduced predators that kill these snakes are feral, free-ranging and even domestic cats and dogs. The coyote has expanded its range from the West all the way to the east coast and now occurs in all eastern states. These opportunistic predators will find nests, dig up eggs and hatchlings, and eat them. Humans are well known to kill snakes and collectors for the pet trade take as many as they can find illegally. Documentation in 1988 and 1989 revealed that about 40% of all known hibernation sites were raided by collectors and all the snakes removed. Removal of individual snakes by killing or collection for the pet trade is equivalent to killing by predators.

Numbers: There are no quantitative estimates of the number of Pine Snakes in New Jersey in the scientific literature or reports provided by the NJ Department of Environmental Protection. Numbers of sightings in some of the areas studied by consultants are in the reports provided. Number of Pine Snakes in a study conducted in Berkeley Township, Ocean County, NJ, 1987-1990 totaled 373 adults, subadults, and hatchlings. Seven Pine Snakes were observed in Colliers Mills Wildlife Management Area in the early 1980s. A total of 104 Pine Snakes was captured in

the Manumuskin River Preserve, Cumberland County, NJ, during 2000-2003. Two snakes were documented for the Greenwood Forest Wildlife Management Area, Lacey Township, Ocean County, NJ, in 1999.

Pine Snakes occur in very different numbers and densities in different parts of its range in New Jersey. Quantitative estimates of population sizes in the areas that have been targeted for field surveys for this species have not been attempted despite the fact that some of these snakes have been marked for individual recognition and recaptured for years. There is also no estimated population size estimate for the Pine Snake in New Jersey based on average population sizes in different parts of the region. Thus, the number of Pine Snakes in New Jersey is unknown.

The Basis for Listing the Pine Snake as State Threatened

The initial attempt to identify endangered and threatened categories for reptiles and amphibians in New Jersey, including the Pine Snake, was a status list published in the New Jersey State Register on 10 April 1975 by the late J.D. Anderson. R.T. Zappalorti gathered opinions from local herpetologists, naturalists, and data obtained on these animals by his company, Herpetological Associates, Inc. and provided a report to the NJ Department of Environmental Protection in 1977. The Pine Snake was listed in this report as Threatened. This was apparently the basis for the official listing in the State Register in 1979. The Pine Snake has remained as state threatened since that time.

The Delphi Process (see below) was conducted in four iterations during late 1999 through 2001 in which consensus among the 16-18 people participating was reached. Eighteen people participated in Round 1. One person placed the Pine Snake in the endangered category (Confidence level 5.0), eleven people placed it in the Threatened category (average Confidence level 6.1), one person stated that it was Secure (5.0), and five had No Opinion (see summary page in Appendix 2). Sixteen people participated in Round 2. Fourteen listed it as Threatened (Confidence level 6.4), one person listed it as Special Concern (6.0), and one had No Opinion (see page in Appendix 1). Consensus was reached at the end of Round 2 and the Pine Snake was not considered in Rounds 3 and 4. Interestingly, a copy of an Excel file containing individual responses and confidence levels for Round 2 provided by the NJ Department of Environmental

Protection yielded different results than shown in the Summary Sheet for that round. Fourteen people listed the Pine Snake as Threatened but the Confidence level ranged from 4 to 8 with an average of 5.625, lower than the 6.4 on the Summary Sheet. I examined all the original response sheets for the Pine Snake in Round 2 and found the following results: 14 people selected the Threatened category with Confidence levels ranging from 5 to 9 and an average of 6.357, comparable to the 6.4 on the Summary sheet for Round 2. Thus, there appear to be some minor discrepancies among the confidence level numbers generated for the second and final Delphi round for the Pine Snake.

A major point used to consider the Pine Snake in New Jersey as Threatened was habitat loss and alteration. Pine Snakes occupy high, dry ground in the Pine Barrens region of southern New Jersey. This habitat is also in demand for other uses, including housing development. Other problems cited for the decision to list this species as Threatened are (1) lack of fire in the snake's natural habitat that clears dense vegetation in patches, opens gaps in the forest, and keeps hardwoods from encroaching, (2) predation by natural and introduced predators on nests, eggs, hatchlings, and females, (3) collection for the pet trade or private personal collections, (4) loss of nesting sites due to changes in land use, (5) loss of hibernation sites due to illegal collection, and (6) loss of individual adults by being killed on paved roads by vehicle traffic and on dirt roads by off-road vehicles. Copies of the Summary sheets for Delphi Rounds 1 and 2 summarize participant statements (Appendix 1).

The Delphi Technique in New Jersey

The Delphi Technique is an expert-based approach to decision support for wildlife conservation biologists and managers that can be used to predict outcomes in situations where sufficient data or information are unavailable. It is a systematic method used for reaching consensus among experts in the absence of quantitative information. The process is putatively characterized by anonymity among the participating experts, controlled feedback via the principle investigator, and a statistical estimator of group opinions. All available data and information are distributed among the participants for their evaluation and decision. Seven

categories were assigned a priori to the process in New Jersey for all vertebrates (from Clark et al., 2006; Appendix 3):

Endangered: a species whose prospects for survival within the state are in immediate danger due to more than one factor (e.g., habitat loss or degradation, overexploitation, predation, etc.). Immediate action may be required to avoid extinction in the state.

Threatened: a species that may become endangered if conditions surrounding it begin to or continue to deteriorate; such species are those already vulnerable as a result of small population size, restricted range, narrow habitat affinities, or significant population decline.

Special Concern: a species that warrants special attention because of inherent vulnerability to environmental deterioration or habitat modification that would result in its becoming threatened. This category would apply to species that meet the foregoing criteria and for which there is little understanding of their current status in the state.

Secure-stable: a species that appears to be secure in the state and not in danger of falling into any of the preceding 3 categories.

Unknown: a species that cannot be assigned to the preceding categories because not enough information exists on which to base a judgment.

No opinion: a species for which the participant does not possess sufficient information or experience on which to base a judgment.

Not applicable: a species that does not occur in NJ as a breeding species, during the non-breeding season, or during migration in NJ.

Expert participants were asked to choose one of the seven categories that most characterized, in their opinion, the status of the Pine Snake. They were asked to rank their level of confidence in their assessment by indicating a numeric designation from a scale of 1 to 8: 1-2

unreliable, 3-4 risky, 5-6 reliable, 7-8 certain). Narrative statements were provided by most participants to show the basis for their status choice for all endangered, threatened, or special concern categories selected. A second round was conducted based on information derived from Round 1 scores and the explanations for inclusion of the Pine Snake in the expert's chosen category. This process was repeated for a total of four rounds. When 85% of participants agreed on a status, the species was dropped from further consideration. This process is summarized more completely in Clark et al. (2006) on using the Delphi Technique for birds in New Jersey, a process used for all groups of animals. The process used for evaluation of the Pine Snake in New Jersey was identical to that described in Clark et al. (2006).

Criticisms of the Delphi Technique as used for the Pine Snake in New Jersey

1. Clark et al. (2006) pointed out that an expert from outside the agency was contracted to act as principal investigator, presumably to avoid agency influence or the perception thereof. However, that was not done for the Delphi Process with amphibians and reptiles. Two NJ Division of Fish, Game and Wildlife agency within the NJ Department of Environmental Protection personnel headed up the Delphi Process, Mr. Eric Stiles initially until his move to a federal agency followed by Dr. Larry Niles, Bureau Chief, Endangered and Nongame Species Program.

2. The list of names of participants provided by the NJ Department of Environmental Protection for the Delphi Process for amphibians and reptiles includes people who, in my opinion and knowledge, have experience with Pine Snakes in New Jersey and some who do not. Of the 18 people in Round 1, six apparently have experience with the Pine Snake, four do not due their expertise in other areas, four NJ Division of Fish, Game and Wildlife personnel who may or may not have field experience with this species, and four people unknown to me. The list of participants in Round 2 was nearly identical to that for Round 1, with the exception of one person who participated in Round 1 only and one who participated in Round 2 only. Thus, the effective Delphi process for the Pine Snake appears to have been based primarily on the six people who know this species and not the 18 as suggested by the result summaries.

Other Methods Available for Determining the Status of the Pine Snake

Two methods are available to wildlife managers, conservation biologists, and researchers that can be used to determine whether a species or population is declining. Such information is directly applicable to consideration of species for inclusion under state and federal endangered species laws. Both are quantitative. One relies on extensive and often difficult to obtain information about the population and species life histories. The other is less expensive and time consuming but can yield important data on population trends at the landscape level. I point out that neither has been used by the NJ Department of Environmental Protection for determination of the listing category for the Pine Snake or for evaluation of the population status of the Pine Snake over time.

Population Viability Analysis (PVA)

A large body of information on such things as growth rates, age at maturity, and survivorship are needed to provide quantitative estimates of the status of the Pine Snake population in the Pinelands. Is the entire population stable, growing, or declining? Are subpopulations in separate areas stable, growing, or declining? And is there a mix of these possibilities throughout the range of the Pine Snake in New Jersey? The population parameters needed to answer such questions under PVA are very much like those used by human insurance statisticians for actuary tables designed to estimate age- and gender-specific insurance rates. Below is a brief review of the population and demographic parameters needed to develop models that estimate how the Pine Snake population would respond to a variety of pressures. I provide information on what is known currently for each.

Number of offspring produced in a clutch or litter: Number of eggs produced per female is 3-16.

Female age at maturity: estimated at age 4 for females and males.

Number of offspring produced by a female in her lifetime: unknown

Age-specific sex ratio in the population: unknown.

Length of life: Pine snakes will live up to 15 years in captivity but length of life in nature is unknown.

Survivorship rates of life history stages: Survivorship of eggs and hatchlings in the nest is likely low due to the diversity and numbers of predators that dig up nests and eat them. However, there are no quantitative data on survivorship rates of either of these life history stages. Likewise, there are no quantitative data on survivorship rates of adults.

Hatchling survivorship depends in part on the incubation temperature of the eggs. Hatchlings from eggs incubated at low temperatures were less responsive to potential predators in and out of the nest than those incubated at higher temperatures. Females with eggs are vulnerable and conspicuous to predators during the nesting season. They are slower than females without eggs and easier to catch.

Age-specific reproductive rates: Younger females may produce fewer eggs than older females and may not lay eggs every year, as is known for other large snakes. However, no data on this important parameter are available.

Demographic model (= Life history table): Age-specific survival and fecundity (clutch sizes) schedules are critical elements in development of quantitative estimates of population growth or the potential for population growth. No data on age-specific survival and fecundity are available.

Population growth rates: Estimates of annual growth of the Pine Snake population over a period of years are unknown. These data are needed to see how the snake population varies over time under current conditions in the landscape. They are also needed for models predicting how population size will vary under different changes that may affect them. There is no estimate of population growth or decline for any year in New Jersey.

PVA is a process that evaluates data and models for a population in anticipation that it will persist for some specified time into the future. It includes estimates of the minimal number of individuals that constitute the viable population. Once these estimates are determined, then they can be used in computer simulation models that can be manipulated to answer various questions. One can vary the parameters such as increase in predation, loss of habitat, changes in adult survival rates to see how such changes and stresses impact the population. Results from these model manipulations can then be used to make informed decisions about protection and management options.

The kinds of information needed for such PVA models include all of the parameters listed above in this section. Unfortunately, so little information exists on any of these needed parameters for the Pine Snake that it is impossible to gain any insights into how the species will respond to changes in the landscape. Thus, the only way to anticipate any changes in the Pine Snake population in New Jersey in the face of landscape changes is to speculate.

Occupancy Models

Wildlife studies are often designed to understand changes or differences in the proportion of sites occupied by a species of interest. Many such studies are hampered by the imperfect detection of animals like the secretive Pine Snake. Some sites can appear to be unoccupied when they are actually occupied. Occupancy models seek to solve this problem. These models use information obtained from repeated observations at each study site to estimate detectability (present or not-detected). Detectability can vary dramatically due to site characteristics (e.g., habitat type, presence or absence of water) or survey characteristics (e.g., weather at time of the survey). Occupancy models take into account only the site characteristics, along with the presence or lack thereof of the species being studied. The primary method to obtain the data needed for these models is to visit the site repeatedly at different times and seasons and attempt to find the species in question. The information derived from field work is simply a record of whether a species, in this case the Pine Snake, was detected or not detected during the survey of each site. The same sites are visited repeatedly in the same year and over a series of years. The accumulated records allow development of detection histories, which can then be converted in to mathematical statements. The mathematics are complicated but are fortunately incorporated into

two software packages, MARK and PRESENCE, that are available on the World Wide Web. The data used in occupancy models are relatively easy to obtain and is inexpensive. Unlike the parameters needed for PVA that requires extensive data on various life history and population features, the data only specify presence or absence information.

