

SPECIES PROFILE

Timber Rattlesnake

Crotalus horridus

Federal Listing: Not listed

State Listing: Endangered

Global Rank: G4

State Rank: S1

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ELEMENT 1: DISTRIBUTION AND HABITAT

1.1 Habitat Description

Timber rattlesnakes in the northeast spend the winter in a communal den, a rocky area with crevices leading to a hibernaculum below frost line (Brown 1993). They emerge from the den in May, and proceed to transient habitat, a relatively exposed rocky area where they can alternately bask and seek shelter from the sun; this may or may not be the den site. Males and non-gravid females often bask until the skin is shed, before making extensive movements into summer range habitat, often mixed deciduous forest. Gravid females are relatively sedentary and remain near exposed slopes and protective rocks until parturition, usually in September (Brown et al. 1982). Males pursue reproductive females by scent pheromone trails in order to mate with them, usually mid- to late summer. The resulting copulations provide sperm that is retained through hibernation for next years' ovulation (M. McCurley, personal communication).

The timber rattlesnake is a sit-and-wait predator, primarily preying on small mammals and birds to a lesser extent (Ernst and Ernst 2003). All individuals of the population return to the den in September. Depending on weather conditions, they may bask at the den, but they often go into the den immediately upon return. Young snakes may follow the scent trails of adults to find communal den sites (Reinert and Zappalorti 1988)

1.2 Justification

The Northeast Endangered Species and Wildlife Diversity Technical Committee determined that the timber rattlesnake is a species of regional concern in the northeastern United States. This species warrants federal endangered or threatened species listing consideration, including prelisting status reviews (Therres 1999). In New England, timber rattlesnakes are listed as extirpated in Maine and Rhode Island, and endangered in Connecticut, Massachusetts, Vermont, and New Hampshire. In New Hampshire, the timber rattlesnake is likely the most endangered of any wildlife species, as there is only one known extant population. Timber rattlesnakes have large home ranges, especially males, and individuals may be killed as they cross roads or as human-snake encounters increase (see element 3). Southern New Hampshire is rapidly developing, and large undeveloped tracts of land needed to sustain timber rattlesnake populations are dwindling rapidly. As a result, opportunities for natural recolonization or restoration have been substantially reduced.

1.3 Protection and Regulatory Status

Listed as state endangered and protected by the Endangered Species Conservation Act (RSA 212-A). A petition to list the timber rattlesnake as federally endangered was submitted in September 1991; this petition was rejected by the USFWS in January 1992.

1.4 Population and Habitat Distribution

Rattlesnakes have been historically reported from scattered locations throughout the southern half of the state, extending into the White Mountains. Clusters of reports came from along the Connecticut River in the southwest corner of the state, along the

Merrimack River, the Lakes Region, and from the edge of the White Mountains. Historic locations for timber rattlesnakes included Rattlesnake Island in Lake Winnepesaukee (reportedly the site of heavy nineteenth century depredations for the manufacture of rattlesnake oil (Oliver and Bailey 1939)), and other locations near the lake; the Mt. Thorn area in Bartlett (Allen 1899); Dan Hole Pond (Carle 1953) in Tuf-tonboro; Bear Brook State Park and Pinckney Hill in Allenstown and Rattlesnake Hill in Hooksett; the Mt Wantastiquet/Rattlesnake Mountain area of Hinsdale, Chesterfield, Swanzey and Winchester; and Fall Mountain in Walpole. Oliver and Bailey (1939) note that a Conservation Officer reported that rattlesnakes were occasionally killed in the Mt. Monadnock area, although these reports may not be confirmed.

In addition, there are many geographic features named for rattlesnakes in New Hampshire (table 1). Some of these were indeed probably named for the animal being present there, although one must bear in mind that almost all reports of rattlesnakes in recent times referred to milk snakes (*Lampropeltis triangulum*), a harmless snake which ‘rattles’ its tail against the ground when disturbed, making a sound that people may mistake for that of a rattlesnake.

