

## SPECIES PROFILE

# Blanding's Turtle

## *Emydoidea blandingii*

**Federal Listing:** Not listed  
**State Listing:** Species of Special Concern  
**Affected Species:** N/A  
**Global Rank:** G4  
**State Rank:** S3  
**Author:** Michael N. Marchand, NHFG

### ELEMENT 1: DISTRIBUTION AND HABITAT

#### 1.1 Habitat Description

Blanding's turtles require large habitats consisting of a diversity of wetland types and hydroperiods, sandy open areas for nesting, and limited human disturbance (Joyal 1996, Jenkins and Babbitt 2003). Aquatic habitats include marshes, ponds, forested and shrub swamps, fens, shallow slow-moving rivers, backwaters, oxbows, and vernal pools (Ernst et al. 1994, Fowle 2001). Additional habitats include buttonbush basin swamps, highbush blueberry-winterberry shrub thickets, and deep emergent marsh-aquatic beds (Sperduto 2004, Jenkins and Babbitt 2003). Slow moving streams and rivers may be important for dispersal and travel between wetlands (Southwell 2002). Adults prefer clean shallow water with a soft organic bottom and abundant aquatic vegetation (Ross and Anderson 1990, Ernst et al. 1994). Duckweed (*Lemna*) is a common floating plant associated with Blanding's turtles (Ross and Lovich 1992).

Habitat use may shift seasonally and vary geographically. In some populations, vernal pools are used extensively in spring and summer (Joyal 1996), and when summer temperatures are high, Blanding's turtles may become relatively inactive. Turtles may estivate in vernal pools, shrub swamps, marshes, and ponds (Joyal 1996, Graham 1999, Fowle 2001).

Female turtles lay eggs in upland habitats, usually between late May and early July. Suitable nest sites

include an open canopy with sand, loam, or gravelly substrate (Graham 1999). Human-altered sites (e.g., pastures, road edges, yards, cornfields, gravel pits, and power line right of ways) may be used (Linck et al. 1989, Joyal 1996, Jenkins and Babbitt 2003). Hatchlings may rest in moss, leaf litter, and grass tussocks prior to migrating from nesting areas to aquatic habitats (Butler and Graham 1995). Juveniles may use marsh edges and shrubby wetlands that provide refugia from predators (Pappas and Brecke 1992).

#### 1.2 Justification

Like most turtles, Blanding's turtles are long-lived (up to 77 years in the wild; Brecke and Moriarty 1989) and are characterized by a late age of sexual maturity (14-20 years for female Blanding's turtles; Congdon and van Loben Sels 1993), relatively low fecundity (average 13 eggs per year, DePari et al. 1987, Congdon et al. 1983), and high rates of adult survival. Small increases in annual adult mortality (as little as 2-3%, Congdon et al. 1993, Gibbs and Shriver 2002), especially among females, can have catastrophic effects on populations. Blanding's turtles require large mosaics of wetland and upland habitats with relatively limited development.

Blanding's turtles occur patchily and at low densities throughout much of their range (Power et al. 1994) and are listed as endangered in Maine, threatened in Massachusetts and New York, and a Species of Special concern in New Hampshire. In New Hampshire, Blanding's turtle habitat overlaps with the highest human population densities. Therefore, turtles are extremely vulnerable to rapid development, especially where road density and traffic volume is high.

Blanding's turtles were listed as a candidate (candidate 2) for federal listing because of concerns over range-wide declines. Following a change in federal policy that eliminated federal candidate species listing,

the Northeast Endangered Species and Wildlife Diversity Technical Committee developed a list of species of regional concern. The Blanding's turtle was included in this list and was identified as a species that warrants federal or threatened species listing considerations as well as prelisting status reviews (Therres 1999).

### 1.3 Protection and Regulatory Status

See Marsh and Shrub Wetland Profile for regulations regarding wetland impacts.

- NHFG Rule FIS 803.02. Importation. Blanding's turtles shall not be imported to New Hampshire
- NHFG Rule FIS 804.02. Possession. Blanding's turtles shall not be possessed in New Hampshire.
- NHFG Rule FIS 811.01 Sale of Reptiles. No person shall sell Blanding's turtles in New Hampshire

### 1.4 Population and Habitat Distribution

Populations range from southern Ontario, south through Wisconsin, to Michigan, Minnesota, Ohio, Indiana, Illinois, Iowa, and Nebraska. Peripheral populations exist in Missouri and Pennsylvania and isolated populations of Blanding's turtles occur in Nova Scotia, New York, and New England (Ernst et al. 1994). In New England, Blanding's turtles are restricted to eastern Massachusetts, southeast and south-central New Hampshire, and south-coastal Maine.