Monitoring occupancy at a large number of sites and in different habitat types in the range of the Pine Snake can reveal changes in the status of this snake over broad areas. The reports provided by the NJ Department of Environmental Protection indicate that some number of sites have been surveyed for Pine Snakes and that some of these places have been surveyed several times over the past 20 or so years. There must also be records of sites visited with no detection of Pine Snakes. Thus, some data for the development of detection histories for Pine Snakes already exist for several locations, although they must be accumulated and organized. If these locations meet the assumption of independent samples (detection at one site is independent of detection at another site) necessary for the models and if some of the sites are in places with different forms of land use, then occupancy models may be constructed with little to no additional field surveys. These results can then be used to provide a more robust and quantitative evaluation of the status of the Pine Snake in New Jersey. Such an exercise would lead directly to support or lack of it for the listing of the Pine Snake as Threatened based on the Delphi process.

I suspect, however, that several years of additional surveys in a variety of habitat types (e.g., Low and Medium Intensity Developed sites, Evergreen/Pine Forest, Cultivated Crops) would be necessary to provide the data necessary for a full evaluation of the status of the Pine Snake in New Jersey. Such an effort would be a great improvement over using the Delphi Process on which to base decisions about species that have legal ramifications.

Conclusions

Criticisms

1. The fieldwork on the Pine Snake in New Jersey, most of it under contract to environmental consulting firms, that has been conducted since the listing of this species in 1979 has focused on surveys for additional locations, location of hibernacula and suitable nesting areas, development and construction of artificial dens, radio-tracking of adults and a few juveniles in some areas,

categorization of habitats used, biological studies on behavior and ecology, and anecdotal observations of road- and predator-caused mortality. Such approaches have been developed and used over the past 20+ years. There have apparently been no attempts to obtain quantitative estimates of population sizes or population growth or decline. There have apparently been no attempts to develop a comprehensive management plan by partnering with all the stakeholders in the Pinelands. And there has been no attempt to develop quantitative computer models to evaluate effects of various threats. It seems obvious that the NJ Department of Environmental Protection has not moved past the survey and accumulation of natural history, ecological, and behavioral data phase. Agency personnel seem to be stuck in the same paradigm for the past two decades.

2. There are at least 387 sites in the New Jersey Pinelands where Pine Snakes have been documented. These sites are on several habitat types in both public and private lands. This large number of known sites and the broad range of occurrence on a variety of habitat types in the Pinelands does not support two of the criteria in the official definition of the Threatened category, namely, restricted range and narrow habitat affinities.

3. Aside from anecdotal observations and statements by the experts involved in the Delphi process to the contrary, the NJ Department of Environmental Protection has not demonstrated that the Pine Snake population in New Jersey has declined in size. That is, they have not demonstrated quantitatively that the Pine Snake has suffered a "significant population decline" as noted in the official definition of the Threatened category. Indeed, the Delphi participants noted in Rounds 1 and 2: "Seems to be making a comeback but not ready for removal from the list" and "It appears to be fairly common" (Appendix 2).

4. The NJ Department of Environmental Protection has not generated a single quantitative estimate of population size anywhere in the range of the Pine Snake in New Jersey. Based on numbers and listings of Pine Snakes that have been marked or tagged for individual recognition as noted in unpublished reports, it appears that some data exist that would allow at least a population size estimate to be generated for one or two sites using relatively simple population models. This has not been done.

5. The NJ Department of Environmental Protection has not proven publicly, in reports made available to me or in the published scientific literature, that the "conditions surrounding it begin or continue to deteriorate" (from the definition of Threatened) criterion has been analyzed or met. There is apparently (based on documents provided) that a digital GIS data layer of all known locations has been developed. However, in nothing that was made available to me was there any indication that this GIS layer of locations has been evaluated with respect to changes over time (comparison of old localities with land use with newer localities and land use), or encroachment into natural Pine Snake habitat by other land uses. Thus, this criterion from the official definition of the Threatened category has not been fully evaluated in any way, much less quantitatively.

6. The NJ Department of Environmental Protection has apparently not undertaken any study of the threats to the survival of the Pine Snake. Yet, there are many problems with road-kills on and off paved surfaces, illegal collection for the pet trade, and the predators of eggs and nests. There is no mention of any discussion of road tunnels for animal movement under roads, evaluation and control of natural, introduced, and subsidized predators, or use of prescribed fire for maintenance of some of the forests in the Pinelands to bring them back to natural conditions. New Jersey Department of Environmental Protection has apparently failed to be proactive in their plans and activities to protect the Pine Snake from a variety of well-known threats.

Support

1. A very important finding of the past 20 years of fieldwork has been the identification of hibernacula sites in the field and the development and construction of effective and workable artificial hibernacula. These hibernacula are critical features on the landscape without which the Pine Snake would not survive. A second important finding is the location and understanding of nest site location, nest construction by females, and threats to the eggs and hatchlings. This information is critical to any conservation or management plan on the Pine Snake.

2. The use of radio-telemetry to track snakes to obtain information on movement patterns, home range sizes, habitat use, and behavior in financially-supported studies of the Pine Snake has yielded much valuable information on their lives and insights into their behavior and use of the various habitats on the land. This information has, unfortunately, not been used in any estimates of population size and dynamics or in development of conservation or management plans.

3. Observations and data on poaching of Pine Snake hibernacula and nest sites by people collecting this animal illegally for the pet trade, data on the mortality of snakes by vehicles on hard surface roads and off-road vehicles on sand roads, and observations of predation by subsidized predators are important for an understanding of the layers of threats to the survival and persistence of the Pine Snake. Subsidized predators are those, such as raccoons and coyotes, whose populations may be unnaturally high due to subsistence from human sources (e.g., trash and hiding places). These predators are voracious and will kill and eat anything they can get. Collectively, the impacts from poachers, vehicles, and subsidized predators form a serious threat to long-term survival of the Pine Snake. Such information was taken into account when it was listed as Threatened.

Primary Conclusion

The information used in the decision to list the Northern Pine Snake as state Threatened in New Jersey is weak at best and based only on expert opinion and not on any quantitative estimates of population sizes or trends or land use analyses such as that provided by GIS applications. The inclusion of the Northern Pine Snake in the Threatened category in the New Jersey Department of Environmental Protection appears to be suspect due to the vague and limited support of all the parts of the official definition of this category. The protection status of the Northern Pine Snake in New Jersey is clearly in need of reevaluation and that process should be based on quantitative data. The information in available public sources and the documents provided by the New Jersey Department of Environmental Protection do not fully support listing the Northern Pine Snake as state Threatened.

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Appendix 1

A. Spatial Data Generation for ENSP Northern Pine Snake Locations.

Appendix 2

A. New Jersey Division of Fish and Wildlife web page on the Pine Snake.

B. Instructions to Delphi participants for review of New Jersey amphibians and reptiles for protection categories.

C. Summary of the scores on the Pine Snake and comments from Round 1 of the Delphi process.

D. Summary of the scores on the Pine Snake and comments from Round 2 of the Delphi process.

E. Copy of the Excel spreadsheet on scores and confidence levels for the Pine Snake. Note that the confidence score average is different from the average score in Appendix 1 D.

Appendix 3

A. Copy of Clark et al. (2000).

APPENDIX 1

Spatial Data Generation for ENSP Northern Pine Snake Locations

Scope:
We generated an ArcView shapefile, for 384 locations where the northern pine snake has been observed. The data for these locations were derived from an 11 x 17-inch (ANSI-B) paper map provided by Mitchell Ecological Research LLC., Richmond, Virginia.

Methods and Results:
We obtained a digital "source map" and metadata (Appendix I) in shapefile format (stco.shp) the county boundaries of New Jersey from the New Jersey Dept. of Environmental Protection (NJDEP), Bureau of Geographic Information Systems' website (www.state.nj.us/dep/gis/digidownload/metadata/statewide/stco.htm). This shapefile was used to georeference and rectify the paper, or "target map" that had been scanned into raster format (~50 ft [on the ground] pixels). We used 3rd-order polynomial rectification using 15 ground-control point (GCP) pairs (*i.e.*, known locations on source and target maps such as county intersections forming "tees" [Figure 1, Table 1]). We were able to co-register the target and source maps to within a average of ~66 ft of error for the fifteen GCPs.

Figure 1. Example of GCP selection of known locations on source and target maps (three pairs shown [A, B, and C]).

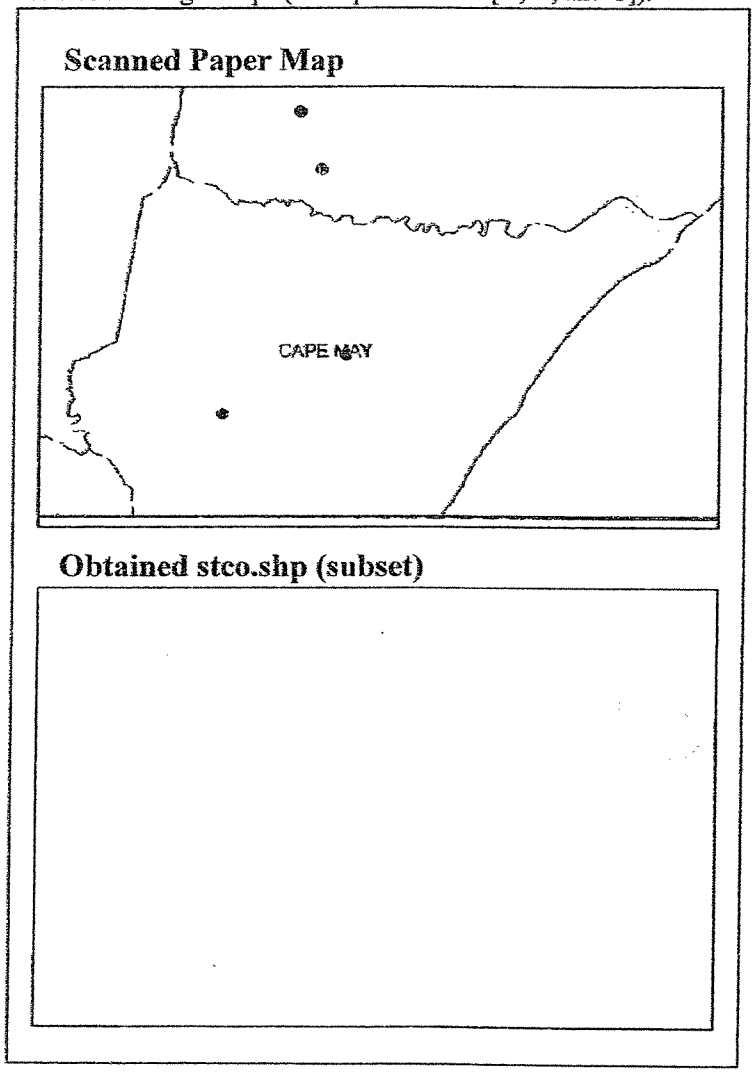

Table 1. List of the 15 ground-control points used to rectify the paper map provided. Projection and coordinate system (respectfully): Transverse Mercator, NAD 1983 State Plane New Jersey (FIPS 2900 Feet). Geographic Coordinate System and Datum (respectively): GCS North American 1983, North American 1983

X coordinate	Y coordinate
480723.250	169790.094
425694.313	326596.187
477277.937	453722.437
335394.000	422691.531
546744.812	234716.937
355239.719	248558.234
385859.781	282461.969
375166.625	125914.305
389964.750	178809.063
429473.281	478674.594
514948.055	263793.656
467548.898	475238.996
601868.451	475073.237
518174.269	487710.183
327437.229	227880.981

The size of the observation points on the rectified map represented a 2500-ft diameter "on the ground" area. However, in most cases we were able to identify and digitize the centers of these areas (assumed to be the true location) within ~1 pixel (~50 ft). There were some problems locating some of the centers, especially for overlapped or clustered groups of locations. The newly digitized locations were saved as an ArcView (point) shapefile in an ArcGIS document (Appendix II). Thus, the average deviation of location points is estimated to be ~116 ft (66 from the county boundaries and 50 ft for the digitized points).

