Marbled Salamander

Ambystoma opacum

Photo by Lloyd Gamble

Federal Listing	N/A
State Listing	E
Global Rank	G5
State Rank	S1
Regional Status	High

Justification (Reason for Concern in NH)

The marbled salamander is a Regional Species of Greatest Conservation Need, and is of high regional concern. The marbled salamander is at the northern periphery of its range in New Hampshire and appears to be extremely rare in the state. Few documented occurrences of the species exist for New Hampshire; however, a systematic survey to determine the location of all potential populations has not been conducted. The southern distribution of this species in the state, together with intensive developmental pressure in the same area, places this species at significant risk of extirpation.

Distribution

The marbled salamander is endemic to the eastern half of the United States. It ranges from southern New Hampshire, west through southeastern New England and Pennsylvania to the Lake Michigan region, and south to eastern Texas and northern Florida (Klemens 1993, DeGraaf and Yamasaki 2001, NatureServe 2004). In New England, this species occurs throughout Connecticut, Rhode Island, Massachusetts east of the Connecticut River, and in the Berkshire Hills of western Massachusetts (Klemens 1993, DeGraaf and Yamasaki 2001). One specimen was collected from western Vermont (DeGraaf and Yamasaki 2001).

Historically, marbled salamanders were reported from Milford (Hoopes 1938) and Hollis (NHNHB 1965), both in Hillsborough County south-central New Hampshire. Records from RAARP (2005) indicated that a marbled salamander was observed in Hinsdale, Cheshire County in 2000 (photo verified), and another was possibly observed in Hollis in 1997 (no photo or specimen but near location of historic report). Beginning in 2006, visual surveys were conducted in the spring for the presence of marbled salamanders in pools in Hollis, Brookline, Mason, Hinsdale, and Milford. In 2006-2008, surveys documented two sites occupied by marbled salamander; one of the sites was occupied for three consecutive years.

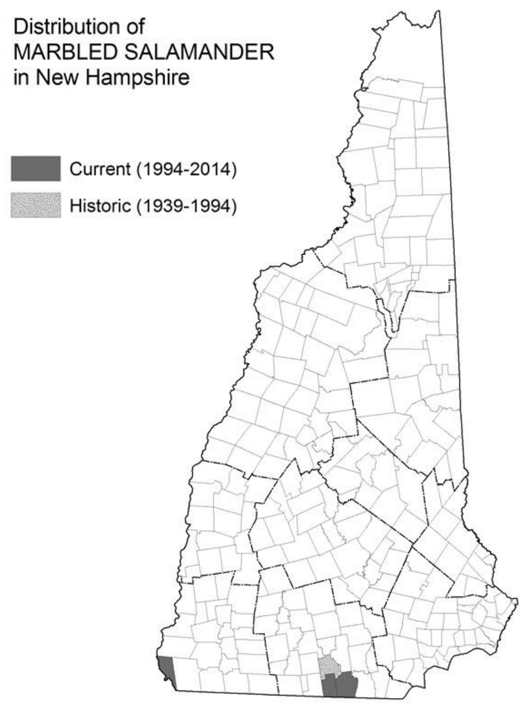
Habitat

Marbled salamanders breed in seasonally flooded, palustrine wetlands, but spend most of their lives in the forested uplands surrounding these wetlands (Noble and Brady 1933, Bishop 1941, Petranka 1989, Klemens 1993). Marbled salamanders use several types of palustrine wetlands (e.g., ephemeral pools and streams, fishless swamps, ponds with low water levels) for breeding and nesting (Noble and Brady 1933, Bishop 1941, Petranka 1989). Eggs are laid along the exposed edges of the wetlands, and wetlands must flood in the late fall or early winter in order for eggs to hatch (Bishop 1941, Petranka 1989). Salamanders hide nests, usually in bare mineral soil, beneath leaf litter, grass clumps, or logs, or within root complexes (Jackson et al. 1989, Petranka 1990, Figiel and Semlitsch 1995). To sustain a viable marbled salamander population, a wetland must hold standing water for about 10 months in most years (approximately September to June), so that the salamander larvae have sufficient time to develop and metamorphose (Noble and Brady 1933, Bishop 1941).