There is now only one known extant population. No rattlesnakes were reported from 1981 to 1991, despite efforts to search for them at locations that they had traditionally inhabited, e.g., Pinckney Hill in Allenstown, Mt. Wantastiquet in Chesterfield, Dan Hole Pond in Tuf-tonboro (Carle 1958). In 1991, a forester accurately reported a rattlesnake to the author, and the den site was located in 1992.

1.5 Town Distribution Map

N/A

1.6 Habitat Map

UNH (J. Taylor, Department of Zoology and S. Hale, Complex Systems Research Center) completed a potential habitat map for timber rattlesnakes for New Hampshire. Maps for timber rattlesnake were primarily derived from the New Hampshire Landcover 2001 dataset, soils dataset, and the digital elevation model (UNH Complex Systems Research Center, GRANIT), as well as data on development and unfragmented forests. The landcover, soil, and aspect data layers were then combined to produce a final

layer with all possible combinations of favorable/non-favorable landcover and transient/non-transient soil types, and aspect categories. Various query combinations can be performed to extract polygons matching user-defined criteria. Finally, the maps were overlain with the location of all geographic features containing ‘rattlesnake’ in their name. There were no available soils data for Merrimack and Belknap counties, the White Mountain National Forest, and other parts of the North Country.

1.7 Source of information

The major sources of information included the authors’ professional experiences, scientific literature, historic newspaper articles, and personal communications with current experts and laymen.

1.8 Extent and Quality of the Data

Historical occurrence data are good, although the extent to which geographic features with ‘rattlesnake’ in their names actually attest to existence of the animals at that location is uncertain. In addition, not all historic den sites within larger known metapopulations are likely documented.

1.9 Distribution Research

Field-survey sites historically occupied by timber rattlesnakes in New Hampshire and those identified as potential through habitat mapping efforts (see element 1.6). Site assessments should include an assessment of potential habitat based on surrounding land-uses. All potential reports from the public should be forwarded to one contact person at NHFG. NHFG biologists or individuals contracted by the state should follow-up on any credible reports of rattlesnakes in undocumented locations.

ELEMENT 2: SPECIES/HABITAT CONDITION

2.1 Scale

The information discussed in this profile focuses on the one known extant population but discusses historic populations when appropriate.

2.2 Relative Health

The condition and viability of the extant population needs further detailed evaluation. Based on limited information, the population seems relatively stable over the last decade, and reproductive females continue to produce viable offspring. However, because there is only one known den site, the population is extremely vulnerable to human-induced or natural extirpation resulting from demographic or environmental stochasticity. There are also concerns about the genetic health of the population and the possibility of genetic drift and inbreeding depression (see element 3, Threats).

2.3 Population Management Status

No official population management occurs for timber rattlesnakes at this time. The known population is periodically monitored by conservation officers at NHFG, biologists, and expert naturalists.

2.4 Relative Quality of Habitat Patches

At the known extant site, existing habitat quality is relatively high. Most of the summer range is undeveloped continuous mixed deciduous forest, some of which is in protected as conservation land, and road density is low. However, much of the critical habitat is on private land. Because rattlesnakes roam widely (> 5 km) Brown 1993), one occasionally leaves the forested summer range and enters human development, where it may encounter humans (see element 3-Threats).

Several sites bearing the rattlesnake have been destroyed by gravel extraction activities or development (see element 3-Threats). A historic den site at Pinckney hill, in close proximity to Bear Brook State Park was apparently active at least up to 1983 (A. Chaput, personal communication) and was the site of the killing of 10 adult timber rattlesnakes by the landowner in September, 1976 (H. Laramie, personal communication).

2.5 Habitat Protection Status

The area of habitat currently permanently protected is not sufficient to maintain a population or meta-

population of timber rattlesnakes in New Hampshire (see Conservation Actions).

