

Timber Rattlesnake

Crotalus horridus

Federal Listing	N/A
State Listing	E
Global Rank	
State Rank	S1
Regional Status	Very High



Photo by Brendan Clifford

Justification (Reason for Concern in NH)

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 (Therres 1999). 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. 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. More recently, an emerging snake fungal disease has been implicated in population declines of timber rattlesnakes in multiple northeastern states including the NH population.

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 persecution 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 Tuftonboro; Bear Brook State Park area of Allenstown and Hooksett; the Mt Wantastiquet and Rattlesnake Mountain areas of Hinsdale, Chesterfield, Swanzey and Winchester; and Fall Mountain in Walpole. Oliver and Bailey (1939) note that a NHEG 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. 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 in NH from 1981 to 1991, despite efforts to search for them at locations that they had traditionally inhabited, e.g., Mt. Wantastiquet in Chesterfield, Dan Hole Pond in Tuftonboro (Carle 1958). In 1991, a forester

Appendix A: Reptiles

accurately reported a rattlesnake to Jim Taylor of the University of New Hampshire, and the den site was located in 1992.

Habitat

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.

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 or October (NHFG Data). 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).

NH Wildlife Action Plan Habitats

- Appalachian Oak Pine Forest
- Rocky Ridge, Cliff, and Talus
- Hemlock Hardwood Pine Forest
- Shrublands



Distribution Map

Appendix A: Reptiles

Current Species and Habitat Condition in New Hampshire

The condition and viability of the one extant population has been studied extensively since 2006 by NHFG biologists. Greater than 30 individuals were identified and uniquely marked during the initial monitoring year. However, multiple snakes were observed basking late into the fall of 2006 with facial and body lesions that is suspected to have been an emerging fungal disease that resulted in mortality to some individuals (Clark et al. 2011). Since 2007 biologists have only observed an average of 9 individuals per year (range 4-14) despite a more intensive monitoring effort than 2006. Since the initiation of annual monitoring, facial and body lesions have been observed on several individuals (some lesions persisting for several years). Biopsies have been collected from some infected individuals for fungal and bacterial testing. In a genetic analysis, the NH population was found to have lower genetic diversity than multiple populations from New York (Clark et al. 2011).

Population Management Status

The population is monitored annually by NHFG to evaluate the population size, reproduction and the health of individual snakes. Several individuals have been treated for bacterial and fungal infections and released back into the wild. Radio telemetry has been used to monitor the recovery of treated individuals and to assess the general habitat-use and movement patterns of healthy individuals. A population recovery plan has been drafted.

Regulatory Protection (for explanations, see Appendix I)

- NHFG Rule FIS 803.02. Importation.
- NHFG Rule FIS 804.02. Possession.
- NHFG Rule FIS 811.01 Sale of Reptiles.
- Endangered Species Conservation Act (RSA 212-A)
- NHFG FIS 1400 Nongame special rules
- Fill and Dredge in Wetlands - NHDES
- Alteration of Terrain Permitting - NHDES

Quality of Habitat

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, some extensive tracts of summer range habitat are 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. Historically, several sites bearing the rattlesnake name were destroyed by gravel extraction activities or development.

Habitat Protection Status

The known den and many of the critical basking areas (as identified by NHFG) have been permanently protected. However, some of the remaining summer-range habitat remains unprotected.

Habitat Management Status

Habitat protection is a top priority for this species in New Hampshire. A site management plan is being drafted. Through targeted small-scale harvests, several potential basking areas (i.e., south-facing rocky hillsides) have been enhanced.

Threats to this Species or Habitat in NH

Threat rankings were calculated by groups of taxonomic or habitat experts using a multistep process (details in Chapter 4). Each threat was ranked for these factors: Spatial Extent, Severity, Immediacy, Certainty, and Reversibility (ability to address the threat). These combined scores produced one overall threat score. Only threats that received a “medium” or “high” score have accompanying text in this profile. Threats that have a low spatial extent, are unlikely to occur in the next ten years, or there is uncertainty in the data will be ranked lower due to these factors.

Disturbance from development that has resulted in reduced genetic variation (Threat Rank: High)

Healthy timber rattlesnake populations typically exist in a metapopulation structure where several over-wintering dens are used and snakes interact during the mating season in the summer habitat in-between. Developments that fragment dens reduces the genetic flow between den sites. Over time isolated populations may lose genetic diversity and show the effects of inbreeding depression.