For upland habitat, marbled salamanders seem to prefer deciduous or mixed-deciduous woodlands (Klemens 1993), especially oak-maple and oak-hickory woods (Minton 1972) and floodplain forests (Petranka 1998). Marbled salamanders also seem to favor dry, friable soils, including sand and gravel deposits and rocky slopes (Bishop 1941, Klemens 1993). Marbled salamanders can inhabit somewhat drier areas than other Ambystoma species (Bishop 1941). Marbled salamanders use deeply imbedded rocks or logs (Klemens 1993) as cover objects, and probably use small mammal burrows as shelter throughout most of the year and as hibernacula in the winter (DeGraaf and Yamasaki 2001). In Connecticut, this species was observed at elevations ranging from 30 to 335 m (Klemens 1993).
The area and configuration of upland habitat needed to sustain a marbled salamander population is unknown, but probably varies according to local site conditions. This species likely operates as metapopulations, which require a multitude of habitat patches (i.e., breeding wetland and adjacent upland forest) connected by habitat that is hospitable to dispersing salamanders, in order to persist (Semlitsch 1998). At the local population level, salamanders in Indiana migrated an average distance of 194 m (range 0- 450 m) from breeding wetlands into the surrounding uplands (Williams 1973 as cited in Semlitsch 1998).

NH Wildlife Action Plan Habitats

- Vernal Pools
- Appalachian Oak Pine Forest



Distribution Map

Current Species and Habitat Condition in New Hampshire

There are no data on population number or population sizes from which to determine relative health of populations. However, as it is likely that the species occurs in low numbers, it may be in danger of extirpation.

Population Management Status

No specific management plans exist for populations at these observation locations. Confirmation of the existence of these populations is necessary. Additionally, a systematic survey, focused on southern New Hampshire, is needed to locate other potential marbled salamander populations. Population management plans can be created after populations have been identified.

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

Two known occupied pools (documented in 2006) are on conservation land. Populations of marbled salamanders, where they exist in New Hampshire, will likely be clustered in relatively undisturbed forest uplands around temporary and seasonally flooded wetlands. Such a habitat mosaic, of seasonally-flooded wetlands embedded in forested upland, is common throughout much of New Hampshire, but is increasingly fragmented by human development, especially in the southern portions of the state, which is where this species is most likely to occur.

Habitat Protection Status

There are insufficient data with which to assess protection status because very few breeding pools have been identified. The two pools documented during 2006 are on conservation lands.

Habitat Management Status

Marbled salamander habitat is indirectly managed through wetland and water resource protection, forestry management regulations (i.e., New Hampshire RSA 482-A; New Hampshire Rule Chapters Wt 100-800; Best Management Practices for Erosion Control on Timber Harvesting Operations in New Hampshire), and through land preservation (e.g., conservation restrictions and land acquisitions). These efforts are not specifically designed to manage for marbled salamanders. Population growth and associated development will likely destroy or degrade potential marbled salamander habitat, despite measures aimed at slowing and redirecting development. Additionally, some forest management techniques (e.g., clear cutting) could also contribute to the fragmentation and degradation of potential marbled salamander habitat (deMaynadier and Hunter 1999, Pough and Wilson 1976 cited in DeGraaf and Yamasaki 2001, Faccio 2003).

Basic distribution and habitat use data for the species are needed to develop effective habitat management plans. In the absence of these basic data, habitat management efforts might focus on limiting disturbance in and around vernal pools that are embedded within a relatively large matrix of minimally disturbed forest. The goal of habitat management efforts should be to maintain habitat patches that allow for metapopulation dynamics (i.e., multiple pool/upland patches connected by dispersal habitat). Thus, the usefulness (to salamanders) of pool buffer zones and dispersal corridors between habitat patches needs to be evaluated. Findings from a study in Massachusetts found that existing regulations for buffer widths (typically 30m) were not sufficient to protect upland habitat use by mole salamanders and highlighted the need to approach conservation of these animals at a broader scale (Gamble et al 2006).

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.

Habitat conversion due to development of surrounding uplands and associated edge effects (Threat Rank: High)

Development may affect breeding habitat (loss and degradation of vernal pools), upland habitat (loss and degradation of forests), and dispersal corridors (by fragmenting landscapes), and may even directly kill vernal pool wildlife such as marbled salamanders. Opportunistic predators (e.g., raccoons) and invasive plant and animal species are more common near human development. Myriad stressors associated with development collectively reduce local population sizes of amphibians, reduce gene flow between populations, and may ultimately extirpate local populations.

