SPECIES PROFILE

New England Cottontail

Sylvilagus transitionalis

Federal Listing: Under review for threatened/endangered status
State Listing: Management concern
Global Rank: G4
State Rank: S3
Authors: John A. Litvaitis and Jeffery P. Tash, University of New Hampshire

Element 1: Distribution and Habitat

1.1 Habitat Description

New England cottontails (hereafter referred to as 'NEC') occupy a variety of habitats including native shrublands and regenerating forests associated with small-scale disturbances that result from beavers (*Castor canadensis*), local windstorms, and human land uses. Less frequent but larger-scale disturbances (including hurricanes and wild fires) also provide early-successional habitats, especially near the Atlantic coast (Lorimer and White 2003). Habitats of NEC are described by vegetation structure (especially height and density) rather than specific plant communities (Eabry 1968).

The most consistent characteristic of NEC habitat is dense understory cover (Fay and Chandler 1955, Eabry 1968, Linkkila 1971). Coniferous stems provide NEC with approximately 3 times the visual obstruction of deciduous stems in winter (Litvaitis et al. 1985). NEC prefer sites with more than 50,000 stem-cover units/ha and are reluctant to venture more than 5 m from cover (Barbour and Litvaitis 1993). In regenerating stands or idle agricultural fields, NEC colonize after secondary succession has progressed and a woody understory is well developed (approximately 5 to 7 years). As the stand matures and young trees develop a closed canopy (approximately 20 to 25 years after disturbance), understory vegetation becomes sparse and the site is no longer suitable for NEC.

1.2 Justification

Since 1960, the distribution and abundance of NEC has declined substantially throughout New England (Johnston 1972, Jackson 1973, Litvaitis 1993). See section 1.4.

1.3 Protection and Regulatory Status

The species is currently being considered for threatened or endangered status by the USFWS (Federal Register: June 30, 2004; Volume 69, Number 125, Pages 39395-39400). The hunting season of NEC in New Hampshire was closed in September 2004.

1.4 Population and Habitat Distribution

Present-day populations of NEC span < 25% of their historic range (figure 1). A recent range-wide survey of the historic range of NEC (protocol described by Litvaitis et al. 2002) indicated that the distribution of NEC in New Hampshire has declined substantially. Only eastern cottontails and snowshoe hares were

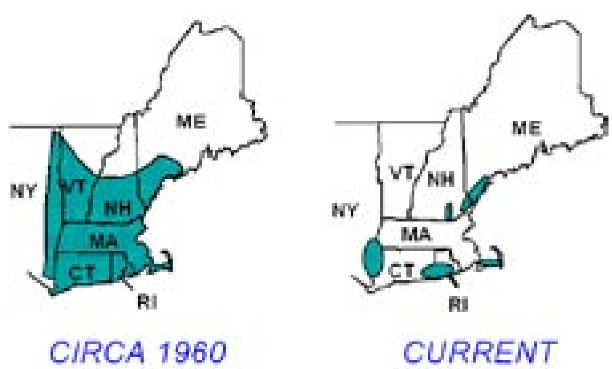

Figure 1. Historical and current distributions of New England cottontails. Historical distribution is a compilation of Hall and Kelson (1959), Johnston (1972), and Jackson (1973). Current distribution is based on a range-wide survey of suitable habitats (J. Tash et al., unpublished data).

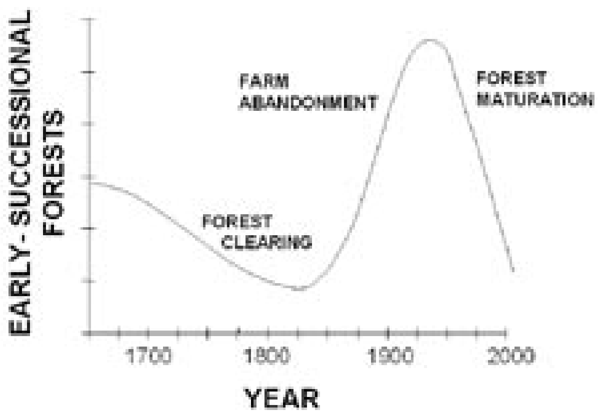

Figure 2. Successional wave that is passing through forests in the northeastern United States following land clearing for agriculture and subsequent abandonment of these lands. Modified from Litvaitis (1993).

found in the western portion of the state.