Deliverables:

- Paper map of final product (ANSI D [34 x22 inches])
- Electronic version of final product (ArcView [point] shapefile format) including associated spatial data
- Metadata for final electronic product

Appendix I. Metadata for the source map shapefile, stco.shp. Copied from the NJDEP County Boundaries for the State of New Jersey website provided above

Metadata:

Identification_Information:

Citation:
Citation_Information:
Originator:
NJ Department of Environmental Protection (NJDEP), Office of Information Resources Management (OIRM), Bureau of Geographic Information Systems (BGIS)
Publication_Date: 20030123
Title: NJDEP County Boundaries for the State of New Jersey
Edition: 2003
Geospatial_Data_Presentation_Form: vector digital data
Series_Information:
Publication_Information:
Publication_Place: Trenton, NJ
Publisher: NJDEP
Online_Linkage:
<http://www.state.nj.us/dep/gis/digidownload/zips/statewide/stco.zip>
Description:
Abstract:
This data contains the county boundaries of New Jersey. Boundary lines were checked against other boundary delineations such as Patton, Hagstrom, and county freeholder maps. Inconsistencies when found were evaluated and in many cases the Township Engineers were called or tax sheets viewed. Changes were made when inconsistencies with other maps were found based on preponderance of data. In area where the line was labeled as approximate, attempts were made to correctly locate the boundary. The 1986 photoquads were used to move the boundary lines to photo-identifiable features as needed. Changes of less than 5 acres were not made. This coverage was DISSOLVED from New Jersey's Statewide Municipality coverage (stmun).

In January 2003 the Census 2000 population information was joined to the former stco coverage to create this stco data layer. Additional attributes included population in 1990 and 1980, and population change between each census.

Purpose:
New Jersey county boundaries were digitized into NJDEP's GIS to provide basic jurisdictional information.
Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: 200301227
Currentness_Reference: ground condition
Status:
Progress: Complete
Maintenance_and_Update_Frequency: As needed
Spatial_Domain:
Bounding_Coordinates:
West_Bounding_Coordinate: -75.587306
East_Bounding_Coordinate: -73.890363
North_Bounding_Coordinate: 41.357564
South_Bounding_Coordinate: 38.924819
Keywords:
Theme:
Theme_Keyword_Thesaurus: None
Theme_Keyword: boundaries
Theme_Keyword: Political Divisions
Theme_Keyword: Statewide
Theme_Keyword: Population
Theme_Keyword: NJDEP
Theme_Keyword: County
Theme_Keyword: Counties
Theme_Keyword: Census 2000
Theme:
Theme_Keyword_Thesaurus: ISO 19115 Topic Category
Theme_Keyword: boundaries
Place:
Place_Keyword_Thesaurus: None
Place_Keyword: New Jersey
Place_Keyword: NJ
Place_Keyword: State of
Access_Constraints: None
Use_Constraints:
Data Distribution Agreement (NJDEP) Agrees to abide by the terms and conditions of the following:

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"This (map/publication/report) was developed using New Jersey Department of Environmental Protection Geographic Information System digital data, but this secondary product has not been verified by NJDEP and is not state-authorized."

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Browse_Graphic:
Browse_Graphic_File_Name:
<http://www.state.nj.us/dep/gis/digidownload/images/statewide/stco.gif>
Browse_Graphic_File_Description: Snapshot image of New Jersey's county boundaries
Browse_Graphic_File_Type: GIF
Native_Data_Set_Environment:
Microsoft Windows 2000 Version 5.0 (Build 2195) Service Pack 1; ESRI ArcCatalog 8.2.0.700

Data_Quality_Information:
Attribute_Accuracy:
Attribute_Accuracy_Report: Fields were attributed and checked.
Logical_Consistency_Report:

County lines were taken from mylar USGS topoquads. Boundary lines were checked against other boundary delineations such as Patton, Hagstrom, and county freeholder maps. Inconsistencies when found were evaluated and in many cases the Township Engineers were called or tax sheets viewed. Changes were made when inconsistencies with other maps were found based on preponderance of data. In area where the line was labeled as approximate, attempts were made to correctly locate the boundary. The 1986 photoquads were used to move the boundary lines to photo-identifiable features as needed. Changes of less than 5 acres were not made. This coverage was DISSOLVED from New Jersey State Municipality coverage (stmun).

Only Attributes were updated in 2003 with current census population data.

Completeness_Report: Complete
Positional_Accuracy:
Horizontal_Positional_Accuracy:
Horizontal_Positional_Accuracy_Report:
NMAS: Lines were proof plotted on mylar and evaluated to the original mylar overlays. Any lines over 30 feet off (1.5 line widths) were edited and redigitized. The information present in these files is provided for the purposes of statistical analysis and census operations only. Coordinates in the TIGER/Line files have six implied decimal places, but the positional accuracy of these coordinates is not as great as the six decimal places suggest. The positional accuracy varies with the source materials used, but generally the information is no better than the established national map Accuracy standards for 1:100,000-scale maps from the U.S. Geological Survey (USGS); thus it is NOT suitable for high-precision measurement applications such as engineering problems, property transfers, or other uses that might require highly accurate measurements of the earth's surface. The USGS 1:100,000-scale maps met national map accuracy standards and use coordinates defined by the North American Datum, 1983. For the contiguous 48 States, the cartographic fidelity of most of the Census 2000 TIGER/Line files, in areas outside the 1980 census Geographic Base File/Dual Independent Map Encoding (GBF/DIME) file coverage and selected other large metropolitan areas, compare favorably with the USGS 1:100,000-scale maps.

The Census Bureau cannot specify the accuracy of features inside of what was the 1980 GBF/DIME-File coverage or selected metropolitan areas. The Census Bureau added updates to the TIGER/Line files that enumerators annotated on maps sheets prepared from the Census TIGER data base as they attempted to traverse every street feature shown on the Census 2000 map sheets; the Census Bureau also made other corrections from updated map sheets supplied by local participants for Census Bureau programs. The locational accuracy of these updates is of unknown quality. In addition to the Federal, State, and local sources, portions of the files may contain information obtained in part from maps and other materials prepared by private companies. Despite the fact the TIGER/Line data positional accuracy is not as high as the coordinate values imply, the six-decimal place precision is useful when producing maps. The precision allows features that are next to each other on the ground to be placed in the correct position, on the map, relative to each other, without overlap.

Vertical_Positional_Accuracy:
Vertical_Positional_Accuracy_Report: n/a
Lineage:

Source_Information:
Source_Citation:
Citation_Information:
Originator: United States Geological Survey
Publication_Date: 1987
Title: USGS Topoquads
Geospatial_Data_Presentation_Form: mylar
Publication_Information:
Publication_Place: Reston, VA
Publisher: USGS
Source_Scale_Denominator: 24000
Type_of_Source_Media: mylar
Source_Time_Period_of_Content:
Time_Period_Information:
Single_Date/Time:
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Time_of_Day: unknown
Source_Currentness_Reference: ground condition
Source_Citation_Abbreviation: USGS Topoquads
Source_Contribution:
State Municipalities (stmun) was dissolved to create State County (stco). Only stco table attributes were updated.
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Process_Description:
Fields were added and linework recompiled.

County lines were taken from mylar USGS topoquads and other sources in 1987. The scale of the original data varies, relying primarily on 1:24,000 topoquads.. Boundary lines were checked against other boundary delineations such as Patton, Hagstrom, and county freeholder maps. Inconsistencies when found were evaluated and in many cases the Township Engineers were called or tax sheets viewed. Changes were made when inconsistencies with other maps were found based on preponderance of data. In area where the line was labeled as approximate, attempts were made to correctly locate the boundary. The 1986 photoquads were used to move the boundary lines to photo-identifiable features as needed. Changes of less than 5 acres were not made. This coverage was DISSOLVED from stmun.

US Census Bureau's census 2000 population tables were joined to existing county polygons in 2003.

Process_Date: 20030127
Process_Step:
Process_Description: Metadata imported.
Source_Used_Citation_Abbreviation: C:\DOCUME~1\jbocchin\LOCALS~1\Temp\xmlC.tmp

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Point_and_Vector_Object_Information:
SDTS_Terms_Description:
SDTS_Point_and_Vector_Object_Type: G-polygon

Point_and_Vector_Object_Count: 23

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Planar:
Grid_Coordinate_System:
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State_Plane_Coordinate_System:
SPCS_Zone_Identifier: 2900
Transverse_Mercator:
Scale_Factor_at_Central_Meridian: 0.999900
Longitude_of_Central_Meridian: -74.500000
Latitude_of_Projection_Origin: 38.833333
False_Easting: 492125.000000
False_Northing: 0.000000
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Planar_Coordinate_Encoding_Method: coordinate pair
Coordinate_Representation:
Abscissa_Resolution: 0.002048
Ordinate_Resolution: 0.002048
Planar_Distance_Units: survey feet
Geodetic_Model:
Horizontal_Datum_Name: North American Datum of 1983
Ellipsoid_Name: Geodetic Reference System 80
Semi-major_Axis: 6378137.000000
Denominator_of_Flattening_Ratio: 298.257222

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Entity_Type_Definition: County Boundaries for the State of New Jersey
Entity_Type_Definition_Source: NJDEP
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Attribute_Label: FID
Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain:
Sequential unique whole numbers that are automatically generated.
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Attribute_Label: Shape
Attribute_Definition: Feature geometry.
Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
Unrepresentable_Domain: Coordinates defining the features.
Attribute:
Attribute_Label: AREA
Attribute_Definition: Total Area

Attribute_Definition_Source: ESRI
Attribute_Domain_Values:
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Range_Domain_Minimum: 192058.67'
Range_Domain_Maximum: 2280000000
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Attribute_Definition: Perimeter of feature in internal units.
Attribute_Definition_Source: ESRI
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Range_Domain_Minimum: 2156.094
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Attribute_Definition: Internal feature number.
Attribute_Definition_Source: ESRI
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Sequential unique whole numbers that are automatically generated.
Attribute:
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Attribute_Definition: User-defined feature number.
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Sequential unique whole numbers that are automatically generated.
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Codeset_Domain:
Codeset_Name: FIPSSTCO
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Attribute_Definition_Source: Federal
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Attribute_Definition: County Name
Attribute_Definition_Source: none
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Range_Domain:
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Attribute_Label: POP1990
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Unrepresentable_Domain: Unique value
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Attribute_Label: POP1980
Attribute_Definition: Population in 1980
Attribute_Definition_Source: Census Bureau
Attribute_Domain_Values:
Unrepresentable_Domain: Unique value
Attribute:
Attribute_Label: CP00_90
Attribute_Definition: Change in Population between 2000 and 1990
Attribute_Definition_Source: none
Attribute_Domain_Values:
Unrepresentable_Domain: Unique value
Attribute:
Attribute_Label: CP90_80
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Attribute_Label: PC00_90
Attribute_Definition: Percentage Change in Population between 2000 and 1990