In New Hampshire, the majority of known Blanding's turtle locations are in the southeast, where many towns have at least one record (See section 1.5). However, NHFG has received one verified record for the town of Moultonborough (photograph) and another record for Holderness (specimen verified by NHFG staff). A third record in adjacent Sandwich was made by the same observer who documented the Blanding's turtle in Moultonborough. These observations appear to be isolated from southern New Hampshire Blanding's turtle locations by the large lakes of central New Hampshire (i.e., Squam and Winnepesaukee lakes). Although these observations are northerly compared with other New Hampshire records, they are south of reported observations in western Maine (Graham 1999).

Specimens were also observed in Auburn and near Cohas brook, Manchester (Huse 1901), Milford

(Babcock 1919), near Allenstown, and in Derry (Oliver and Bailey 1939). Of these towns, recent records have been received for Auburn, Milford, Allenstown, and Derry. Historic towns with no recent records include Manchester (1900), Nashua (1979), New Durham (1982), and Pembroke (1978).

### 1.5 Town Distribution Map

### 1.6 Habitat Map

Blanding's turtle records were buffered by 1 km (Inferred Extent, NatureServe Element Occurrence specifications), and overlapping buffers were merged. These areas were considered occupied. For each occupied area, the following variables were measured: size (ha), area of potentially suitable wetland habitat (ha), conservation land (ha, percent), road density, and amount of development (ha, percent).

### 1.7 Sources of Information

Distribution information came largely from the New Hampshire Reptile and Amphibian Reporting Program (RAARP). High quality records were submitted to NHNHBB and were incorporated in the New Hampshire Rare Species Database. New Hampshire studies included an assessment conducted by D. Carroll along the Lamprey River and a study focused on the Great Bay and Concord areas (Jenkins and Babbitt 2003).

### 1.8 Extent and Quality of Data

Location records incorporated into the Rare Species Database included high quality photographs, specimens, and expert observations. Although most towns where Blanding's turtles currently occur probably have been reported, several towns in the center and periphery of the New Hampshire Blanding's turtle distribution have not verified the species presence to date.

### 1.9 Distribution Research

RAARP volunteers should report observations in towns where historic observations have been recorded (Manchester, Nashua, New Durham, Pembroke), in towns where gaps exist in the known distribution (e.g., Bedford), and in towns at the edge of the spe-

cies' New Hampshire range (e.g., Brookline, Henniker, Warner) where occurrence is likely. The NHB rare species database should be updated with recent reports, including a photo-verified report that was received for Hooksett but has not yet been incorporated into the Rare Species Database.

Where the species is likely to occur, visual and trapping surveys should be conducted. The NHFG should coordinate this effort and should involve other state and federal agencies, universities, non-government organizations, and expert observers.

## ELEMENT 2: SPECIES/HABITAT CONDITION

### 2.1 Scale

Initially, potential Blanding's turtle habitat was mapped throughout the distribution of the species in New Hampshire. However, because of the large area mapped as potential habitat, habitat quality was assessed based on known occupied sites (1 km buffer around locations; see element 1.6).

### 2.2 Relative Health of Populations

There is little information on the condition of Blanding's turtle populations in New Hampshire. Among 100 records (Element Occurrences) in the Rare Species Database maintained by the NHNHB (as of 30 March 2005), 14 are considered historic (before 1985). Thirty-three records were of individuals found only on roads, 52 records consisted of only 1 individual, and only 3 records in the database had greater than 10 observations.

### 2.3 Population Management Status

There is little management of Blanding's turtles in New Hampshire. Possession of Blanding's turtles, including manipulation of individuals for research, requires a permit from the NHFG. Several population studies have been conducted in New Hampshire; D. Carroll conducted a field investigation for rare turtles (i.e., Blanding's, spotted, *Clemmys guttata*, and wood, *Glyptemys insculpta*) in the Great Bay and Lamprey River areas. Recently, an extensive multi-year Blanding's turtle research project was conducted in two areas of New Hampshire: central New Hampshire (Dunbarton, Weare, Hopkinton) and southeastern

New Hampshire (Lee, Durham, Newmarket; Jenkins and Babbitt 2003). The New Boston Air Force Station is currently investigating habitat use and movement of Blanding's turtles on their property (S. Najjar, New Boston Air Force Station, personal communication). Protective screening has been placed over Blanding's turtle nests to prevent predation in some areas, but this effort has not been practiced at a large scale.