Probably the most important disturbance that influenced the abundance of NEC was the clearing of forests for agriculture by European settlers and subsequent abandonment of these lands (Ahn et al. 2002, Hall et al. 2002). Cleared lands were abruptly abandoned in the mid-1800s for more productive farms in the midwestern United States. Many of these tracts reverted to second-growth forests (Irland 1982), and NEC and other early-successional forest species reached unprecedented levels of abundance throughout the northeastern United States in the early 1900s (DeGraaf and Miller 1996, Foster et al. 2002, Litvaitis et al. 2005*b*). Litvaitis (1993) used information on the rate of farmland abandonment and developed a simple model of forest succession to estimate the approximate recruitment of early-successional habitats. Most of the abandoned lands matured into closed-canopy forests by 1960 and species dependent on these habitats quickly declined, including NEC (figure 2). Litvaitis (1993) summarized the approximate range retraction by NEC in New Hampshire (figure 3).

If populations of NEC stabilized at reduced densities reached in the 1960s, conservation actions probably would not be needed. However, early-successional habitats in the northeastern United States continue to decline (Brooks 2003) and remaining populations of NEC in New Hampshire and elsewhere are vulnerable to extinction (Litvaitis and Villafuerte 1996).

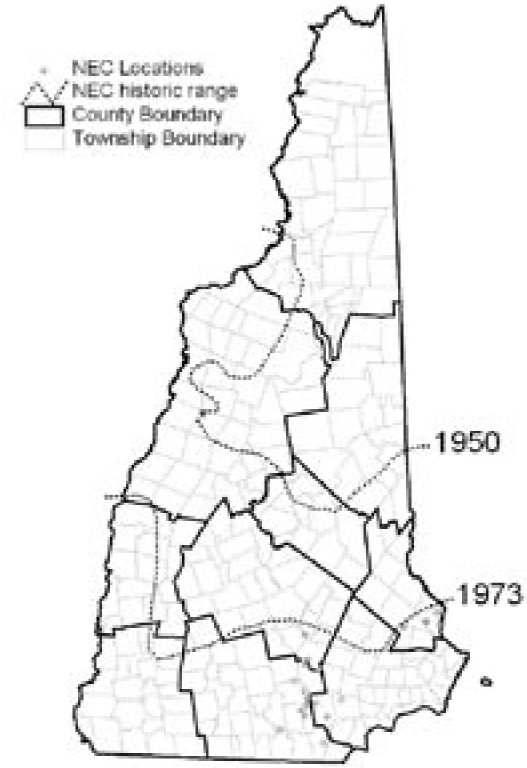

Figure 3. Range change of New England cottontail in New Hampshire from 1950 to present day. The 1950 delineation is based on a survey of conservation officers conducted by C.L. Stevens (unpublished map). Retraction by 1973 is based on livetrapping survey conducted by Jackson (1973). Locations of known populations of New England cottontails are indicated and were based on field surveys during 2002 and 2003.

1.5 Town Distribution Map

Remnant populations are restricted to southeastern and south-central New Hampshire.

1.6 Habitat Map

We used the results of the range-wide inventory that included NEC-occupied sites in Maine and New Hampshire to investigate landscape-scale environmental factors that affect their distribution. Seventeen habitat features, including class I and II road density, local road density, forest-open edge, and percent forest, were inventoried within 1-km around each NEC location and an equivalent number of patches known to be vacant within occupied quads. A 1-km radius (3.14 km^2) represents a reasonable approximation of dispersal distance of NEC (Litvaitis and Villafuerte

1996). We then used GIS to compare the inventoried information between the occupied and unoccupied sites to determine if any differences occurred.