2.6 Habitat Management Status

Habitat protection is a top priority for this species in New Hampshire, either through fee-simple acquisition or acquisition of conservation easements (see Conservation Actions). Some activities such as limited forestry may not be detrimental long-term to timber rattlesnakes, especially if conducted during frozen conditions and the den site is not harmed. Limited managed timber harvesting may provide openings in the forest canopy that provide opportunities for basking individuals. However, this needs further review; a habitat and population management plan needs to be created for this site.

2.7 Sources of Information

The site has been periodically monitored by biologists, expert naturalists, and conservation officers. Other sources of information include a timber rattlesnake assessment for the White Mountain National Forest (Sweeney and Marchand 2002), historical documents (Oliver and Bailey 1939, Carle 1958), and an on-site assessment conducted by Bill Brown (Brown 2002).

2.8 Extent and Quality of the Data

Several individual rattlesnakes from the extant population have been monitored by radio-telemetry in recent years, but movement data are limited for the site, especially for males. Hibernacula and important basking sites are known, but unknown sites may exist. The condition of several historically occupied den sites has been evaluated, but other sites need further field surveys.

2.9 Condition Assessment Research

Annual monitoring should be expanded to include regular monitoring of the den and basking sites, as well as summer activity of males. At a minimum, annual counts of the number of snakes entering and exiting den sites and the number of young born and surviving winter should be conducted. Marking individual snakes (e.g., colored rattle) will help determine biological parameters of the populations, movement

patterns, and identify individuals that are observed at a distance from the den site. Historic or potential den sites should be evaluated for potential expansion of the known site. Genetic studies should be conducted to assess local genetic distinctiveness and possible effects of small population sizes.

ELEMENT 3: SPECIES AND HABITAT THREAT ASSESSMENT

3.1.1 Scarcity (Natural Rarity)

(A) Exposure Pathway

Problems with small population size are well supported in ecological theory (Meffe and Carroll 1998). The population growth rate of the timber rattlesnake in the northern part of its range is survival-limited, with late female sexual maturity (7-11 years, Brown 1991), individual reproduction at 3 to 4 year intervals (Brown 1991), small litter size (6-9 on average, but as low as 3 observed in New Hampshire), and high juvenile mortality (Brown 1993). Because of these traits, recovery of a depleted population is slow. Such a life history requires a long adult lifespan with low adult mortality, and in a small population, the premature death of a single adult may significantly harm a local population. Small populations are also susceptible to genetic drift, inbreeding depression, and demographic and environmental stochasticity (Meffe and Carroll 1998). Brown (1993) estimated that a minimum population size of timber rattlesnakes to be viable might consist of 30-40 individuals, including at least 3-5 reproductive females (Brown 1993). However, if adult mortality were increased by human actions, a population of this size would likely not be viable.

(B) Evidence

Individual timber rattlesnakes from a hibernaculum in Pennsylvania were more closely related to each other than they were to snakes from other hibernacula, suggesting inbreeding (Bushar et al. 1998). Since there is only one known den in New Hampshire, this problem may be exacerbated. Most timber rattlesnake populations have a mixture of black phase and yellow phase individuals. The New Hampshire population is unusual in that most individuals are strongly melanistic. However, Art Chaput (personal communication) once told the author that he had seen yellow phase individuals in New Hampshire, and an old local news-

paper photograph shows a man with what appears to be a yellow phase animal. The loss of the yellow phase and colorations unknown in other timber rattlesnake populations suggest possible future genetic challenges in this population due to genetic drift and/or inbreeding depression. At least one newborn had a scoliotic spine with external adhesion, probably a birth defect (H. B. Bechtel, MD, personal communication). However, the genetic characteristics of the extant population need further analysis.