### 2.4 Relative Quality of Habitat Patches

Ninety-one occupied habitat areas were mapped, ranging from 318 to 5,602 ha (mean 852 ha  $\pm$  839 SD). A 1 km buffer around known Blanding's turtle records restricted the possible sizes of occupied areas. The presence and intensity of roads is a major threat and influences the quality of an area for Blanding's turtles. Total road density in these areas averaged 2.4 km/km<sup>2</sup>  $\pm$  1.4 SD (range 0-8 km/km<sup>2</sup>; see element 3: Threats). Only 24 occupied areas lacked any state routes and interstates. In these areas, residential development was less than 10%.

### 2.5 Habitat Patch Protection Status

The percentage of conservation land in Blanding's turtle occupied areas was 16% (range 0-100%); fee ownership was 13% (0-100%), and conservation easement was 3% (range 0-25%). Sixty-nine occupied areas had less than 20% of land protected, 82 areas had less than 50% protected, and only 4 occupied areas had more than 70% protection. The total area protected in occupied areas ranged from 0 to 1,787 ha (mean = 147 ha).

### 2.6 Habitat Management Status

There is little habitat management in New Hampshire specifically for Blanding's turtles, although the species has been targeted for management on some lands protected by the Great Bay Partnership. Thirty-one wetland impoundments are managed, primarily for waterfowl, by the NHFG, and Blanding's turtles are known to occur in some of these areas. Artificial nesting areas have been created in some areas as part of mitigation during NHFG review of wetland impacts. Nesting areas have also been created on other lands, including some owned by the Army Corps of Engineers, but use of these nesting areas is unknown.

## 2.7 Sources of Information

Information on the condition of Blanding's turtle populations largely was a result of reports received from the RAARP and several localized research and inventory efforts (Carroll 1999, Jenkins and Babbitt 2003). Geographic Information Systems (GIS) were used to assess quantity and quality of known Blanding's turtle observations by using available data layers (e.g., University of New Hampshire Complex Systems).

## 2.8 Extent and Quality of Data

Most records consist of 1 or a few observations, many of which were encounters on roads (see element 2.2). Wetland occupation and habitat use at a fine scale (e.g., wetland polygons) is poorly understood for most of the New Hampshire range of Blanding's turtles, though several sites near Concord and Great Bay have been studied in greater detail (Jenkins and Babbitt 2003).

## 2.9 Condition Assessment Research

- Continue to add and update Blanding's turtle records in the New Hampshire Rare Species Database in accordance with Element Occurrence standards accepted by NHFG and the NHNHBB.
- Coordinate with other states in the New England Blanding's Turtle Working Group (Massachusetts, Maine, New York) to build on existing research. An assessment of each state's Blanding's turtle populations will be included in the Northeast Regional Conservation Plan that will be conducted as part of a Science Support Partner Program grant. A model developed by B. Compton at the University of Massachusetts, Amherst, will be applied to New Hampshire's Blanding's turtle populations as part of this effort. This model (WETCROSS) will help indicate the quality of wetlands based on the likelihood of individual Blanding's turtles crossing roads.
- Identify viable populations and assess demographics. This was the highest ranking research item identified by the New England Blanding's Turtle Working Group (August 2004 survey).
- Assess population viability and habitat use on

conservation land, in especially state parks and wildlife management areas. Short visual (e.g., basking and nesting) and trapping surveys should be used to assess relative condition of populations. Because multiple land uses in protected areas may threaten populations, longer surveys should be conducted at a sample of conservation lands (e.g., Bear Brook State Park, Pawtuckaway State Park, Hopkinton-Everett Flood Control Area, New Boston Air Force Station) to assess effects of land use.

- Assess isolation of populations in New England via genetics studies.

## ELEMENT 3: SPECIES AND HABITAT THREAT ASSESSMENT

### 3.1.1 Development (Fragmentation, Habitat Loss and Conversion)

#### (A) Exposure Pathway

Blanding's turtles use a mosaic of wetland, aquatic, and upland habitats, often traveling a kilometer or greater among them. Thus, a large amount of land is required to protect a population. Reduction in habitat quality or availability may harm populations by causing direct mortality of individuals (construction and forestry equipment, drawdown while turtles hibernating) or indirect mortality due to increased dispersal across inhospitable habitat, increased predation, and increased desiccation.

Female turtles require bare ground and open canopies to lay eggs, and from late May to early July, they leave wetlands in search of suitable nesting habitat. If nesting habitat is not connected to occupied wetland habitat, adult mortality may occur. Humans and their pets may also disturb nesting females and their eggs, and although turtle populations are less sensitive to egg survival than to adult survival, high nest mortality or lack of nesting habitat may harm populations. Also, succession can reduce the quality of nesting areas and may result in reduced recruitment to local populations.