Our data screening yielded 13 variables that differed between known NEC locations and vacant sites (appendix 2). Data analysis indicated that class I and II road density, local road density, forest-open edge, and percent forest were the most significant. Seventy-seven percent of known locations and ninety-one percent of vacant sites were correctly identified using these variables

1.7 Sources of Information

Information on current distribution of NEC came from a recent range-wide survey of the historic range of NEC (Litvaitis et al. 2002, Tash and Litvaitis, unpublished data). We also relied on other published investigations. Sources of information for the habitat map included USGS National Land Cover Characterization Project derived from early to mid-1990s Landsat Thematic Mapper satellite data (Vogelman et al. 2001), class I and II roads, rights-of-way (e.g., powerlines and pipelines) and railroad corridors from United States Census Bureau 2000 TIGER data, and snow coverage data from the Spatial Climate Analysis Service at Oregon State University.

1.8 Extent and Quality of Data

The habitat model does not identify habitats that will support NEC but describes areas that are similar to habitats that are currently occupied by NEC in New Hampshire and Maine. Most of the variables used in model development were obtained at a landscape scale (e.g., abundance of forest edges and class I + II roads), and do not provide a complete description of patch suitability. The most influential feature at the patch scale—understory density—could not be obtained from satellite imagery. Additionally, this model was based on habitats currently occupied by NEC and it does not represent the habitats that the species could potentially occupy but were not encountered during our survey. Based on the distribution of remaining NEC populations in New Hampshire (largely human-dominated landscapes), the features identified as important are probably only important in similar landscapes.

The remaining variables may have more obvious influences on habitat suitability. Local roads (class III and higher) had a negative influence probably because these roads lack the brushy corridor and fragment existing habitats. Forests also had a negative effect because NEC rely on dense understory vegetation that is usually sparse in closed-canopy forests. Finally, the abundance of forest-open area edges (positive influence) may index the abundance of brushy edges that are often found at the edge of forest stands.

The distribution of present-day populations of NEC is substantially affected by heterospecific interactions that were not included in our model. These include competition with expanding populations of eastern cottontails (*S. floridanus*) (Fay and Chandler 1955, Reynolds 1975) and interactions with snowshoe hares (*Lepus americanus*). The latter has not been studied in any detail.

1.9 Distribution Research

Develop a monitoring program to track changes in the abundance and distribution of NEC. This will

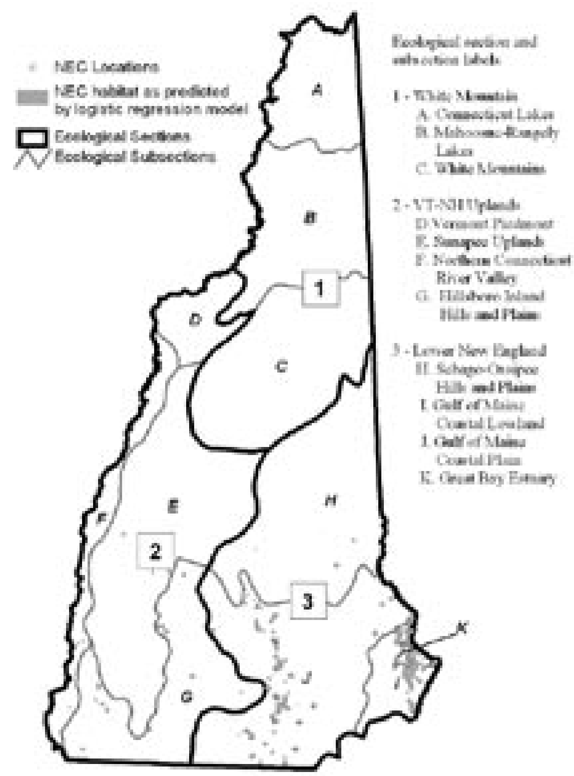

Figure 5. Modeled habitats of New England cottontails based on Class I and II road density, local road density, forest-open edge, and percent forest cover within 1 km. Habitats depicted had a >50% of being occupied.