Historically the remaining known site was likely part of a larger metapopulation. Over time, developments and human persecution have eliminated all former dens leaving the one remaining den which has been isolated for several decades (NHFG Data). In a genetics assessment the NH population was found to have lower genetic diversity than multiple populations from New York (Clark et al. 2011). Morphological abnormalities have been observed in some individuals suggesting inbreeding depression.

Mortality from human persecution and removal from population for collection (Threat Rank: High)

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 (Tyning 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.

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. Several types of recreational activities have been observed on summer-range habitat including use by ATVs, hiking, biking, hunting and target shooting. Occasional human-snake encounters on trails surrounding the site have been reported.

Mortality and species impacts (decreased fitness) of individuals from various diseases (snake fungal disease) (Threat Rank: High)

Since the mid-1990’s an increasing number of snakes in the Eastern United States have been observed with an apparent fungal skin infection that was often referred to as ‘hibernation blisters’. As the number of reported cases has grown the infections have now been termed snake fungal disease (SFD). A novel fungus (*Ophidiomyces ophiodiicola*) has been identified in many individuals with suspected SFD and is thought to be the cause of mortality although some questions remain as to whether this species is the primary or secondary pathogen.

O. ophiodiicola has now been documented in more than 10 different snake species from 11 different states ranging from New Hampshire to Florida and as far west as Arkansas and Minnesota. The infections have been most commonly reported in rattlesnakes and as having a high mortality rate,

Appendix A: Reptiles

although some tracked individuals have survived multiple years and responded to treatment (NEPARC SFD Fact Sheet; NHFG Data). The single remaining NH timber rattlesnake population is estimated to have declined by 50% in the years following the initial observations of SFD in 2006 and 2007 (Clark et al. 2011). A northern ringneck snake and an eastern milk snake from the same site have also tested positive for *O. Ophiodiicola* in recent years (NHFG Data). This disease has also been a conservation concern for rattlesnake populations in Massachusetts (Tom French, personal communication) and Vermont (Doug Blodget, personal communication) and the disease has been fatal for infected massasuga rattlesnakes in Illinois (Matt Allender, personal communication).

Habitat conversion due to development of den and summer habitat (Threat Rank: Medium)

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.

Male rattlesnakes are especially vulnerable during mating season, when they are more likely to encounter humans and cross roads (Aldridge and Brown 1995). Multiple individuals have been found in residential developments in New Hampshire, at least two snakes being killed by local residents. A large portion of the summer-range habitat surrounding the known den is on unprotected land and residential and/or commercial developments will likely be proposed over time if these lands are not permanently protected.

Habitat conversion due to mining occurring at summer, den, or basking areas (Threat Rank: Medium)

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.

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

Disturbance from increased precipitation in spring and summer that reduces basking opportunities (Threat Rank: Medium)

Increased precipitation over the course of the active season reduces basking opportunities, particularly for gravid or unhealthy snakes. Because timber rattlesnakes often bask for several weeks after emergence from hibernation, increased or heavy precipitation events in May or June are particularly problematic. Gravid females spend most of the summer basking on exposed rocky outcrops so a reduction in thermal quality may prolong the basking period or cause reproductive failure.

Record precipitation events for New Hampshire in 2005 and 2006 combined with an emerging snake fungal disease are suspected to have caused a significant decline in the NH population (Clark et al., 2011). The record rain in 2006 (commonly referred to as the Mother’s Day flood) occurred during spring emergence where precipitation was recorded every day for two consecutive weeks (NHFG

Appendix A: Reptiles

Data). In the month following the record precipitation, several snakes were observed basking for extended periods and many were observed with sores on the head and neck. Frequent precipitation that reduced basking opportunities is suspected to have contributed to the failure of three gravid females to produce live young from 2008-2010. Each female was documented giving birth to undeveloped ova (NHFG Data).

Mortality of individuals from vehicles on roadways (Threat Rank: Medium)

Roads fragment habitat, increasing mortality as snakes are forced to cross roads on a more frequent basis. Rattlesnakes are thick, heavy-bodied snakes and therefore are slow to cross roads (Andrews and Gibbons 2005). The loss of any adult from the NH population, particularly females, may have a dramatic effect on the population. While some low-traffic roads that bisect habitat patches may allow for snakes to cross with only occasional mortality, high intensity roads may isolate habitat patches.

Currently there are few public roads surrounding the extant site that could serve as potential threats. However, the private lands surrounding the site are susceptible to development and new roads.