Blanding's turtles may use human-modified areas such as gravel pits, residential lawns, and agricultural areas, for nesting. Thus, adults in these areas are vulnerable to predation, road mortality, disturbance, and mowing equipment (Marchand and Litvaitis 2004a).

Nests near some ecological edges may also be more vulnerable to predation (Temple 1987).

(B) Evidence

An estimated 21,000 ha (51,000 acres) were required to maintain viable populations of Blanding's turtles in Maine (McCullough 1999). Although smaller areas may protect species where populations are denser (Fowle 2001), large blocks of connected habitat are needed to protect Blanding's turtles.

Because Blanding's turtles may use vernal pools and uplands, protection only of large wetlands is not adequate to protect Blanding's turtles (Southwell 2002). Southern New Hampshire is rapidly developing and lands are becoming more fragmented (SPNHF 2005). New Hampshire state regulations are currently ineffective at protecting species that use large wetland complexes, and building and disturbance setbacks from freshwater wetlands are not required under New Hampshire state wetland regulations (except for septic setbacks). Where they occur at the local level, they are not sufficient to protect wide ranging species such as Blanding's turtles without a larger scale planning effort.

As southern New Hampshire develops, wetlands will be threatened by myriad stressors (see Marsh and Shrub Wetland Profile). Although extensive marshes are not likely to be filled, small vernal pools can easily be overlooked during environmental reviews of dredge and fill permit applications (M.N. Marchand, personal observation). Likewise, landowners may remove beaver dams to protect their property with no approval or review process. Wetland drawdowns, especially those conducted in fall, may expose Blanding's turtles to predation, winterkill, and road mortality (Hall and Cuthbert 2000), especially where dispersing individuals are surrounded by dense development (Marchand and Litvaitis 2004a). The effect of managed wetland and lake drawdowns and other water manipulations on Blanding's turtles has not been evaluated in New Hampshire.

### 3.1.2 Transportation Infrastructure (Mortality, Fragmentation, Dispersal Barriers)

(A) Exposure Pathway

Human population density and development is rapidly increasing in southern New Hampshire (SPNHF 2005). Attendant increases in road densities and traf-

fic volume pose direct threats to turtles, which are slow to cross wide roads. Small annual losses of only a few adult Blanding's turtles may result in population extirpation.

(B) Evidence

Blanding's turtles are capable of dispersing long distances through upland habitats (Joyal et al. 2001, Jenkins and Babbitt 2003), and roads that intersect turtle home ranges or migratory pathways will increase the chance of individuals being killed on roads. Thirty-three of 100 Blanding's turtle records (Element Occurrences) known from New Hampshire consisted entirely of individuals observed on roads. Additionally, low population densities and skewed age and sex ratios have raised concerns over the effect of road mortality on some turtle populations in the region (e.g., Joyal et al. 2000, Marchand and Litvaitis 2004a, Gibbs and Steen 2005). Computer modeling suggests that road densities as low as 1 km/ km<sup>2</sup> with fewer than 100 vehicles per lane per day will cause excessive loss of semiterrestrial turtles (e.g., Emydoidea, Gibbs and Shriver 2002). Only 10 of 91 known occupied Blanding's turtle areas in New Hampshire had road densities less than 1 km/km<sup>2</sup>. Although density may be a good initial surrogate for investigating habitat quality, factors such as road width, traffic speed and volume, and position in the landscape should also be considered. Road shoulders, because of the availability of bare soil and open canopies, may attract nesting turtles, increasing the opportunity for road crossings of adult and hatchling turtles. Also, steep-sloping granite curbing can trap turtles on roadways and can decrease the chance of individuals successfully crossing roadways (Najjar, New Boston Air Force Base, personal communication).

#### 3.1.3 Unregulated Take

(A) Exposure Pathway

Individual turtles are removed from local populations, and because populations depend on high adult survival, removal can lead to local extinction.

(B) Evidence

Large-scale commercial collection of Blanding's turtles appears to be low and NHFG has no evidence of commercial collection of Blanding's turtles in New Hampshire. However, reptile dealers have advertised Blanding's turtles in New Hampshire in the past

(Levell 2000). The loss of adult turtles from natural populations can have devastating effects for all species of turtles. Therefore, commercial collection in New Hampshire is worth further investigation and enforcement. Casual collection and relocation of individual Blanding's turtles is probably more common. People may move turtles to distant wetlands, ponds, or lakes, and may occasionally adopt Blanding's turtles as pets.

### 3.1.6 Predation and Herbivory (Subsidized or Introduced Predators)

#### (A) Exposure Pathway

Young turtles and eggs are vulnerable to predators, and the risk of predation increases when subsidized predators such as raccoons are supported by human development.