Attribute_Definition_Source: none
Attribute_Domain_Values:
Unrepresentable_Domain: Unique value
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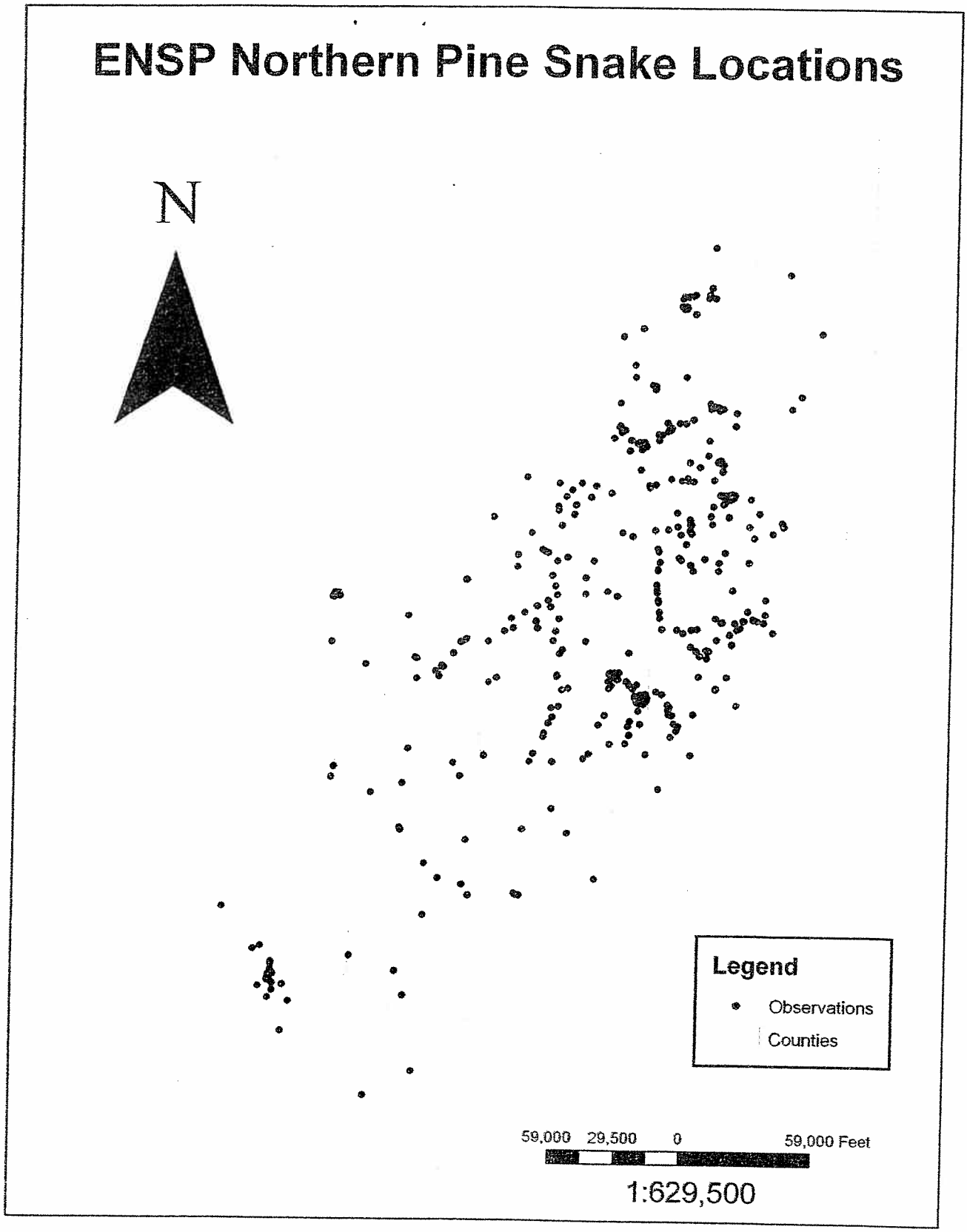
Attribute_Label: REGION
Attribute_Definition: Regions of New Jersey as identified by the Census Bureau
Attribute_Definition_Source: none
Attribute_Domain_Values:
Unrepresentable_Domain: Unique value

Distribution_Information:
Distributor:
Contact_Information:
Contact_Organization_Primary:
Contact_Organization: NJDEP/OIRM/BGIS
Contact_Address:
Address_Type: mailing and physical address
Address: 401 East State Street, First Floor, PO Box 428
City: Trenton
State_or_Province: New Jersey
Postal_Code: 08625-0428
Country: USA
Contact_Voice_Telephone: (609) 777-0672
Contact_Facsimile_Telephone: (609) 292-7900
Contact_Electronic_Mail_Address: gisnet@dep.state.nj.us
Resource_Description: Downloadable Data
Distribution_Liability: See "Use Constraints"
Standard_Order_Process:
Digital_Form:
Digital_Transfer_Information:
Format_Name: AVSHP
Format_Version_Number: 8.2
File_Decompression_Technique: WinZip
Transfer_Size: .5
Digital_Transfer_Option:
Online_Option:
Computer_Contact_Information:

Network_Address:
Network_Resource_Name: <http://www.state.nj.us/dep/gis/stateshp.html>
Offline_Option:
Offline_Media: None
Recording_Capacity:
Recording_Format: None
Fees: None
Ordering_Instructions: None
Available_Time_Period:
Time_Period_Information:
Single_Date/Time:
Calendar_Date: unknown

Metadata_Reference_Information:
Metadata_Date: 20030127
Metadata_Contact:
Contact_Information:
Contact_Person_Primary:
Contact_Person: Craig Coutros
Contact_Organization: NJDEP/OIRM/BGIS
Contact_Position: GIS Specialist
Contact_Address:
Address_Type: physical address
Address: 401 East State Street, First Floor, PO Box 428
City: Trenton
State_or_Province: New Jersey
Postal_Code: 08625-0428
Country: USA
Contact_Voice_Telephone: 609-777-0672
Contact_Facsimile_Telephone: 609-292-7900
Contact_Electronic_Mail_Address: gisnet@dep.state.nj.us
Metadata_Standard_Name: FGDC Content Standards for Digital Geospatial Metadata
Metadata_Standard_Version: FGDC-STD-001-1998
Metadata_Time_Convention: local time

Appendix II. Final Map of digitized locations of the northern pine snake.

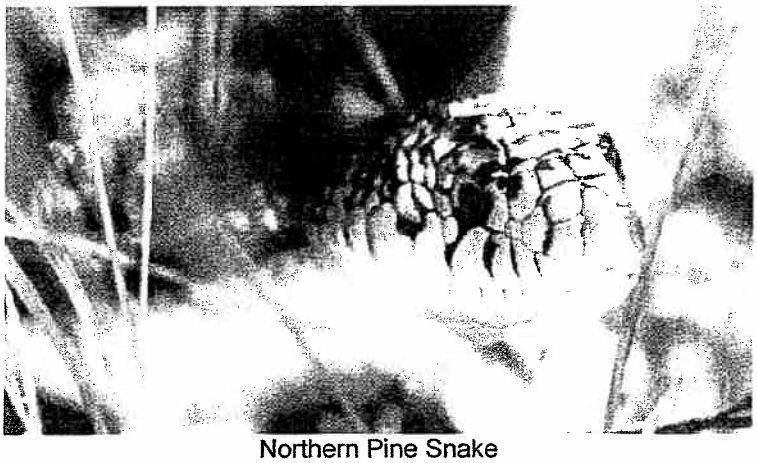


APPENDIX 2

Northern Pine Snake - September 2003 Species of the Month

If unexpectedly encountered on the trail or in the woods, this large, white-and-black patterned snake would most likely vibrate its tail, hiss loudly, and then try to escape. Though its bold appearance and actions may fool or scare some people, this particular species of snake is not venomous. In fact, it is harmless to people and is a beneficial predator in nature.

The **Northern pine snake** (*Pituophis melanoleucus melanoleucus*) is a threatened species in New Jersey and was the September Species of the Month. The designation was part of a yearlong program to commemorate the 30th Anniversary of the **New Jersey Endangered Species Conservation Act** and the formation of DEP's Endangered and Nongame Species Program (ENSP).



Northern Pine Snake

In Search of a Secretive Snake...

- There are four types of pine snakes that can be found in the United States. The northern pine snake is found in the Northern and Eastern-Central regions of the country, in areas with sandy soils and dry upland forests. The population distribution of this pine snake is spotty and all indications suggest that pine snake abundance is decreasing throughout the Northeastern region. As a result, all states in which they are found have listed them as either endangered or threatened.
- The New Jersey Pinelands may provide residence for some of the largest populations of pine snakes in

Coiled Northern Pine Snake

Northern Pine Snake on sand

Northern PIne Snake

the Northeast, but even in the protected Pinelands this species may be at risk.

- The northern pine snake is known for being secretive and is therefore challenging to study and detect. This species of snake, which rarely climbs vegetation and prefers to be on the ground, has the ability to tunnel underground and excavate its own nests, summer dens and places to hibernate. Therefore, scientists believe that it prefers the more pliable sandy soils and forested areas of the Pinelands.

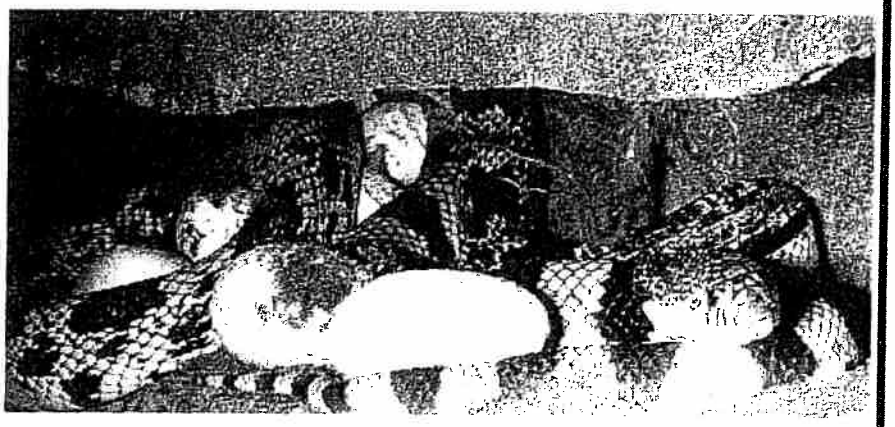
- The northern pine snake populations in New Jersey have been affected by a loss of habitat due to development, illegal collecting (due to its popularity as a pet), and other more individualized behavior such as the thoughtless killing of snakes by hikers, automobile drivers and users of off-road vehicles.

- Department biologists in the Endangered and Nongame Species Program have created a technique for using land cover and soils information to produce maps of potential pine snake habitat. They used scientific literature, information from pine snake experts and the DEP's Geographic Information Systems and wildlife databases to develop the maps. These maps, which depict potential pine snake habitat, have been completed for the southern New Jersey Pinelands. Biologists plan to compare known locations of pine snakes with the mapped habitat to help refine the mapping criteria and guide future management plans.

Northern Pine Snake – Facts of Interest

- The northern pine snake can grow to 5 feet to 7 feet long and has a black and dull white pattern. There are dark blotches along the top and sides of the body which are less distinct in the front part of the body and more distinct in the hind part. The belly is white with rows

of black dots along either side.



- This species of snake has a small pointed head with a tipped snout and thick neck, which are helpful when it moves soil around or burrows. It also has a special scale at the front of its snout that shields its nose and protects it as it tunnels underground. In fact, much of its time is spent hidden underground.

- The pine snake is a nonvenomous constrictor. It kills its prey by coiling itself around it in order to suffocate the animal. Pine snakes are known to eat mammals as large as rabbits, as well as small rodents and birds. They are usually most active in early morning or late afternoon when they leave their burrows to hunt.

- Pine snakes are egg-layers and typically lay their eggs in underground nests that they excavate in open sandy areas. Eggs are usually laid in mid-summer, and adult females have the tendency to re-use their nest sites year after year.

Ways You Can Help

- Avoid killing a snake if encountering one in a natural area, either when you are traveling on foot or in a vehicle. Back away slowly and do not disturb it.

- Anyone who is interested in reptiles and amphibians and enjoys being outdoors can become a volunteer with the Herp Atlas Project. Department staff and volunteers are collecting data on the locations and abundance of all reptile and amphibian species throughout the state. This data will be used to map the critical habitat and distribution of these species, which will allow the agency to better plan for the state's wildlife conservation efforts.

- Attention, observant nature lovers! Department staff would like to learn about your sightings of an endangered, threatened or rare species in New Jersey. To file a report of a sighting, download and complete the Threatened and Endangered Species Report Form. This data helps biologists and wildlife managers to look at habitat and population trends and then develop appropriate conservation strategies.

Order a Conserve Wildlife special interest license plate for your vehicle. It's tax-deductible, with 80% of the payment benefiting New Jersey's Endangered and Nongame Species Program.