3.1.2 Development

(A) Exposure Pathway

Residential and commercial developments may directly destroy habitat (den sites, basking sites, transient, summer range) required by local rattlesnake populations. As a result, prey sources may be reduced, preferred vegetation may be altered, and snakes may become more vulnerable to humans and other predators. NHFG may have to dedicate significant time to relocating snakes that are found in human developments. Automobiles can result in direct mortality of individuals (Aldridge and Brown 1995), and road construction near rattlesnake populations will increase access to those areas. Recreational demands (e.g., ATV, bike, and hiking trails) on private and public lands may also impact rattlesnake populations by increasing snake-human encounters.

(B) Evidence

Male rattlesnakes are especially vulnerable during mating season, when they are more likely to encounter humans and cross roads (Aldridge and Brown 1995). Several individuals have been found in residential developments in New Hampshire, at least two snakes being killed by local residents. Much of the known timber rattlesnake habitat is on private land and residential and/or commercial developments will likely be proposed over time if these lands are not protected. Effects of recreational activities on the current population need further evaluation.

3.1.3 Development (Habitat Loss and Conversion)

(A) Exposure Pathway

Timber rattlesnakes congregate in den sites during winter. Extracting of gravel or rock at the den site

will destroy a critical habitat component for local rattlesnake populations. In addition, large vehicles carrying rock and gravel could kill individual snakes if within transient or summer range habitat. In New Hampshire, there is only one known den site, so any disturbance to the den site or surrounding habitats could be catastrophic.

(B) Evidence:

Several sites in New Hampshire having “rattlesnake” names are currently or have been destroyed by commercial mining extractions (e.g., Rattlesnake Mountain, Concord; Rattlesnake Hill, Hooksett).

3.1.4 Unregulated Take

(A) Exposure Pathway

All other populations in New Hampshire have been destroyed by human actions. People tend to fear snakes, especially venomous species, and will kill snakes when they are encountered. In addition, because snakes congregate at den sites, knowledgeable collectors (commercial pet trade, personal use) are capable of depleting or eliminating local populations (Tynning 1992, Klemens 1993). In fact, one individual, Rudy Komarek, has reportedly greatly contributed to population depletions, including populations in New York and Massachusetts (Brown et al. 1994). The current New Hampshire population is vulnerable to illegal killing and collection. As a survivorship-limited species, loss of a single reproductive female from the remaining population may be enough to reduce the net reproductive rate below what is sustainable, leading to local and state extinction.

(B) Evidence

Unregulated take and persecution are undoubtedly the reasons behind extirpation of populations at traditional locations. Legislation once encouraged the killing of rattlesnakes, and zealous collectors and “bounty” hunters have decimated populations in the state.

3.2 Sources of Information

Sources included professional experiences, direct observation of the extant population, and searches of traditional locations, literature reviews, and personal communications.

3.3 Extent and Quality of Data

The major threats to the extant population are known. The frequency of unregulated take and other sources of unnatural mortality are probably not completed known.

3.4 Threat Assessment Research

Constant monitoring of the population is required to document potential and actual threats to the only known extant population.

ELEMENT 4: CONSERVATION ACTIONS

As a first step to protecting timber rattlesnakes in New Hampshire, the NHFG needs to develop a detailed recovery plan for timber rattlesnakes in New Hampshire. This plan will more thoroughly detail monitoring and research needs, education and technical assistance, habitat protection, restoration and management, and recovery goals. To ensure that timber rattlesnakes are not extirpated from New Hampshire, conservation efforts should focus on maintaining and/or restoring multiple metapopulations in New Hampshire, which will require a combination of efforts. The immediate primary goal is to protect the known existing population. Specific recovery goals need to be established. Specific conservation objectives and monitoring responses will be evaluated for this plan based on available information and will be updated as new monitoring or other information becomes available. In the interim, the status of the extant population must be monitored intensely each year.

4.1.1 Habitat Protection

Habitat protection will be critical to the future survival of timber rattlesnakes in New Hampshire. Ideally, all habitat used by female rattlesnakes should be protected, along with known habitat used by male snakes, and dispersal corridors to other historic or potential den locations. It is imperative that the areas around the den be afforded maximum protection and that all activities proposed in the protected area be compatible with timber rattlesnake conservation. Land values in southern New Hampshire are high, and a large land purchase will require a coordinated

effort among state agencies, conservation agencies, municipalities, and private funding.