#### (B) Evidence

High predation rates at turtle nests may affect long-term recruitment (Marchand and Litvaitis 2004b). In southern New Hampshire, raccoons are the most common predator of turtle nests (Marchand et al. 2002), and elsewhere predation rates have reached 93% (Congdon et al. 1983) and 94% (Butler and Graham 1995).

Short-tailed shrews (*Blarina brevicauda*, Standing et al. 2000) and eastern chipmunks (*Tamias striatus*) (Grgurovic 2003) may also prey on neonate Blanding's turtles, and although protected by their size and hinged plastron, adult Blanding's turtles are occasionally injured or killed by predators (Standing et al. 1999, Congdon et al. 2000). In Missouri, 31% of Blanding's turtles collected had injuries or missing body parts (Kofron and Schreiber 1985).

### 3.2 Sources of Information

Information on threats came from literature reviews, summary reports, expert reviews, New England Blanding's Turtle Working Group meetings and questionnaire, and available GIS data layers from various sources.

### 3.3 Extent and Quality of Data

Some threats have been studied more in Massachusetts and southern Maine, and these data are relevant

to New Hampshire. Although life span, age of maturity, and fecundity may vary, Blanding's turtles consistently mature late and depend on high adult survivorship. Road mortality and loss of contiguous habitat are known threats, and, though less understood, disease, invasive plants, genetic isolation, and effects of agriculture and forestry activities in New Hampshire are potential threats.

### 3.4 Threat Assessment Research

- The efficacy of Blanding's turtle management (e.g., water level management and agriculture), should be evaluated
- Populations that are isolated by anthropogenic barriers (e.g., high-traffic roads) should be identified, and options for increasing safe passage of traveling turtles should be considered
- Blanding's turtle populations should be monitored (e.g., with radio telemetry) in areas where underpass systems have been installed or are proposed

### ELEMENT 4: CONSERVATION ACTIONS

- Protect large blocks of unfragmented habitat with a diversity of wetland complexes (see Habitat Protection Strategies).
- Work with towns to protect critical habitat through land acquisition, prime wetland designation, and wetland buffer regulations (see Habitat Protection Strategies).
- Maintain beaver flowages and their function in the landscape (see Marsh and Shrub Wetland Profile).
- Design and place roads and other transportation networks (e.g., railways, bike trails, sidewalks) to reduce threats to Blanding's turtles and other rare wildlife (see Roads strategies).
- Educate public about rules and regulations pertaining to Blanding's turtles and other reptiles and amphibians (e.g., sale and possession) through updated and improved NHFG website and other media (see Wildlife Collection strategies).
- Reduce anthropogenic food sources for predators (see Predator control strategies).

#### 4.1.1 Identify Blanding's turtle habitat that will be crucial for protection through acquisition, easement, development restrictions, and mitigation (see Habitat Protection)

##### (A) Direct Threats Affected

All threats caused loss of extensive, interspersed, interconnected, and diverse wetland complexes

##### (B) Justification:

- Protecting and managing habitat for Blanding's turtle will reduce the opportunity for future development (especially road construction).
- Blanding's turtles depend on high annual adult survival rates. Removing threats that increase adult mortality is critical to long-term viability.
- Known Blanding's turtle habitat has been mapped, and future documentation will be incorporated into protection strategies. Priority habitats can be identified by GIS.
- Blanding's turtle require large blocks of relatively undeveloped land. These areas are rapidly disappearing, particularly in southern New Hampshire, and land protection for this species needs to start immediately.
- As new Blanding's turtle populations are documented, locations can easily be incorporated into land protection policy.

##### (C) Conservation Performance Objective

Protect and manage large blocks of habitat in southern New Hampshire to protect Blanding's turtles.

##### (D) Performance Monitoring

The area of land protected, and the type of protection afforded, can easily be summarized for a given year by ensuring that the conservation lands database is continually updated. Based on protection successes and failures, protection priorities can be adjusted. Statewide land protection efforts can be summarized into known, potential, and unlikely Blanding's turtle habitats.

##### (E) Ecological Response Objective

Protection of large unfragmented blocks of land

with wetland and upland habitat will maintain adult survival rates and thus contribute to the health of Blanding's turtle in New Hampshire.

##### (F) Response Monitoring

Long-term monitoring is needed at a sample of priority sites to ensure that protection is effective and worthwhile. A combination of mark-recapture, radio telemetry, and basking and nest site surveys should be conducted to monitor long-term trends in population. Viable populations would be indicated by the density and structure of Blanding's turtle populations, threats to annual adult survival, and the area of land protected.