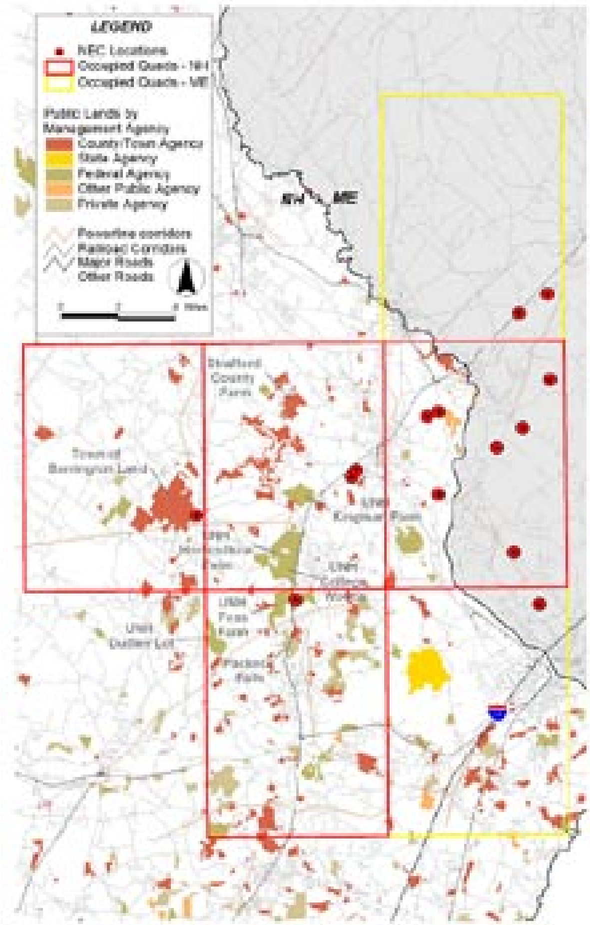

Figure 5. Distribution of public land in relation to habitats occupied by New England cottontails in southeastern New Hampshire.

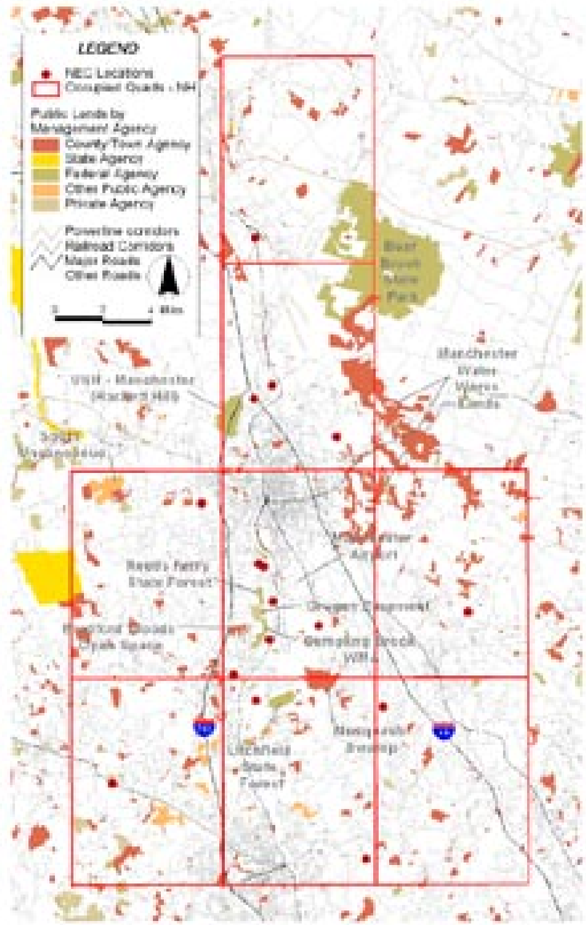

Figure 6. Distribution of public land in relation to habitats occupied by New England cottontails in southcentral New Hampshire.

become increasingly important as management efforts are directed toward expanding remaining populations. A monitoring program that relied on fecal analysis would be cost effective (Kovach et al. 2003).

Element 2: Species Habitat Condition

2.1 Scale

Based on the ephemeral nature of habitats, and the restricted distribution of NEC, we believe ecological subsections (Sperduto and Nichols 2004) is an appropriate scale to develop habitat management plans (figure 4).

2.2 Relative Health of Populations

Remaining populations of NEC in New Hampshire span a modest portion of the region that was occupied historically, including the Seacoast (figure 5) and Merrimack River Valley (figure 6).