4.1.2 Technical Assistance and Education

Information about the perilous state of the rattlesnake in New Hampshire should be made available to those close to (e.g., residential neighborhoods) or working in the summer range of occupied timber rattlesnake habitat (e.g., foresters), and the general public (NHFG website, press releases), along with information about rattlesnake biology, contact information in case a rattlesnake is encountered, and penalties for harming, harassing, or killing a rattlesnake. However, secrecy about the exact location is critical in preventing unscrupulous people from destroying individuals or critical habitat components (Brown 1993).

4.1.3 Restoration and Management

Timber rattlesnake populations are known to exist in a metapopulation structure, with several den sites within dispersal distances of each other. In New Hampshire, only one den is known to remain, although habitat in close proximity may remain.

Captive breeding has been successfully initiated for other endangered fauna in New Hampshire (e.g., Karner blue butterfly). Although captive breeding of rattlesnakes is relatively new, there are individuals and organizations within New England that have the experience to at least begin experimental captive breeding. Goals of captive breeding would include maintaining a genetic stock of New Hampshire rattlesnakes, in the event that a catastrophic event occurs in the natural population. Captive-breed individuals could also be used to augment the natural population, both in terms of number of individuals and genetic material. Appropriate methodology for breeding and releasing individual snakes would require detailed discussion prior to taking any actions.

Translocation of rattlesnakes to formerly occupied dens has been suggested as a possible conservation strategy (Brown 1993). However, this technique needs further evaluation and intense monitoring if implemented (see Dodd and Seigel 1991). In studies of nuisance timber rattlesnakes translocated from state parks in North Carolina to less populated areas, Sealy (1995) found that the snakes did not thrive. Reinert and Rupert (1999) conducted a controlled

radiotelemetry study in which behavior of translocated rattlesnakes was compared to that of residents and found immediate and long-term negative effects of translocation. There are too few rattlesnakes in New Hampshire to attempt this at present without the initiation of a captive breeding program. Release of captive-raised neonates to augment existing populations may be a more feasible option (Conner et al. 2003).

Appropriate habitat management in rattlesnake habitat will be addressed when a full recovery plan is developed. Likely, there should be several buffers of varying distances from the den and basking sites that allow different levels of management and recreational activities (Brown 1993). Appropriate habitat management must be clearly communicated to those involved (e.g., foresters).

Although not a primary conservation technique, fencing to prevent rattlesnakes from entering private property or other threatening habitat has been suggested. However, preventing rattlesnakes from accessing habitat could be considered take of an endangered species habitat (Amato and Rosenthal 2001). Fencing should not be used as a justification for the construction of residential or commercial structures in rattlesnake habitat. Fencing may be a viable option if snakes continually enter an existing residential area at the periphery of the snakes' summer range.

4.1.4. Regulation and Policy

Continue to actively pursue and enforce violations that involve humans illegally killing rattlesnakes. Monitoring of the local population will help determine what habitat should be reviewed and protected during NHFG's review of proposed developments.

4.2 Conservation Action Research

The extant population must be monitored to assess viability and success of proposed conservation actions. For example, individual age-specific survivorship and reproductive data should be taken annually so that over time life-table methods can be used to estimate the net reproductive rate. The genetic structure of the existing New Hampshire population should be analyzed and compared to other populations in the region.