##### (G) Implementation

Known occupied Blanding's turtle habitat has been mapped by NHFG. New reports will be updated as verified records become available. Occupied Blanding's turtle habitats will be used to prioritize unfragmented blocks identified by the Comprehensive Wildlife Strategy process. Specific land protection might include the following:

- Work with the Great Bay Partnership to protect important Blanding's turtle habitat in the Coastal Watershed
- Add protection to and linkage between areas adjacent to large protected areas in south-central New Hampshire (especially Bear Brook, Pawtuckaway, and North Meadows State Parks)
- Identify and protect other large areas that are likely to support Blanding's turtles, including those in south-central New Hampshire
- Protect wetlands and uplands adjacent to slow rivers in southern New Hampshire (e.g., Lamprey River)
- Protect corridors between viable populations in New Hampshire, Massachusetts and Maine

When land is purchased with conservation of mitigation funds, or when existing habitat is enhanced or restored, protecting Blanding's turtles should be a priority. Other uses should be considered only when they do not jeopardize the long-term viability of Blanding's turtle populations. Therefore, ownership and management authority must be considered when acquiring pieces of conservation land.

(H) Feasibility

Protection of large blocks of habitat with diverse wetland complexes is compatible with other large-scale land protection priorities. Land values in southern New Hampshire are high and rising, so protection must be prioritized. Long-term monitoring is labor intensive, and so can only be initiated at a few priority sites.

**4.1.2 Evaluate Blanding's turtle protection status and develop guidelines for regulatory review of threats to known or potential habitat, Regulation and Policy**

(A) List of Direct Threats Affected

All habitat-based threats affected

(B) Justification

- The Blanding's turtle is currently listed as a Species of Special Concern, and this designation provides less protection than the New Hampshire Endangered Species Conservation Act (RSA 212-A).
- Restricting activities that harm Blanding's turtles will minimize mortality
- Because turtle habitat is under heavy pressure from development, protection is urgent
- New information on known and new populations will be incorporated into the review process.

(C) Conservation Performance Objective

Minimize threats to the Blanding's turtle through regulatory processes (residential, commercial, transportation and trail networks, and habitat management).

(D) Performance Monitoring

Guidelines will be developed so that NHFG project reviewers can provide a consistent and adequate response, and project reviewers will be able to indicate whether regulations are having a positive effect on Blanding's turtle habitat.

(E) Ecological Response Objective

To reduce the destruction of Blanding's turtle habitat in southern New Hampshire and maintain viable, connected populations.

(F) Response Monitoring

Long-term monitoring will be conducted at a few

priority Blanding's turtle sites. Shorter sampling efforts (basking and nesting surveys) can be applied to a larger number of known or potential Blanding's turtle sites. If threats from development are possible and can't be avoided through the regulatory review, qualified individuals hired by developers should monitor local turtle populations.

(G) Implementation

The Blanding's turtle is currently listed as a special concern species in New Hampshire. This designation carries limited regulatory protection and the species may warrant additional protection under the New Hampshire Endangered Species Conservation Act (RSA 212-A). Therefore, Blanding's turtles should be considered for listing at the next revision. Meanwhile, NHFG has authority over wildlife and can review wetland dredge and fill applications submitted to the NHDES. NHFG biologists should develop standard guidelines so project reviewers at NHFG and DES have a consistent regulatory review and so that permit applicants can expect a consistent review. Although guidelines should provide consistency, further requirements may be required depending on the scope of the project and the viability of the local Blanding's turtle population.

(H) Feasibility

Sufficient information is available to consider Blanding's turtle for state protection under RSA 212-A. Standard guidelines could be developed based on other states' successes and failures and on recommendations from the New England Blanding's Turtle Working Group. Unfortunately, NHFG reviews projects through other state agency permitting processes (especially NHDES) and does not currently have a conservation permit process of its own. Thus, implementing strong regulations is likely to be challenging. Therefore, priority sites should receive the greatest regulatory review.

**4.1.3 Coordinate a regional Blanding's turtle working group**

In February 2004 the "Northeast Blanding's Turtle Working Group" was initiated with the goal of sharing resources and identifying regional priorities for conserving Blanding's turtles. In October 2004, the USFWS funded a grant proposal to produce a

regional status report and a conservation plan for Blanding's turtles in the Northeast, to assess road mortality and population viability through modeling, and to conduct population viability analyses for the entire Northeast region. Information gathered from this study will help determine if the Northeast Blanding's turtle population warrants federal endangered species listing as a Distinct Population Segment. In addition, results of this study will help focus future funding, identify common priorities, guide conservation groups to protect viable populations of turtles, and guide the development of future transportation projects (Science Support Partnership Program Study Plan 2004).

#### 4.2 Conservation Action Research:

Work with the New England Blanding's Turtle Working Group to update and prioritize areas for protection based on models and results of ongoing Blanding's turtle research.