Mortality of individuals from forestry equipment (Threat Rank: Medium)

Timber rattlesnakes have large home ranges and most summer activity is spent in mature deciduous or mixed forests. The vehicles used in commercial harvests may cause direct mortality of snakes.

Snakes have been routinely observed in forested habitat through incidental observations and the use of radio telemetry, with some locations more than one mile from the known den. In recent years forestry operations have been observed on private and conserved public lands within one mile of the den.

Mortality and disturbance from increased recreation (hiking, mountain biking, OHRV) (Threat Rank: Medium)

Brown (1993) found that snakes avoided basking sites that were disturbed by humans. Disturbance to gravid females may reduce reproductive success (Parent and Weatherhead 2000). Recreational activities that result in human-snake encounters may end with snakes being killed. Many people have an irrational fear or hatred toward snakes, and this may be amplified when encountering a venomous species.

Multiple types of recreational activities have been documented within the dispersal range of the known population. Activities include the use of ATVs, mountain-biking, hiking, camping, hunting and target shooting. Human-snake encounters are known to have occurred with ATV riders and hikers. Through radio telemetry several individuals have been observed crossing or basking near trails that are frequented by ATVs (NHFG Data). Hikers have reported rattlesnakes to NHFG from a known basking area and several recreational trails.

List of Lower Ranking Threats:

Actions to benefit this Species or Habitat in NH

Conduct habitat management at the extant site to improve basking opportunities.

Primary Threat Addressed: Disturbance from increased precipitation in spring and summer that reduces basking opportunities

Specific Threat (IUCN Threat Levels): Climate change & severe weather

Objective:

Conduct targeted habitat management to improve basking opportunities for gravid females.

General Strategy:

Suitable basking areas at the den or surrounding sites are critical to gravid females. Non-gravid individuals also use these sites while shedding their skin or to combat the effects of fungal infections. In lieu of natural disturbances (e.g., fire, hurricanes) basking areas may become shaded through natural forest succession. Once identified, these sites should be maintained with an open canopy with the use of hand-felling to minimize disturbance to basking rocks. Management on rocky hillsides should occur during the inactive period (November-March) to avoid disturbing basking snakes. During the summer months rattlesnakes spend the majority of their time in mature hardwood or mixed forests. Timber harvests that occur in these areas should leave at least a 50% canopy cover.

Political Location:

Statewide

Watershed Location:

Statewide

Increase the genetic diversity at the extant site

Primary Threat Addressed: Disturbance from development that has resulted in reduced genetic variation

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

Conduct population management to maintain a viable population

General Strategy:

Captive breeding has been successfully initiated for other endangered fauna in New Hampshire (e.g., New England cottontail, Karner blue butterfly) and could be applied to timber rattlesnake conservation. 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-bred 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.

Political Location:

Statewide

Watershed Location:

Statewide

Monitor the known population for prevalence and impact of SFD and other wildlife diseases.

Appendix A: Reptiles

Primary Threat Addressed: Mortality and species impacts (decreased fitness) of individuals from various diseases (snake fungal disease)

Specific Threat (IUCN Threat Levels): Invasive & other problematic species, genes & diseases

Objective:

Evaluate the health of individual snakes and provide treatment as necessary.

General Strategy:

Evidence of SFD has been observed in the NH population since 2006. All snakes that are encountered should be visually inspected with binoculars or by hand and photographed to determine the presence of lesions. Collect samples for disease testing and rehabilitate individual snakes as necessary. Follow rehabilitated snakes with radio-telemetry to determine behavior and survival.

Political Location:

Statewide

Watershed Location:

Statewide

Annually monitor the population to assess the population structure, reproductive output and health of individuals.

Objective:

Monitor the population to detect changes that may require conservation actions

General Strategy:

Conduct annual den surveys (visual surveys, time-lapse photography) in the spring and fall to document the population size. Mark all encountered individuals with PIT tags to determine survival. Identify gravid females that become established at basking areas and document reproductive success. Use radio-telemetry to follow adult and juvenile snakes to document habitat use and to monitor the health of individuals.

Political Location:

Statewide

Watershed Location:

Statewide

Monitor the known site for illegal activity and enforce violations of the NH ESA

Primary Threat Addressed: Mortality from human persecution and removal from population for collection

Specific Threat (IUCN Threat Levels): Biological resource use

Objective:

Protect the population from human persecution.

General Strategy:

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.