Do you enjoy learning about New Jersey wildlife? Being outdoors? Interacting with the public? Assisting with meaningful volunteer initiatives? If so, join the Wildlife Conservation Corps, the state's largest natural resource management volunteer group. Volunteer opportunities are diverse and include lending assistance with trout stocking; operating check

stations; maintaining shooting ranges; and instructing the public. Adults interested in public speaking are also invited to join the Corp's Endangered and Nongame Species Program's Speakers Bureau. The bureau provides speakers to organizations interested in learning more about New Jersey's threatened and endangered species.

Want to learn new information quickly about New Jersey wildlife? The Division of Fish and Wildlife offers eight E-mail "mailing list" choices to the public. Visit the E-mail List Subscription Page to learn more about this free service and how to sign up.

Join the Conserve Wildlife Foundation and/or make a donation NOW!

Additional Sources of Information

- Northern Pine Snake Fact Sheet - DEP Division of Fish and Wildlife *(pdf, 50kb)
- Northern Pine Snake - Habitat Assessment and Mapping - DEP Division of Fish and Wildlife

Check this out for purchase!

- Field Guide to Reptiles and Amphibians of New Jersey and Related CD - DEP Division of Fish and Wildlife

Hot off the press!

- Endangered and Threatened Wildlife of New Jersey Book - Now on Sale (336-page color guide to the state's 73 endangered and threatened wildlife species)

-- Some files on this site require adobe acrobat pdf reader to view. download the free pdf reader

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Department of Environmental Protection
P. O. Box 402
Trenton, NJ 08625-0402

Last Updated: October 7, 2004

New Jersey Division of Fish and Wildlife

Northern Pine Snake

Habitat Enhancement

Currently, the Endangered and Nongame Species Program is working with the Division's Bureau of Land Management to enhance pine snake habitat in a portion of Greenwood Forest Wildlife Management Area. The area will also being managed to enhance quail habitat and to provide an area for hunting dog field trials.

Northern Pine Snake Habitat Assessment and Mapping

ENSP biologists have developed habitat delineation criteria for the northern pine snake, based on current literature and discussions with pine snake experts. Working with the Division's wildlife database and Geographic Information System databases, staff biologists created a technique for using land cover and soils information to produce maps of potential pine snake habitat.

Maps depicting potential pine snake habitat have been completed for the entire southern New Jersey Pinelands. As a next phase in this project, biologists plan to compare known locations of pine snakes with the mapped habitat to help refine mapping criteria and to help guide habitat management plans.

Background

Within New Jersey the northern pine snake occurs exclusively within the southern half of the state in the Pine Barrens of the outer coastal plain. This population of *Pituophis melanoleucus melanoleucus* is disjunct and distant from the larger range which includes the western Appalachians of Virginia, North Carolina, southern Kentucky, Tennessee, northern Alabama, northern Georgia, as well the piedmont of southern North Carolina, and nearly all of South Carolina (Connant 1975). Throughout its range the pine snake is nearly always associated with dry upland forests, most often with pine woods (Connant 1975, Woodward & Barthalmus 1992).

The New Jersey Department of Environmental Protection lists the northern pine snake as a threatened species. This listing is based on the isolation of the New Jersey population, vulnerability to illegal collecting, and loss of habitat to development pressures. The United States Department of the Interior - Fish and Wildlife Service previously listed the northern pine snake as a candidate (C2) for listing under the federal Endangered Species Act. The C2

classification denoted taxa "for which the information now in possession of the Service indicates that proposing to list the species as threatened or endangered is possibly appropriate, but for which conclusive data are not available to support proposed rules at this point." Collection for the pet trade and habitat loss were cited as possible factors in local population declines that may warrant listing by the Service.

While the general distribution and habitat associations of northern pine snakes in New Jersey have been known for some time, only recently have researchers begun to investigate their more specific habitat requirements (Burger and Zappalorti 1989, 1988, 1986, Burger et. al. 1988, Zappalorti and Burger 1986, Zappalorti et. al. 1983). These studies have generally established that habitats required by P. m. melanoleucus in New Jersey are provided primarily within dry pine-oak forest types growing on very infertile sandy soils such as Lakehurst or Lakewood sands (Burger and Zappalorti 1988, 1989). Within these generalized habitats, pine snakes select open sandy clearings with little ground cover for nesting. Summer den sites are also typically located in clearings near fallen logs. Winter hibernacula are located in nearby areas providing more vegetation cover and leaf litter (Burger et. al. 1988, Burger and Zappalorti 1986). The greater spatial frequency and temporal persistence of clearings within sandy, infertile soils may partially account for association of pine snakes with these soils. Soil texture may also be important because pine snakes are among the only snakes known to excavate their own hibernacula and summer dens.

The information provided by these studies provides a basis for beginning to map potential northern pine snake habitat by overlaying maps of suitable soils with maps of suitable vegetation cover. Mapping the location and extent of potential habitat is a critical step in the development of a conservation plan for the northern pine snake in New Jersey. Maps depicting suitable habitat will provide a valuable tool for directing pine snake surveys. An understanding of available habitat is also needed to identify areas that may be depleted or unoccupied because specific critical habitat components such as hibernacula or nesting sites are absent or because of over-collecting. When these areas are identified, biologists can experiment with applying management techniques such as provision of artificial hibernacula, prescribed burning, etc. Information on the location of potential pine snake habitat will also assist permitting agencies such as the Pinelands Commission and the Land Use Regulation Program in the review of development permit applications.

The availability of land cover (vegetation) and soils coverages in digital Geographical InformationSystem (GIS) format provided us with the ability to create maps of suitable habitat by combining these data layers following specific criteria. Digitally mapped vegetation and soils information is available for New Jersey through the Integrated Terrain Unit (ITU) maps prepared by the New Jersey Department of Environmental Protection (NJDEP) - Bureau of Geographic Information and Analysis (BGIA). ITU maps comprise a series of digital maps that integrate the separate layers of land use/land cover, soils, geology, and flood prone areas into one seamless, sliverless digital coverage in the GIS.

Methods

We developed maps of potential pine snake habitat by combining the ITU land cover and soils data layers according to predetermined criteria. Before combining coverages we ranked available land cover (vegetation) types as primary (preferred), secondary (suitable), or unsuitable. Soils were ranked as primary (preferred), secondary (suitable), or tertiary (occasionally suitable).

Given the association of pine snakes with pine-oak forests we ranked as primary all polygons classified in the ITU land cover classification as coniferous forested uplands (>75% coniferous forest) and all areas mapped as mixed coniferous/deciduous forested uplands (>50% 75% coniferous trees). Because pine snakes also occasionally use oak-pine forests and other dry upland habitats such as the pine plains areas, we ranked as secondary all polygons mapped on ITU maps as mixed deciduous/coniferous forest (>25% <50%) or as coniferous shrubland (brush cover >25%, composed of >75% coniferous species) or mixed shrublands (brush cover >25% <75% of either coniferous or deciduous species). All remaining polygons of various non-preferred vegetation types were ranked as not suitable and eliminated from inclusion in areas mapped as pine snake habitat.

The Lakewood and Lakehurst soils found to be preferred by pine snakes (Burger and Zappalorti 1988) are characterized as highly leached, sandy, extremely infertile soils known as "sugar sands." Lakewood soils occupy higher upland portions of drainages. Lakehurst soils occupy lower areas with a fluctuating water table that typically reaches the subsoil in late winter (Markley 1979). Based on the association of northern pine snakes with these soils, we ranked them as primary. We also included Evesboro sands among primary soils because this series shares several important characteristics with Lakewood soils (sandy, xeric, excessively drained, acidic, very infertile). Together these three soils comprise the "Lakehurst - Lakewood - Evesboro association" (USDA 1971). Evesboro sands typically support a pine-oak cover, which provides the most widely used habitat for pine snakes. Further, known concentrations of northern pine snakes (e.g. in southeastern Cumberland County) occur on areas of Evesboro soils (R.T. Zappalorti pers. com. 1991). Notably, Evesboro soils are not common in the areas where published studies describing pine snake habitat associations were carried out. This may explain the lack of reference to Evesboro soils within areas of preferred habitat.

We ranked as secondary soils a group of sands and loamy sands having characteristics similar to the Lakewood, Lakehurst and Evesboro series. Secondary soils included Klej sands, Klej loamy sands, Hammonton loamy sands, Woodmansie sands, and abandoned sand mines. These soils also often support a pine-oak forest cover. All remaining polygons of various non-preferred soil types were ranked as tertiary.

Based on their preference for a pine dominated cover growing on Lakewood-Lakehurst-Evesboro soils we ranked polygons created by the overlap of primary vegetation with primary soil types as the most suitable (preferred) pine snake habitat (1-A). However, because we suspect that habitat suitability of a parcel is enhanced by proximity to preferred habitat, inclusion and classification of other soils-vegetation combinations depended on the classification of adjacent polygons. This scheme for classification of remaining polygons attributes slightly greater importance to vegetation than to soils.

For polygons created by the overlap of primary cover types with secondary soils we assigned habitat suitability based on contiguity with 1-A parcels. Those polygons that were adjacent to 1-A habitat were also ranked as preferred (1-B) habitat. Those polygons that were not contiguous with 1-A habitat were ranked as suitable habitat (#2).

Similar "contiguity analysis" was performed for polygons created from the overlap of secondary vegetation with primary soils and where primary vegetation overlapped with tertiary soils. These areas were considered suitable when polygons were contiguous with areas of 1-A or 1-B habitat. When polygons were isolated from areas of primary habitat they were excluded. Areas where secondary vegetation overlapped with secondary soils were considered

unsuitable whether or not they were contiguous with primary habitat.

Findings

For the five counties, a total of 63,030.27 ha or 12.90% of the land area represented by the five counties was found to contain either primary (26,585.05 ha, 5.44% of land area) or secondary (36,445.22 ha, 7.46% of land area) vegetation. By definition, the entire area represented by the five counties, a total of 488822.38 ha, was ranked as either primary (31,657.79 ha, 6.48%), secondary (23,335.21 ha, 4.77%), or tertiary (433,829.38 ha, 88.75%) with respect to soil.

Application of the described habitat mapping criteria and procedures resulted in mapping a total of 12,422.62 ha in the five counties as potential northern pine snake habitat. This represents approximately 2.54% of the total land area represented by the five counties.

Discussion

The relatively low occurrence of potential pine snake habitat in this five-county area resulted from low occurrence of preferred soils and preferred vegetation, low overlap of suitable soils and suitable vegetation, and low connectivity between secondary habitat and primary habitat (failure to meet contiguity criteria). Only around 13.0% of the land area of the five-county area included vegetation cover considered suitable for pine snakes (pine, pine-oak, or oak-pine), and only 5.4% was mapped as the preferred pine or pine-oak types. Primary soils (Lakewood, Lakehurst, and Evesboro) comprised only ~6.5% of the total land area and "secondary soils" comprised only 4.8%. A relatively small portion (37.0%) of the primary vegetation coverage (pine or pine-oak) and an even smaller portion (25.8%) of the primary soil types were ultimately included in the areas mapped as potential pine snake habitat. Given the position of these counties on the periphery of the New Jersey Pinelands, these results are not surprising.

Most of the mapped potential habitat occurred in scattered pockets in all of the counites. The only large areas of contiguous habitat occurred in Cumberland County. A relatively large area of "preferred" habitat was mapped in the western part of the county just west of the Manumuskin River. Several clusters of nearly contiguous habitat were mapped along both sides of the Maurice River. The five habitat categories we mapped should not be taken as an ordered ranking of habitat potential except for the distinction between "preferred" and "suitable" habitat. While we suspect that these five habitat categories may differ in their overall potential suitability, there is insufficient information from studies performed thus far to characterize their relative suitability. We elected to maintain the differentiation so map users can ascertain the reason that a particular area was included as mapped potential habitat and to illustrate the spatial distribution and relationship of the inclusion criteria.

Given additional criteria with which to define suitable habitat, further refinement in the classification of habitat suitability within these areas may be possible using existing ITU coverages. For example, landscape-scale variables such as minimum habitat patch size and distance between habitat patches should be examined and included in future refinements of habitat maps. Additional information not currently included on ITU mapping, but possibly available in GIS format, could also be used to further refine habitat suitability classifications. Locations of open sandy areas essential for nesting and denning could be superimposed on the habitat maps to detect the most highly suitable habitats and/or to modify the existing classifications. Using digitized aerial photography or other remote sensing coverages, we may

be able to use GIS to perform this analysis.