### ELEMENT 5: REFERENCES

#### 5.1 Literature

- Brecke, B., and J.J. Moriarty. 1989. *Emydoidea blandingi* (Blanding's turtle) Longevity. *Herpetological Review* 20:53.
- Congdon, J.D., A.E. Dunham, and R.C. van Loben Sels. 1993. Delayed sexual maturity and demographics of Blanding's turtles (*Emydoidea blandingi*): implications for conservation and management of long-lived organisms. *Conservation Biology* 7:826-833.
- Congdon, J.D., R.D. Nagle, O.M. Kinney, M. Osen-toski, H.W. Avery, R.C. van Loben Sels, and D.W. Tinkle. 2000. Nesting ecology and embryo mortality: implications for hatchling success and demography of Blanding's turtles (*Emydoidea blandingi*). *Chelonian Conservation and Biology* 3:569-579.
- Congdon, J.D., D.W. Tinkle, G.L. Breitenbach, and R.C. van Loben Sels. 1983. Nesting ecology and hatching success in the turtle *Emydoidea blandingi*. *Herpetologica* 39:417-429.
- Congdon, J.D., and R.C. van Loben Sels. 1993. Relationships of reproductive traits and body size with attainment of sexual maturity and age in Blanding's turtles (*Emydoidea blandingi*). *Journal of Evolutionary Biology* 6:547-557.
- DePari, J.A., M.H. Linck, and T.E. Graham. 1987. Clutch size of the Blanding's turtle, *Emydoidea blandingi*, in Massachusetts. *The Canadian Field-Naturalist* 101:440-442.
- Ernst, C.H., J.E. Lovich, and R.W. Barbour. 1994. *Turtles of the United States and Canada*. Smithsonian Institution Press, Washington and London, USA.
- Fowle, S.C. 2001. Priority sites and proposed reserve boundaries for protection of rare herpetofauna in Massachusetts. Natural Heritage and Endangered Species Program. Massachusetts Division of Fisheries and Wildlife, Westborough, Massachusetts, USA.
- Gibbs, J.P., and D.A. Steen. 2005. Trends in sex ratios of turtles in the United States: Implications of road mortality. *Conservation Biology* 19:552-556.
- Graham, T.E. 1999. *In* Maine Amphibians and Reptiles, M.L. Hunter, A.J.K. Calhoun, and M. McCollough. The University of Maine Press, Orono, Maine, USA.
- Huse, W.H. 1901. The Testudinata of New Hampshire. *Proceedings of the Manchester Institute of Arts and Sciences* 2:47-51.
- Jenkins, R., and K.J. Babbitt. 2003. Developing a conservation strategy to protect land habitat functions for New Hampshire's reptiles and amphibians using the Blanding's turtle (*Emydoidea blandingi*) as a flagship species. Final report submitted to the New Hampshire Fish & Game Department, Concord, New Hampshire, USA.
- Joyal, L.A. 1996. Ecology of Blanding's (*Emydoidea blandingi*) and spotted (*Clemmys guttata*) turtles in southern Maine: population structure, habitat use, movements, and reproductive biology. M.S. Thesis, University of Maine, Orono, Maine, USA.
- Joyal, L.A., M. McCollough, and M.L. Hunter, Jr. 2000. Population structure and reproductive ecology of Blanding's turtle (*Emydoidea blandingi*) in Maine, near the northeastern edge of its range. *Chelonian Conservation and Biology* 3:580-588.
- Joyal, L.A., M. McCollough, and M.L. Hunter, Jr. 2001. Landscape ecology approaches to wetland species conservation: a case study of two turtle species in southern Maine. *Conservation Biology* 15: 1755-1762.
- Kiviat, E. 1997. Blanding's turtle habitat requirements and implications for conservation in Dutchess