Appendix A: Reptiles

Political Location:

Statewide

Watershed Location:

Statewide

Provide education and technical assistance to landowners in close proximity to the extant population

Primary Threat Addressed: Mortality and disturbance from increased recreation (hiking, mountain biking, OHRV)

Specific Threat (IUCN Threat Levels): Human intrusions & disturbance

Objective:

Protect individual snakes from human persecution.

General Strategy:

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).

Political Location:

Statewide

Watershed Location:

Statewide

Work with landowners and foresters to implement forestry BMPs to minimize impacts to rattlesnakes

Primary Threat Addressed: Mortality of individuals from forestry equipment

Specific Threat (IUCN Threat Levels): Biological resource use

Objective:

Protect individual snakes from mortality during forestry operations.

General Strategy:

Snakes from the existing site may spend extended periods during the summer months on private lands where forestry may occur. Timber rattlesnakes are slow moving and vulnerable to being hit by forestry equipment. NHFG should keep in contact with landowners and foresters regarding plans for timber harvests and conduct site walks as necessary. Mid-October through March are preferred time periods for forestry operations to avoid mortality to individual snakes.

Political Location:

Statewide

Watershed Location:

Statewide

Restore historic den sites within snake dispersal distance from the extant den

Primary Threat Addressed: Disturbance from development that has resulted in reduced genetic variation

Appendix A: Reptiles

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

Create a metapopulation structure to increase the viability of the population

General Strategy:

Timber rattlesnake populations are known to exist in a metapopulation structure, with several den sites within dispersal distances of each other. Although only one known den remains there is enough suitable habitat to support a metapopulation. Historic den sites within this complex are known and should be targets of restoration.

Political Location:

Statewide

Watershed Location:

Statewide

Conduct presence surveys at known historic sites

Primary Threat Addressed: Habitat conversion due to mining occurring at summer, den, or basking areas

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

Identify populations so conservation measures can be taken.

General Strategy:

Some sites that historically supported rattlesnake populations have high quality habitat that remains. Timber rattlesnakes are long-lived species with an average life span of 20-25 years (Brown 1993) and have been documented to live over 40 years in the wild (Bill Brown, personal communication). Small remnant populations located in remote or difficult to navigate areas (i.e., talus slopes) with large tract of undeveloped land may go unnoticed. Multiple surveys conducted during spring and fall may be needed to document an extant population.

Political Location:

Statewide

Watershed Location:

Statewide

Protect all the known basking areas and summer range habitat of the extant population

Primary Threat Addressed: Habitat conversion due to development of den and summer habitat

Specific Threat (IUCN Threat Levels): Residential & commercial development

Objective:

Protect sufficient habitat to maintain natural movement corridors and minimize snake-human encounters

General Strategy:

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. The den site and

Appendix A: Reptiles

some basking areas are protected at the remaining extant site but several hundred acres of potential basking and summer habitat surrounding the den remain unprotected. 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.

Political Location:

Statewide

Watershed Location:

Statewide

References, Data Sources and Authors

Data Sources

The major sources of information included the authors' professional experiences, scientific literature, historic newspaper articles, and personal communications with current experts and laymen. The site has been annually monitored by NHFG biologists, expert naturalists, and conservation officers since 2006. 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). A genetics assessment of the known populations was conducted in 2010 (Clark et al 2011). Threat assessments were conducted by a group of NHFG biologists (Michael Marchand, Brendan Clifford, Loren Valliere, Josh Megysey).

Data Quality

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. Several individual rattlesnakes from the extant population have been monitored with radio-telemetry in recent years but data on extensive summer range movements is lacking, 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.

2015 Authors:

Brendan Clifford, NHFG; Michael Marchand, NHFG

2005 Authors:

James Taylor, UNH; Michael Marchand, NHFG.

Literature

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. 1991. Bibliography of *Crotalis horridus*. In Tynning, 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. 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

Appendix A: 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.
- Clark, R. W., Marchand, M. N., Clifford, B. J., Stechart, R., and Sierra Stephens. 2011. Decline of an isolated timber rattlesnake (*Crotalus horridus*) population: interactions between climate change, disease, and loss of genetic diversity. *Biological Conservation*: 144(2):886-891
- 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.
- Parent, C. and J. Weatherhead. 2000. Behavioral and life history responses of Eastern Massasauga Rattlesnakes (*Sistrurus catenatus catenatus*) to human disturbance. *Oecologia* 125:170-178.
- 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.