Ground-proofing of ITU land cover classifications or use of other more accurate vegetation coverages may also result in reclassification of some habitat areas. Preliminary checking suggested that some areas of oak-pine forests may be misclassified as mixed coniferous/deciduous (pine-oak) on ITU maps. Consequently, many areas currently mapped as preferred (1A or 1B) habitat possibly should be mapped as suitable (2, 3 or 4). If this problem of land cover classification is pervasive, then the current habitat mapping would tend to "over-include" and/or "over-classify" suitable habitat.

There are few confirmed occurrences of northern pine snakes in this five-county area. We have not yet compared the distribution of occurrences with our habitat mapping. In future phases of this project, we plan to assess the correspondence between mapped habitat and pine snake distribution. Comparison of currently known pine snake occurrences with mapped habitat is likely to produce valuable insights that will help refine mapping criteria and also direct future field surveys. Caution will be necessary in this examination because Natural Heritage occurrences include imprecise and occasionally inaccurate location information. A further test of the maps and the habitat classification will also include directed field surveys of potentially suitable habitat. We are currently examining techniques that could be applied to quickly assess the presence/absence of pine snakes in a particular area.

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Home NJ InTouch DEP HOME

Instructions to Expert Panelists for Reviewing Status Assessments for Select New Jersey Reptiles and Amphibians

Please read these instructions carefully before completing the questionnaire.

For Round 2, a summary of reviewers' opinions and their explanations appear for each species. Based on the information provided, and your knowledge and expertise, select the **single** status code that best applies to the species in New Jersey. With each selection, also indicate your level of confidence in your assessment by circling a **single**, appropriate number. At the end of each species account is a field entitled "**New Comments**" which is available for new or additional status explanations. If you have no new comments to add or feel one of the remarks listed in the comments section from Round 1 captures your opinion, you can simply underline it as your own. Comments must be listed for a species and cannot include generalizations for species groups.

The key and explanation of the letter and numeric codes are as follows:

STATUS ASSESSMENTS

E - Endangered: Applies to a species whose prospects for survival with the state are in immediate danger due to one of several factors, such as loss or degradation of habitat, over-exploitation, predation, competition, disease or environmental pollution, etc. An endangered species likely requires immediate action to avoid extirpation from NJ.

T - Threatened: Applies to species that may become Endangered if conditions surrounding it begin to or continue to deteriorate. Thus, a Threatened species is one that is already vulnerable as a result of, for example, small population size, restricted range, narrow habitat affinities, significant population decline, etc.

SC - Special Concern: Applies to species that warrant special attention because of inherent vulnerability to environmental deterioration or habitat modification that would result in their becoming Threatened. This category would also be applied to species that meet the foregoing criteria and for which there is little understanding of their current population status in the state.

S - Stable (or increasing): Applies to species that appear to be secure in NJ and not in danger of falling into any of the preceding categories in the near future.

U - Unknown: Applies to species for which you believe it is not possible to assign any of the preceding categories because enough information does not exist.

NO - No Opinion: Applies to any species for which you feel <u>you</u> do not possess sufficient information or experience on which to base a judgement, although other people may have such information.

NA - Not Applicable: Applies to species that do not occur in NJ.

CONFIDENCE LEVELS

Please rate your level of confidence for your status assessments by indicating a numeric designation for every choice that you make. Ratings run on a continuous scale.

Unreliable		**Risky**		**Reliable**		**Certain**	
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**

These four categories are defined loosely for this exercise as:

Unreliable: Great risk of being wrong; of no use as a basis for a decision.

Risky: Substantial risk of being wrong; unwilling to use as a basis for decision without other information.

Reliable: Some risk of being wrong; willing to make a decision based on this but recognizing some chance of error.

Certain: Low risk of being wrong; decision based on this will not be totally wrong because of at least some support fact(s).

New Comments

In this space, please indicate briefly the basis for your choice for Endangered, Threatened, and Special Concern designations, including your underlying assumptions, views, or facts to support your position. Provide the information you feel will be helpful to the panel members in explaining your decision. Explanations should be as specific as possible but need not be exhaustive. If there is new published documentation in support of your assessment; please provide the citation for it (if known). *Please write legibly, so that your input can be used for Round 2.* You may use extra sheets or the back of the sheet.

PLEASE RETURN BY May 26, 2000

Enclosed is an envelope for returning the questionnaire to use by May 26, 2000. We will tabulate the results of this first round and distribute the second round in January. Since this is a review of selected species, we hope one or two more rounds will be sufficient to reach consensus.

Summary for Round 1 for Round 2

Northern Pine Snake

Status	# of People	Confidence Level
E	1	5.0
T	11	6.1
SC		
S	1	5.0
U		
NO	5	
NA		

Your New Status	Your New Confidence Level
T	5

Comments:

- Broad range, but limited to vulnerable habitat. Infrequent occurrence. (t)
- Habitat loss including alteration/loss of upland habitat including denning & nesting sites. Road mortality also a threat. (t)
- Restricted distribution & continued loss of habitat in unprotected Pinelands areas. (t)
- Widespread in Pinelands but disjunct from other populations. Development continues to diminish habitat on edge of Pinelands, especially in Ocean County. Populations east of Garden State Parkway may be "doomed". (t)
- Although some populations are okay, others have been decimated. (t)
- Though more common than Corn Snake this species has suffered tremendously from habitat alteration. Although not in immediate danger of extirpation it continues to decline as its upland habitats are developed. It remains susceptible to collecting. Recommend threatened status. (t)
- Encountered frequently in the Pine Barrens. This population is disjunct from the nearest population in North Carolina. (t)
- Suffers from illegal collecting and remains endangered even with the protection of Pinelands. (e)
- Seems to be making a comeback but not ready for removal from the list. (t)
- Wide distribution. Probably suffers from collecting, road kill & habitat destruction. (s)
- Pers. Comm. With other herpetologists & personal experience. (t)
- Some good, potentially viable populations on protected lands within Pinelands. Development (habitat destruction) & road mortality outside protected lands pose a major threat. (t)

New Comments:

R2

Participants Initials_____ Summary for Round 2

Northern Pine Snake

Status	# of People	Confidence Level
E		
T	14	6.4
SC	1	6.0
S		
U		
NO	1	
NA		

Your New Status	Your New Confidence Level
Consensus Reached for Status: T	

Comments:

- Seems to be making a comeback in some areas of the Pine Barrens but absent from others…still needs protection. (t)
- Wide distribution. Probably suffers from collecting, road kill & habitat destruction - home building. (t)
- Coming into the pines in the 1950's & 1960's saw many road kills. See very few road kills in recent years. This is cause for concern about recruitment to off set road kills. I still see the same number of Pine Snakes along the railroad right-of-way from Chatsworth to west of High Crossing. (t)
- Peripheral habitat areas, e.g. east of G.S. Parkway continue to be lost. Species seems secure in core of Pinelands. Much of population on state and federal (military) lands. Continued threat from collecting and isolation of population are main reasons to continue listing as "T". (t)
- Somewhat limited distribution, frequent road mortality, and collecting pressure warrant threatened status. Although many populations are in protected Pinelands areas, some records appear to overlap with Pinelands areas that are zoned for development. (t)
- Road mortality continues to kill these snakes. Habitat loss and disturbance goes on all over the edge of the Pine Barrens. Coyotes, foxes, and skunk dig-up and eat their eggs and hatchlings. It should remain as a "T" species. (t)
- It appears to still be fairly common. Its habitat in NJ is widespread and in good shape. Probably still collected illegally (like many other herps). (sc)

New Comments:

MDSA	NOCO	NCFR	NDTE	NPSN
S	6T	5S	5S OR SC	7T
U	4SC	4U	4SC	6T
NO	SC	5NO	NO	T
NO	SC	6NO	SC	6T
U	5SC	4SC	3SC	6T
NO	T	6T	6SC	8T
S	4S	8SC	4SC	4T
U	4SC	3S	3T	6T
U	5.5T	5T	5.5SC	5.5T
NO	SC	NO	SC	6SC
U	5SC	5S	5SC	4T
NA	7SC	6NO		T
S	4SC	4S	4SC	5T
U	SC	5S	5SC	5T
SC	3SC	5SC	5SC	5T
NO	SC	6	SC	6NO

14 T
1 SC
1 NO

Round 2

(4-8)

8 x1
7 x1
6 x4
5.5 x1
5 x3
4 x2

5.625

APPENDIX 3

Division of Fish, Game and Wildlife
Endangered and Nongame Species Program
PO Box 400
Trenton, NJ 08625-0400
Ph: (609) 292-9400 Fax: (609) 984-1414
e-mail: lniles@dep.state.nj.us
Please visit our website: www.state.nj.us/dep/fgw/ensphome.htm

April 25, 2000

«FirstName» «LastName»
«Company»
«Address1»
«Address2»
«City», «State» «PostalCode»

Dear «FirstName»:

I would like to thank you for participating in Round 1 of the listing revision process for New Jersey's reptiles and amphibians. Enclosed are instruction sheets for Round 2 of the species status assessment, the Round 2 status assessment forms, and information on the Jefferson-Blue Spotted Salamander complex. As I mentioned in an earlier letter, the process of establishing species' status in New Jersey is called the Delphi method, which consists of a series of anonymous reviews allowing you to comment and read the comments of others. Through this process, expert opinions and data can be shared to reach a consensus on a species status. So, you can see your input in this process is essential.

In short, the Round 2 status assessment forms summarize participants' rankings from Round 1 and provide the full text of any comments listed. You can opt to keep or change your status and confidence levels for Round 2. Note, it is important to select only one category for both the status and confidence level. Also, comments should be restricted to a single species and not generalized for species groups.

Please note there are four minor changes to species list in Round 2. First, by request of some participants, Fowler's Toad has been added to the species being assessed. Second, a participant recommended we consider the two subspecies of Chorus Frog (Upland Chorus Frog and New Jersey Chorus Frog) separately. Under the state endangered species statute, subspecies may be listed, so we divided the Chorus Frog into the two subspecies. Third, also due to participant feedback we have added the Coastal Plains Milk Snake subspecies. Lastly, as several participants noted, Tremblay's Salamander and Silvery Salamander are no longer recognized as true species. Since these former species are now recognized as hybrids, we have listed Blue-spotted Salamanders to include individuals with >50% of the Blue-spot genome and Jefferson Salamander to include individuals with >50% of the Jefferson genome.

Please complete and return this evaluation by **May 26, 2000**. We hope to keep this to a tight time schedule.

Thank you very much for your prompt response and invaluable contribution to this task.

Sincerely,

Larry Niles, Ph.D., Bureau Chief
Endangered and Nongame Species Program

Encl.

Peer Reviewed

An Objective Means of Species Status Assessment: Adapting the Delphi Technique

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Abstract

A status assessment for wildlife species is necessary for many states in the United States with the authority to list species as endangered and threatened. Status may confer legal protection or conservation priority within a state. The methods used to define species status vary across states, but most rely on subjective determinations made by a group of experts. We adapted the Delphi Technique, a systematic method of reaching consensus, to achieve greater objectivity in determining the relative endangerment or stability of a species' population. We used the method to determine the status of birds native to New Jersey by having experts choose a status, enumerate their confidence in it and justify their choice, on forms via mail. We compiled results and sent them back to all participants to review the information anonymously provided by others and vote again on each status based on this information, as well as their own experience and opinion. We continued this process for 4 rounds, reaching consensus on the status of 91% of 283 species in breeding and nonbreeding seasons. We used the results to assign legal status of bird species in the state. We present this as an appropriate technique to attain greater objectivity in species status assessment. (WILDLIFE SOCIETY BULLETIN 34(2):419–425; 2006)

Key words

consensus, Delphi Technique, endangered, Endangered Species List, species status.