- County, New York. Pages 377-382 in *Proceedings: conservation, restoration, and management of tortoises and turtles*, J.V. Abbema and P.C.H. Pritchard, editors. New York Turtle and Tortoise Society and Wildlife Conservation Society.
- Kiviat, E., G. Stevens, R. Brauman, S. Hoeger, P.J. Petokas, and G.G. Hollands. 2000. Restoration of wetland and upland habitat for the Blanding's turtle, *Emydoidea blandingii*. *Chelonian Conservation Biology* 3:650-657.
- Kofron, C.P., and A.A. Schreiber. 1985. Ecology of two endangered aquatic turtles in Missouri: *Kinosternon flavescens* and *Emydoidea blandingii*. *Journal of Herpetology* 19:27-40.
- Linck, M.H., J.A. DePari, B.O. Butler, and T.E. Graham. 1989. Nesting behavior of the turtle, *Emydoidea blandingii*, in Massachusetts. *Journal of Herpetology* 23:442-444.
- Marchand, M.N. and J.A. Litvaitis. 2004a. Effects of habitat features and landscape composition on the population structure of a common aquatic turtle in a region undergoing rapid development. *Conservation Biology* 18:758-767.
- Marchand, M.N. and J.A. Litvaitis. 2004b. Effects of landscape composition, habitat features, and nest distribution on predation of simulated turtle nests. *Biological Conservation* 117:243-251.
- Marchand, M.N., J.A. Litvaitis, T.J. Maier, and R.M. DeGraaf. 2002. Use of artificial nests to investigate predation on freshwater turtle nests. *Wildlife Society Bulletin* 30:1092-1098.
- McCullough, M.A. 1999. Conserving a landscape for Blanding's and spotted turtles in Maine and New Hampshire. Abstracts of the 55<sup>th</sup> Annual Northeast Fish and Wildlife Conference, Manchester, New Hampshire, USA.
- NatureServe. 2004. NatureServe Explorer: An online encyclopedia of life [web application]. Version 4.1. NatureServe, Arlington, Virginia. Available <http://www.natureserve.org/explorer>. (Accessed: January 4, 2005).
- Oliver, J.A. and J.R. Bailey. 1939. Amphibians and reptiles of New Hampshire exclusive of marine forms: Pages 195-217 in *Biological Survey of the Connecticut watershed*, H.E. Warfel, editor. New Hampshire Fish and Game Department Survey Report 4.
- Pappas, M.J. and B.J. Brecke. 1992. Habitat selection of juvenile Blanding's turtles, *Emydoidea blandingii*. *Journal of Herpetology* 26:233-234.
- Power, T.D., T.B. Herman, and J. Kerekes. 1994. Water colour as a predictor of local distribution of Blanding's turtles, *Emydoidea blandingii*, in Nova Scotia. *The Canadian Field-Naturalist*:17-21.
- Ross, D. A., and R. K. Anderson. 1990. Habitat use, movements, and nesting of *Emydoidea blandingii* in central Wisconsin. *Journal of Herpetology* 24: 6-12.
- Ross, D.A., and J.E. Lovich. 1992. Does the color pattern of two species of turtles imitate duckweed? *Journal of Pennsylvania Academy Sciences* 66:39-42.
- Science Support Partnership Program. 2004. Study Plan Status Review and Conservation of Blanding's turtles in New England. A proposal to the U.S. Geological Survey-Biological Resources Division. U.S. Fish and Wildlife Service.
- 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.
- Southwell, D.K. 2002. Conservation assessment for Blanding's turtle (*Emydoidea blandingii*). USDA Forest Service, Eastern Region. Hiawatha National Forest, U.S. Forest Service Eastern Region, Escanaba, Michigan, USA.
- Standing, K.L., T.B. Herman, and I.P. Morrison. 1999. Nesting ecology of Blanding's turtle (*Emydoidea blandingii*) in Nova Scotia, the northeastern limit of the species' range. *Canadian Journal of Zoology* 77:1609-1614.
- Standing, K.L., T.B. Herman, and I.P. Morrison. 2000. Predation of neonate Blanding's turtles (*Emydoidea blandingii*) by short-tailed shrews (*Blarina brevicauda*). *Chelonian Conservation and Biology* 3:658-660.
- Temple, S.A. 1987. Predation on turtle nests in increases near ecological edges. *Copeia* 250-252.
- Therres, G.D. 1999. Wildlife species of regional conservation concern in the northeastern United States. *Northeast Wildlife* 54:93-100.

## 5.2 Data Sources

- New Hampshire Natural Heritage Bureau. 2005. Database of Rare Species and Exemplary Natural Community Occurrences in New Hampshire.

Department of Resources and Economic Development, Division of Forests and Lands. Concord, New Hampshire, USA.

New Hampshire Reptile and Amphibian Reporting Program (RAARP). Coordinated by New Hampshire Fish & Game Department's Nongame & Endangered Species Program.

#### **ELEMENT 6: LIST OF FIGURES**

Figure 1. Town distribution map of known Blanding's turtle locations in New Hampshire, March 2005. Town records reported included a photograph, specimen, or were reported by an expert observer. Most reports were received through the New Hampshire Reptile and Amphibian Reporting Program (RAARP).

## Distribution of Blanding's Turtle in New Hampshire

### Distribution

- Known
- Historic



Known = verified observations based on specimens, photos, or expert observation [e.g., NHFG's Reptile & Amphibian Reporting Program (RAARP), museum specimens, etc].  
Historic = observations more than 20 years old.