ELEMENT 5. REFERENCES

5.1 Literature

[For thorough bibliographies on timber rattlesnakes, see Bill Brown (1991, 1993)]

- Allen, G. M. 1899. Notes on the Reptiles and Amphibians of Intervale, New Hampshire. Proc. Boston Soc. Nat. Hist. 29:63-75.
- Amato, C. A. and R. Rosenthal. 2001. Endangered species protection in New York after STATE V. SOUR MOUNTAIN REALTY, INC. Environmental Law Journal. 10:117-145.
- Brown, W. S. 2002. Conservation and management of New Hampshire's endangered timber rattlesnake (*Crotalus horridus*): Preliminary recommendations. Unpublished final report to New Hampshire Fish & Game, Nongame and Endangered Species Program.
- Brown, W. S. 1991. Bibliography of *Crotalis horridus*. in Tyning, Thomas F., ed. Conservation of the Timber Rattlesnake in the Northeast. Massachusetts Audubon Society, Lincoln MA.
- Brown, W. S. 1993. Biology, Status, and Management of the Timber Rattlesnake (*Crotalis horridus*): A Guide for Conservation. Herpetological Circular no. 22. Society for the Study of Amphibians and Reptiles.
- Brown, W. S., L. Jones, and R. Stechert. 1994. A case in herpetological conservation: notorious poacher convicted of illegal trafficking in timber rattlesnakes. Bulletin Chicago Herpetological Society.
- Brown, W.S., D.W. Pyle, K.R. Greene, and J.B. Friedlander. 1982. Movements and temperature relationships of timber rattlesnakes (*Crotalus horridus*) in northeastern New York. Journal of Herpetology. 16:151-161.
- Bushar, L.M., H. K. Reinert, and L. Gelbert. 1998. Genetic variation and gene flow within and between local populations of the timber rattlesnake, *Crotalus horridus*. Copeia 1998:411-422.
- Carle, H. D. 1958. What has happened to our snake populations? Bull. NH Acad. Sci. August 1958.
- Conner, R. N., D. C. Rudolph, D. Saenz, R. R. Schaefer, and S. J. Burgdorf. 2003. Herpetological Review. 34:314-317.
- Dodd, C. K. and R. A. Seigel. 1991. Relocation, repatriation, and translocation of amphibians and reptiles: are they conservation strategies that work? Herpetologica 47:336-350.
- Ernst, C. H. and E. M. Ernst. 2003. Snakes of the United States and Canada. The Smithsonian Institution. Washington, D.C., USA and London, England.
- McDuffie, J. 1968. See education as solution to state's rattler problem. Foster's Daily Democrat, January 13, 1968.
- Meffe, G.K and C. R. Carroll. 1998. Principles of Conservation Biology, 2nd ed. Sinauer, Sutherland MA.
- Oliver, J. A. and J. R. Bailey. 1939. Amphibians and Reptiles of New Hampshire. in Biological Survey of the Connecticut Watershed. Survey Report no.4. New Hampshire Fish and Games Department, Concord NH.
- Reinert, H. K. and R. R. Rupert, Jr. 1999. Impacts of translocation on behavior and survival of timber rattlesnakes, *Crotalus horridus*. Journal of Herpetology 33:45-61.
- Reinert, H. K. and R. T. Zappalorti. 1988. Field observation of the association of adult and neonatal timber rattlesnakes, *Crotalus horridus*, with possible evidence for conspecific trailing. Copeia. 1988:1057-1059.
- Sealy, J. B. 1995. Movements and management of nuisance rattlesnakes in a state park in North Carolina, Abstract, 38th Meeting of the Society for the Study of Amphibians and Reptiles, Boone NC.
- Society for the Protection of New Hampshire Forests. 2005. New Hampshire's Changing Landscape. Population growth and land use changes: what they mean for the Granite State. Executive Summary. Concord, New Hampshire, USA.
- Therres, G. D., Chairman of the Northeast Endangered Species and Wildlife Diversity Technical Committee. 1999. Wildlife species of regional conservation concern in the northeastern United States. Northeast Wildlife 54:93-100.
- Tyning, T.F. (editor). 1992. Conservation of the timber rattlesnake in the Northeast-a symposium held December 1, 1991 in Northampton, MA, published by the Massachusetts Audubon Society.