The United States Fish and Wildlife Service (USFWS) and many state wildlife agencies periodically assess the status of wildlife populations to determine whether a species should be listed as sensitive, threatened, or endangered. Species status is important because it confers additional legal protection and establishes conservation priorities for agencies. The USFWS species assessment process relies heavily on information provided by state and regional sources (U.S. Fish and Wildlife Service 2001). These assessments are conducted by agency biologists in concert with public input (Nicholopoulos 1999). State wildlife agencies that have the legal authority to conduct species status assessments typically use population levels and species vulnerability to make their decisions (Millsap et al. 1990). Because the status of a species has legal standing and may have economic implications, the process used should be rigorous and defensible.

As of 2004, 44 states reported having a formal sensitive species list (Niles and Korth 2005). Most states had procedures for maintaining the credibility of their lists, particularly through a formal list review process ranging from every year to every 10 years. However, a standard methodology for assessing a species status is lacking (Dobkin 1994). Niles and Korth (2005) reported that 30 states reviewed their lists frequently (every 5 years or less), and 13 reviewed their list as needed. The basis for establishing species status varied substantially, however, with only 19 states reporting use of explicit criteria for determining status (Niles and Korth 2005).

In a survey we conducted in 2002 on listing procedures, most states (57% of 42 states responding to this question; 49 total responding) reported using a process of review by experts in a group setting, where species status is determined by the group in a single evaluation meeting (R. Baum, Princeton University, Princeton, N.J., USA, unpublished data). Seven states reported using forms to gather experts' opinions, which were later tabulated by staff. New York was unique in reporting a method that involved a second review after initial status determinations. Only New Jersey reported using an iterative, anonymous method to reach consensus.

The expert review process used by most states has limitations. Consensus can be difficult to reach if information or personalities cause dissension in the group and not all experts are present. Some states have implemented a scoring method to quantify the facets of a species' life history, abundance, and distribution as a means to assess its vulnerability to extirpation (Landry et al. 1979, Millsap et al. 1990). Both methods usually are not iterative, thus may not always reflect an objective consensus of the participants (Dalkey 1969).

To determine status and conservation priority in Florida, the state's Game and Fresh Water Fish Commission adapted a method that ranks species status according to biological vulnerability and management needs (Millsap et al. 1990). The method incorporates biological and action scores. Biological scores are determined by summing 7 variables indicating distribution, abundance, and life history. Action scores are the sum of 4 variables reflecting the current distribution, population trends, limiting factors, and current conservation efforts. Scores are then ranked to determine the species' status. A similar technique that includes input from wildlife professionals and public stakeholders is used by Texas Parks and Wildlife Department (Thompson 1984). These 2 methods are similar in that each used a single-step evaluation process and had reviewers assign numbers to biological status, habitat condition, and threats to rank their evaluations. While the use of numbers appears to provide an objective methodology, assigning numbers to many of these factors is fraught with the same degree of subjectivity as expert opinion

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meetings. Further, these single-step processes do not offer the opportunity for consensus-building that comes through a multistage, iterative process.

The Delphi Technique

The Delphi Technique is a systematic method for reaching consensus among experts in which absolute, quantitative answers are either unknown or unknowable (Linstone and Turoff 1975). It is an iterative process characterized by anonymity among the participating experts, controlled feedback via the principal investigator, and a statistical estimator of group opinion (Dalkey 1969). By structuring the group communication process, the Delphi Technique helps the group reach a consensus of opinion by incorporating all available data and disseminating those data among all participants. This technique has been used to reach consensus decisions in natural resource management (Zuboy 1981, Applegate 1982, Nichols and Applegate 1987), wildlife habitat criteria for habitat suitability indices (Crance 1987, Jirka and Homa 1990, Uhmann et al. 2001), and for establishing water requirements for fish (Taylor and Ryder 2003). The technique also was used by Hess and King (2002) to choose focal wildlife species and important habitats for use in conservation planning in a suburban region of North Carolina.

We used the Delphi Technique to determine the status of 283 nongame bird species in New Jersey during breeding and nonbreeding seasons. We solicited the participation of recognized experts, but they were not identified by name during the process or at its completion. Rather, they participated in group decisions anonymously through the mail and reacted to common information. All communications flowed between the principal investigator and participants. We describe the methodology as applied to species status assessments and make recommendations for its use by state agencies. We present the full results of the assessment of bird species status.

Methods

The assessment of the status of New Jersey birds occurred in 2 parts. The initial evaluation in 1992–1994 included all 283 species known to occur in the state, and each species was assessed separately for the breeding and nonbreeding seasons (Dobkin 1994). The second assessment was limited to a subset of 13 species in 1997–1998 for which new information had become available since completion of the first assessment. The new information obtained from the completed New Jersey Breeding Bird Atlas and targeted surveys suggested declines or increases since the first assessment. A group of 6 biologists familiar with the more recent data chose the subset of species from the entire list of 283 species.

We contracted an expert from outside the agency to serve as principal investigator to develop and conduct the initial assessment of all 283 bird species. The principal investigator also was a member of the Endangered and Nongame Species Advisory Committee, an independent advisory group to the New Jersey Endangered and Nongame Species Program.

We selected participants based on their knowledge and experience with birds of New Jersey and their familiarity with the status of bird populations either regionally within the state or statewide. We identified 27 potential panelists for the initial assessment. We sent prospective panelists letters inviting them to participate; 21 agreed.

We mailed to all panelists detailed instructions, the evaluation sheets with a list of species (Fig. 1), and a postage-paid return envelope. We instructed participants to identify their evaluations with their initials for internal tracking only. We asked participants to choose the status of each species during breeding and nonbreeding seasons in New Jersey from among 7 categories provided:

1. Endangered: a species whose prospects for survival within the state are in immediate danger due to ≥1 factor, such as loss or degradation of habitat, overexploitation, predation, competition, disease, or environmental pollution. An endangered species likely requires immediate action to avoid extinction within the state.
2. Threatened: a species that may become endangered if conditions surrounding it begin to or continue to deteriorate. Thus, a threatened species is one that is already vulnerable as a result of small population size, restricted range, narrow habitat affinities, or significant population decline.
3. Special concern: a species that warrants special attention because of inherent vulnerability to environmental deterioration or habitat modification that would result in their becoming threatened. This category also would apply to species that meet the foregoing criteria and for which there is little understanding of their current status in the state.
4. Secure–stable: a species that appears to be secure in the state and not in danger of falling into any of the preceding 3 categories in the near future.
5. Unknown: a species that cannot be assigned to the preceding categories because not enough information exists on which to base a judgment.
6. No opinion: a species for which the participant does not possess sufficient information or experience on which to base a judgment.
7. Not applicable: a species that does not occur in New Jersey as a breeding species, during the nonbreeding season, or during migration in New Jersey.

For each status selected, we asked panelists to rate their level of confidence in their assessment by indicating a numeric designation from a scale of 1–8 (i.e., 1–2 = unreliable, 3–4 = risky, 5–6 = reliable, and 7–8 = certain). Unreliable meant a great risk of being wrong and of no use as a basis for a decision. Risky meant substantial risk of being wrong and unwilling to use as a basis for decision without other information. Reliable meant some risk of being wrong and willing to make a decision based on this. Certain meant low risk of being wrong.

In the explanation section for each species, we asked panelists to briefly state the basis for their status choice (i.e., underlying assumptions or facts to support their position) for all endangered, threatened, and special concern designations. Their explanations provided additional information for consideration by other panelists in subsequent rounds, as well as documentation of species status and threats for the state's administrative record. Participants could also use the explanation section to argue status designations made in preceding rounds.

Evaluations were returned to the principal investigator for

SPECIES STATUS ASSESSMENTS

GREAT BLUE HERON

BREEDING STATUS:
E T SC S U NO NA (circle one)

Confidence Level:
Unreliable Risky Reliable Certain
1 2 3 4 5 6 7 8 (circle #)

Explanation:

NON-BREEDING STATUS:
E T SC S U NO NA (circle one)

Confidence Level:
Unreliable Risky Reliable Certain
1 2 3 4 5 6 7 8 (circle #)

LITTLE BLUE HERON

BREEDING STATUS:
E T SC S U NO NA (circle one)

Confidence Level:
Unreliable Risky Reliable Certain
1 2 3 4 5 6 7 8 (circle #)

Explanation:

NON-BREEDING STATUS:
E T SC S U NO NA (circle one)

Confidence Level:
Unreliable Risky Reliable Certain
1 2 3 4 5 6 7 8 (circle #)

BLACK-CROWNED NIGHT HERON

BREEDING STATUS:
E T SC S U NO NA (circle one)

Confidence Level:
Unreliable Risky Reliable Certain
1 2 3 4 5 6 7 8 (circle #)

Explanation:

NON-BREEDING STATUS:
E T SC S U NO NA (circle one)

Confidence Level:
Unreliable Risky Reliable Certain
1 2 3 4 5 6 7 8 (circle #)

COOPER'S HAWK

BREEDING STATUS:
E T SC S U NO NA (circle one)

Confidence Level:
Unreliable Risky Reliable Certain
1 2 3 4 5 6 7 8 (circle #)

Explanation:

NON-BREEDING STATUS:
E T SC S U NO NA (circle one)

Confidence Level:
Unreliable Risky Reliable Certain
1 2 3 4 5 6 7 8 (circle #)

gure 1. Example of the "first-round" species status evaluation form, sent to all panelists.

mpilation. We created a new survey round that listed the mber of panelists who chose each status designation for each cies in each season (e.g., see boxed "Round 1" scores in Fig. 2), median confidence level for each status designation, and the mpiled panelists' explanations for each species (Fig. 2). Thus, we t the second and subsequent rounds to participants for their ntinued evaluation, giving them the opportunity to consider the ta, opinions, and explanations provided anonymously by others ach round. We compiled explanations separately by round, and ded them iteratively to the evaluation sheets; information peared one time in the explanation even if more than one panelist provided the same information; information provided in a previous round was not repeated in succeeding rounds. We included all explanations from panelists without judgment as to their accuracy. When 85% of participants agreed on a status, we dropped the species or season from subsequent rounds. Agreement among 85% of reviewers was determined a priori as indicating consensus (Dobkin 1994). In previous studies, consensus often was not defined, or implied to be 100%; Crance (1987) applied a minimum 80% agreement. We conducted 4 rounds. Following compilation of the fourth round, all participants received a summary of the final results.

ROUND 2: SPECIES STATUS ASSESSMENTS

See Instructions for Status and Confidence Level codes

GREAT BLUE HERON

BREEDING STATUS:

	E	T	SC	S	U	NO	NA (circle one)
Round 1		6	9	2			
Confidence		6.2	5.7	6.0			

NON-BREEDING STATUS:

	E	T	SC	S	U	NO	NA (circle one)
Round 1			2	9			
Confidence			5.5	6.0			

Confidence Level:

Unreliable		Risky		Reliable		Certain		
1	2	3	4	5	6	7	8	(circle #)

Confidence Level:

Unreliable		Risky		Reliable		Certain		
1	2	3	4	5	6	7	8	(circle #)

Explanation: Round 1: Seems to be holding on, with new colonies every year. Although increasing, numbers are still below the apparent historical numbers of the 1920's-1930's. Clearly increasing: the number of colonies has gone from 5 or 6 in the 1970's to over 20 in the 1990's. SC recom. because the birds are so concentrated and vulnerable to disturbance, toxics, disease, predators, wood cutting, etc. that the trend could reverse. Many colonies are quite small and could be subject to development. Still quite rare in northern NJ. Although they seem to be increasing, the loss of just 1 or 2 big colonies would severely decrease the total population. Too soon to remove from T&E list, especially since many colonies are closely allied with headwater areas that are rapidly developing. Original T status was based on small number of pairs with most concentrated at only 3 locations; over last 20 years data show a significant increase in both pairs and locations. There seems to be suitable habitat not used.