Vernal pools, an essential habitat feature for marbled salamanders, often occur in discrete patches within a matrix of terrestrial habitat. Amphibians that breed in these habitats may exist as metapopulations (e.g., Gill 1978, Sjögren 1991, Sinsch 1992, Marsh and Trenham 2001). The long-term persistence of populations depends on the exchange of individuals through dispersal and the colonization probability of vernal pools from terrestrial adult populations (Hanski and Gilpin 1991, Sjögren, 1991, Dodd 1997, Semlitsch and Bodie 1998, Skelly et al. 1999). Most amphibians use terrestrial habitat to obtain food and shelter from predation, desiccation, or freezing (Madison 1997, Lamoureaux and Madison 1999, Knutson et al. 1999). Therefore, the suitability of terrestrial habitat surrounding a vernal pool is likely to have a significant influence the composition and abundance of amphibians that breed in or otherwise utilize a vernal pool.

In the last few decades, commercial and residential development in New Hampshire have increased dramatically, in conjunction with accelerated human population growth and immigration (Sundquist and Stevens 1999). Similar urbanization has eliminated the marbled salamander from large portions of its former range on Long Island and mainland New York (Klemens 1993). Petranka (1998) noted that thousands of local populations of marbled salamanders have already been eliminated due to habitat loss. Windmiller (1996) noted that increasing urbanization likely reduces mole salamander abundance and excludes salamanders from otherwise suitable habitat. Gibbs (1998a) suggested that ambystomatids are predisposed to local extinction caused by habitat fragmentation.

Habitat conversion and impacts of the loss of breeding pools from the direct filling of wetlands for development (Threat Rank: Medium)

Vernal pools are filled for residential and commercial development, recreation, agriculture, and road development. Vernal pool filling results in immediate loss of habitat and, for some species, population extirpation. Wetland filling also increases the distance that dispersing amphibians must travel to reach suitable breeding habitat, resulting in decreased gene flow between local populations and decreased colonization of unpopulated breeding pools. This could disrupt metapopulation dynamics and long-term viability of the species.

Amphibians, particularly ambystomatid salamanders including marbled salamanders, generally breed in the same wetland every year (Semlitsch et al. 1993, Semlitsch 1998). It is not well known how these species respond when a breeding wetland is no longer available (i.e., filled). Some ambystomatid salamanders will return to breeding wetlands even after those wetlands have been filled, whereas others have been able to disperse to nearby created wetlands (Pechmann et al. 2001). Created mitigation wetlands usually are unsuccessful at replicating the functions or wildlife habitat of the wetlands they are intended to replace (Brown 1999).

Wetland loss in the United States from historic draining and filling is well documented (e.g., Dahl 1990, 2000). Lack of reliable data for vernal pools creates difficulty in accurately determining historic losses. An important aspect of wetland loss is not simply the continued loss of habitat, but the historic undervaluing of vernal pool habitat as well. Size has traditionally been used an important criterion for assessing wetland value. Without increased protection priority for vernal pools, it is certain that vernal pool habitat will decrease in the future.

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

Vehicle traffic can kill vernal pool-dependent species by hitting and crushing them as they cross roads. This can have a significant impact on some species and in severe cases could result in local extirpation. Roads may act as partial barriers to overland dispersal or migration, perhaps resulting in decreased gene flow between populations and decreased colonization of unpopulated vernal pools. This could disrupt metapopulation dynamics and long-term viability of some species.

Roads also create edge habitat. Along these edges, soil and air moisture may be reduced, leading to increased salamander desiccation. Roads may act as conduits for predators that prey on amphibians or turtle eggs (e.g., skunks and raccoons), and dispersal avenues for invasive plants and animals. Runoff from roads can also reduce habitat quality of vernal pools via pollution, increased salt levels, sedimentation, and erosion in pools and adjacent habitats.

Roads are a significant source of direct mortality for migrating amphibians (Fahrig et al. 1995, Ashley and Robinson 1996, Mazerolle 2004, Forman 2003), and salamander abundance in roadside habitats may be reduced (deMaynadier and Hunter 2000). Gibbs (1998) found that forest-road edges are less permeable to ambystomatid salamanders than are forest interior and forest-open land edges. Recent research conducted in southern New Hampshire suggests that roads have a negative impact on wood frogs (*Lithobates sylvatica*) and spotted salamanders (*Ambystoma maculatum*), a similar salamander that also breeds in vernal pools (Mattfeldt 2004). Amphibians can experience delayed development or mortality from runoff contamination from roads, including road salt (Trombulak and Frissell 2000, Turtle 2000).