LITTLE BLUE HERON

BREEDING STATUS:

	E	T	SC	S	U	NO	NA (circle one)
Round 1		3	10		4		
Confidence		6.0	5.5				

NON-BREEDING STATUS:

	E	T	SC	S	U	NO	NA (circle one)
Round 1							
Confidence							

Confidence Level:

Unreliable		Risky		Reliable		Certain		
1	2	3	4	5	6	7	8	(circle #)

Confidence Level:

Unreliable		Risky		Reliable		Certain		
1	2	3	4	5	6	7	8	(circle #)

Explanation: Round 1: Seems stable in areas of reproduction, but problems of habitat, foxes and contaminants threaten. Current numbers not too different than 1977-78. LBHE is similar to YCNH - concentrated in rookeries they are vulnerable to foxes and other predators; some former rookery sites are abandoned. SC status as with GBHE, but may have a natural variability in population. T status because 7 birds/colony and 220 breeding adults translates to 31 colonies between Cape May and Pt. Pleasant - not a lot; if the mean colony size is highly variable, there are many fewer colonies and even fewer viable ones. Number of birds and colonies about the same as GBHE when that was listed as T.

Figure 2. Example of the "second-round" species status evaluation form, reflecting first-round status assessments and comments by panelists.

Nineteen of the original 21 panelists participated in the second assessment (1997–1998). We provided participants with summaries of new information from 2 sources that were not readily available to the public: the New Jersey Breeding Bird Atlas and surveys conducted by the New Jersey Endangered and Nongame Species Program. Evaluation forms used the same format as in the earlier assessment but were limited to the 13 species (and specific seasons) under consideration. Methodology also was the same except that the principal investigator was a designated Endangered and Nongame Species Program staff member (an assessment "coordinator"). We conducted 3 rounds during the second assessment.

Results

In the initial comprehensive assessment of 283 bird species for each of 2 seasons (566 assessments), consensus was reached in 4 rounds for 91% of the species and for 95% of the species/seasons classifications. Consensus was reached for 47 species in the first round, 132 of the 236 species considered in the second round, 59 of the 104 species considered in the third round, and for 18 of the remaining 45 species considered in the fourth round. Of the 21 panelists who had agreed to participate, the number who actually completed evaluation forms for each of the rounds was 19, 18, 17, and 19 in rounds 1 through 4, respectively.

Status designations could not be resolved for 27 species, of which only 3 species were unresolved in both breeding and nonbreeding seasons. Combined response and turnaround time (for compilation) was between 6 and 9 months for each round, with each successive round requiring less time than the preceding round.

Thirty (11%) of 283 species were categorized as either

Table 1. Final avian status designations for species classified as endangered or threatened in 2 assessments of species status in N.J., USA.

Species	Breeding status (confidence level)	Nonbreeding status (confidence level)
Pied-billed grebe (*Podilymbus podiceps*)	Endangered (6)	Special concern (5)
American bittern (*Botaurus lentiginosus*)	Endangered (6)	Special concern (5)
Black-crowned night-heron[a] (*Nycticorax nycticorax*)	Threatened (6)	Secure (6)
Yellow-crowned night-heron (*Nyctanassa violacea*)	Threatened (7)	Unresolved
Osprey (*Pandion haliaetus*)	Threatened (6)	Secure (5)
Bald eagle (*Haliaeetus leucocephalus*)	Endangered (7)	Threatened (6)
Northern harrier (*Circus cyaneus*)	Endangered (5.5)	Special concern (6)
Cooper's hawk[a] (*Accipiter cooperii*)	Threatened (6)	Secure (5)
Northern goshawk (*Accipiter gentilis*)	Endangered (6)	Secure (5)
Red-shouldered hawk (*Buteo lineatus*)	Endangered (6)	Threatened (6)
Peregrine falcon (*Falco peregrinus*)	Endangered (7)	Unresolved
Black rail (*Laterallus jamaicensis*)	Threatened (6)	Unresolved
Piping plover (*Charadrius melodus*)	Endangered (7)	Endangered (7)
Upland sandpiper (*Bartramia longicauda*)	Endangered (7)	Endangered (6)
Red knot[a] (*Calidris canutus*)	N/A	Threatened (6.5)
Roseate tern (*Sterna dougallii*)	Endangered (6.5)	Endangered (6)
Least tern (*Sterna antillarum*)	Endangered (7)	Endangered (6)
Black skimmer (*Rynchops niger*)	Endangered (6)	Threatened (5)
Barred owl (*Strix vana*)	Threatened (6.5)	Threatened (6)
Long-eared owl (*Asio otus*)	Threatened (6)	Threatened (5)
Short-eared owl (*Asio flammeus*)	Endangered (6)	Special concern (5)
Red-headed woodpecker (*Melanerpes erythrocephalus*)	Threatened (6)	Unresolved
Loggerhead shrike (*Lanius ludovicianus*)	Endangered (7)	Endangered (7)
Sedge wren (*Cistothorus platensis*)	Endangered (6)	Endangered (6)
Vesper sparrow (*Pooecetes gramineus*)	Endangered (6)	Threatened (5)
Savannah sparrow (*Passerculus sandwichensis*)	Threatened (6)	Secure (5,5)
Grasshopper sparrow (*Ammodramus savannarum*)	Threatened (6)	Special concern (5)
Henslow's sparrow (*Ammodramus henslowii*)	Endangered (6)	Endangered (6)
Bobolink (*Dolichonyx oryzivorus*)	Threatened (5)	Secure (6)

[a] Final status reached in second part (Birds II, 1997–1998) of the evaluation process.

ndangered or threatened in the breeding or nonbreeding season. lineteen of 283 species (7%) were designated as endangered, and of these were categorized as endangered in both seasons. Fifteen ecies received threatened designations, but 4 of these were tegorized as endangered in one season and threatened in the her. Thirty-six species received special concern designations, hich included 5 species categorized as endangered or threatened one season.

In the second assessment, consensus was reached in 3 rounds : 11 of the 13 species (85%). No consensus was reached for y of the 13 species in the first round, but was reached for 2 ecies in the second round and for 9 of the remaining 11 species the third round. Response and turnaround time was 3–4 weeks each round, and 16–19 reviewers participated in each round. e second assessment resulted in 6 changes to the initial status essment, including the downgrade of 2 species from eatened to special concern. Two of the 13 species were ssified as threatened from the initial assessment of special ncern. Taken together, the 2 assessments resulted in final gnations of 29 species as endangered or threatened, 13 of ch were categorized as endangered or threatened in both ons (Table 1).

e presented the results of the first bird status assessment, along h subsequent changes based on the second assessment, to the dangered and Nongame Species Advisory Committee. The mmittee decided species designations that were unresolved in Delphi process when the indecision was between priority designations. For example, participants were split in their assessment of Cooper's hawk (*Accipiter cooperii*; breeding season) between threatened and special concern, and the committee decided to designate the bird as threatened, a reclassification from its previous endangered status. The committee did not become involved in their own review of the biological basis used by the experts. They generally maintained a listed status (endangered or threatened) for species already on the endangered species list if the Delphi process indecision was between a listed and an unlisted status; thus, no species would be removed from the endangered species list unless there was consensus. If indecision was between listing a species for the first time versus special concern status, the committee examined the Delphi results for a majority of votes and the weight of the comments. We note that for the avian assessments, 2 of the panelists also served on the Endangered and Nongame Species Advisory Committee making the final decisions.

For all species lacking a consensus designation, the results of the Delphi process provided guidance for the agency by suggesting the species' status and related justification. Although we attempted to reach consensus on all species, we considered some species unresolved by the method when assessments resulted in approximate 50/50 splits between statuses. In all cases, the Endangered and Nongame Species Advisory Committee made the final determination of legal status changes. The committee's determinations followed the results of the Delphi process for all species in which an 85% consensus on status was

reached. For species with unresolved status, the committee used the Delphi process results to help make the judgment on status. For example, if a majority (but <85%) of panelists suggested a threatened status, the committee voted to assign the threatened status.

Discussion

Using this adaptation of the Delphi Technique, experts were able to state their opinion on each species' status and provide information to support it. Through the process of successive rounds, participants could modify their opinion based on information provided by all panelists. In this way, they could potentially learn new information and opinions and modify their own opinions where appropriate. Alternatively, if they believed strongly in their position, they could continue to assert that position and present additional data to support it.

The Delphi method is a combination of the best aspects of current methods, expert opinions, and attempts to quantify population trends and threats to species. Further, Dalkey (1969) showed that the anonymous controlled-feedback process made group estimates more accurate than the estimates resulting from face-to-face discussions. Applied in complex issues, it also has the advantage of allowing participants time to consider the questions (Hess and King 2002).

Species status designations carry regulatory implications and, therefore, are subject to tests in the legal system. Application of the Delphi Technique to species status determinations may make these designations more objective, ultimately making state endangered species law more defensible. The documentation created in the written discussion across rounds of reviews can be used in such legal challenges to support species status designations.

In recommending this method, we suggest limiting the number of species to be evaluated. Asking participants to make 566 assessments to cover all 283 bird species resulted in a process that took several years to complete, mainly due to slow response time. Most states are starting with existing lists of endangered spec and conducting updates (Niles and Korth 2005). In these cases is possible to select species for which the status is likely to char or for which there are new data. Conducting the Delp evaluation on only a subset of species for which there v concern substantially reduced the time to complete each rou and was less taxing on all participants. These assessmer typically were completed in less than 1 year. The first applicati of this method was developed and conducted by an outside exp under contract because staff time was limited and no st members were familiar with the method. After establishment the methodology, and particularly by limiting the evaluations small subsets of species, it became reasonable for staff biologi to coordinate the assessments. Further, with the widespre availability of electronic mail, correspondence has become easi and faster, which can improve communication and less response time. Although this technique requires substantial more time than the single-meeting approach, we believe th benefits of the iterative process are worth the extra time ar effort.

This method of species status assessment had the added benef of helping New Jersey agency biologists to better understand th range of concerns as expressed by the experts involved, albe anonymously. Experts often shared data otherwise unavailable, well as anecdotal information useful to wildlife researchers an managers. Most importantly, agency biologists revised the state endangered and threatened wildlife list with a high level c confidence in its accuracy and defensibility.

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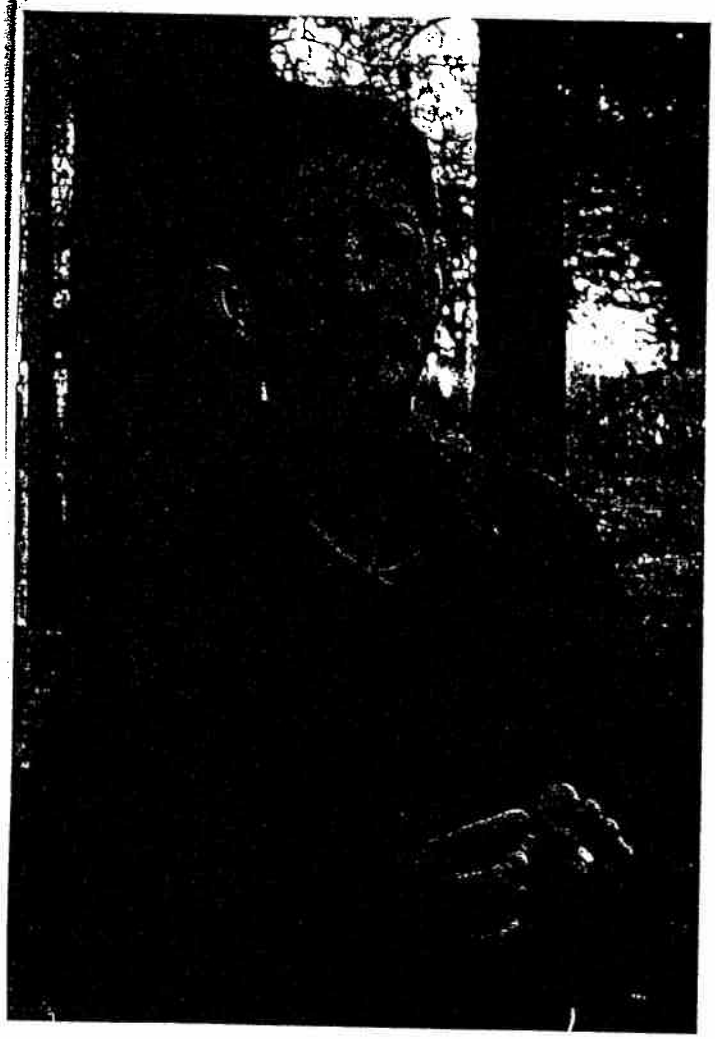

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