List of Lower Ranking Threats:

Mortality and habitat degradation from toxins and contaminants

Mortality and habitat degradation from acid deposition

Mortality and species impacts (decreased fitness) from various diseases (ranavirus, chytrid)

Mortality and habitat degradation from heavy recreational and education near pools

Mortality and habitat loss from forestry practices

Mortality and degradation from increased droughts

Actions to benefit this Species or Habitat in NH

Determine habitat use and dispersal patterns of marbled salamanders

Objective:
Determine habitat use and dispersal patterns of marbled salamanders in New Hampshire occupied sites.

General Strategy:
Collect existing information on salamander dispersal and use of vegetated corridors, and conduct New Hampshire-specific research on salamander species and their use of buffer zones and dispersal corridors. Thus, the usefulness to salamanders of pool buffer zones and dispersal corridors between habitat patches needs to be evaluated.

Political Location:
Cheshire County, Hillsborough County

Watershed Location:
Lower CT Watershed, Merrimack Watershed

Develop conservation plan for marbled salamanders in NH.

Primary Threat Addressed: Habitat conversion due to development of surrounding uplands and associated edge effects

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

Objective:
Develop a statewide and site-specific conservation plans for marbled salamanders in New Hampshire.

General Strategy:
Use survey data to inform conservation planning process. Develop overall conservation plan for species as well as site-specific plans for any documented sites. Evaluate other potential conservation actions such as species augmentation or translocation.

Political Location:
Cheshire County, Hillsborough County

Watershed Location:
Lower CT Watershed, Merrimack Watershed

Evaluate adverse impacts and develop guidance for minimizing threats.

Primary Threat Addressed: Habitat conversion due to development of surrounding uplands and associated edge effects

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

Objective:
Evaluate all projects that have potential to cause harm to marbled salamander populations and provide guidance to minimize impacts to those populations.

General Strategy:
Marbled salamanders are listed as endangered in New Hampshire. As such, NHFG will review any proposed activities (residential and commercial development, recreation, habitat management, etc.) that has the potential to harm marbled salamanders. NHFG will work with applicants and permitting

staff from other state and federal agencies, primarily Department of Environmental Services (Wetlands Bureau) and U.S. Army Corps of Engineers, to identify avoidance and minimization conditions for permit applicants. NHFG will develop guidelines for consistent and effective review of projects potentially impacting marbled salamanders. Guidelines will consider scenarios where impacts should be avoided and scenarios where impact minimization of mitigation may be appropriate. Pre- and post- construction monitoring of marbled salamander and associated habitat (e.g., vernal pools) should be considered as a component of project review.

Political Location:
Cheshire County, Hillsborough County

Watershed Location:
Lower CT Watershed, Merrimack Watershed

Monitor for the presence of marbled salamanders

Objective:
Conduct a systematic survey and mapping of the distribution of this species in New Hampshire (and adjacent areas of Massachusetts).

General Strategy:
Monitor populations for habitat patch occupancy and determine stability and growth rates of local populations. Determine potential for regional dynamics at metapopulation level (i.e., determine interaction of spatial arrangement of viable habitat, local threats, and dispersal capacity of the species).

Political Location:
Cheshire County, Hillsborough County

Watershed Location:
Lower CT Watershed, Merrimack Watershed

Location Description:
Start with known occupied sites, and historic sites, then move into adjacent suitable habitat.

References, Data Sources and Authors

Data Sources

Information relating to the distribution of this species was gathered through an extensive literature review, and from surveys conducted from 2006-2009. During this period, 128 pools were surveyed for the presence of marbled salamander.
Threat assessments were conducted by a group of NHFG biologists (Michael Marchand, Brendan Clifford, Loren Valliere, Josh Megysey).

Data Quality

Before 2006, there had been no comprehensive survey conducted for this species in New Hampshire. The species was known to occur in southern New Hampshire historically (Hoopes 1938, Taylor 1993). Out of 128 sites surveyed in 2006-2009, only two sites had marbled salamander present. The New Hampshire Natural Heritage Bureau Rare Species Database has 5 current records (after 1995) of marbled salamander in the state, and one historic record (before 1995).
Information relating to the condition of this species and its habitat was gathered during an extensive literature review, a review of New Hampshire laws and administrative codes, and a review New Hampshire's Reptile and Amphibian Reporting Program.

2015 Authors:

Appendix A: Amphibians

Loren Valliere, NHFG; Michael Marchand, NHFG

2005 Authors:

Jessica Veysey, UNH; Kimberly Babbitt, UNH

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