2.3 Population Management Status

There have not been any habitat-based management efforts directed toward NEC. The recent closing of hunting seasons on this species will have little influence on long-term patterns of abundance.

2.4 Relative Quality of Habitat Patches

Modeled habitats with a greater than 50% probability of NEC occurrence (according to the generated model) averaged 223 ha, and 65% of sites were greater than 5 ha. Again, a distinction must be made between model habitats and actually occupied habitats. Litvaitis and Villafuerte (1996) reported that patches occupied in southeastern New Hampshire ranged from 0.2 to ~15 ha, and that populations of NEC in the region are functioning as induced metapopulations (Litvaitis and Villafuerte 1996). In such an arrangement, small patches (less than 3 to 5 ha) may represent the majority. Such patches are dependent on the colonization of surplus rabbits from larger patches of habitat (Litvaitis and Villafuerte 1996). Although large patches have been identified, the majority of these sites probably do not contain adequate patch-specific features (especially dense understory vegetation) to support NEC.

2.5 Habitat Patch Protection Status

Habitats with a greater than 0.5 probability of NEC occurrence (according to model predictions) totaled 34,061 ha. Approximately 21% (7,222 ha) occur on existing conservation lands or easements. Modeled habitats were most abundant in the Lower New England Ecosection (28,593 ha), especially in Gulf of Maine Coast Plain (13,454 ha) and Gulf of Maine Coast Lowland (14,523 ha) subsections.

2.6 Habitat Management Status

There is no NEC-specific habitat management.

2.7 Sources of Information

Land use and land cover data were obtained from the New Hampshire Land Cover Assessment 2001 database at the Complex Systems Research Center of UNH.

2.8 Extent and Quality of Data

There has been sufficient research on patch-specific habitat features. This information would be complemented by additional efforts to understand landscape elements that influence metapopulation survival (Litvaitis and Villafuerte 1996).

2.9 Condition Assessment Research

Substantial research has been conducted on the status and distribution of NEC and their habitat in New Hampshire.

Element 3: Species and Habitat Threat Assessment

3.1.1 Altered Natural Disturbance (Natural Succession)

(A) Exposure Pathway
NEC are obligate residents of habitats with dense understory vegetation. Forest succession and contemporary land uses have limited the generation of such habitats (Brooks 2003), and natural disturbance regimes in relatively young forests are not sufficient to provide adequate habitats (Litvaitis et al. 1999, Litvaitis 2003). Additionally, the current range occupied by NEC in New Hampshire (Figures 5 and 6) are embedded in rapidly developing landscapes (Sundquist and Stevens 1999).

(B) Evidence
Based on existing literature and recent survey of NEC habitats in New Hampshire.

3.1.2 Predation and Herbivory

(A) Exposure Pathway
Predation is the most common proximate mortality factor of NEC. Cottontails occupying small patches of habitat (les than 3 ha) are most vulnerable (Barbour and Litvaitis 1993, Brown and Litvaitis 1995, Villafuerte et al. 1997).

(B) Evidence
Extensive investigations of NEC in New Hampshire.

3.1.3 Scarcity (Competition)

(A) Exposure Pathway
NEC are sympatric with eastern cottontails and snowshoe hares in New Hampshire. Eastern cottontails are currently found along the Connecticut River Valley where NEC have apparently been extirpated. Allopatric populations of eastern cottontails also occur in the southern portion of the Merrimack River Valley and along the Atlantic coast to Great Bay in the southeastern portion of the State (Tash and Litvaitis, unpublished data). Stochastic events (e.g., winter with deep snow) also may benefit snowshoe hares.

(B) Evidence
Speculation based on literature review.

3.2 Sources of Information

Extensive research conducted in New Hampshire (reviewed by Litvaitis et al. 2005*a*).

3.3 Extent and Quality of Data

Substantial information on NEC status and conservation is available on New Hampshire populations.

3.4 Threat Assessment Research

The interactions between NEC and either eastern cottontails or snowshoe hares in contemporary landscapes, where human land uses are a dominant force creating early-successional habitats, warrant additional investigation.

Element 4: Conservation Actions

4.1. Development of early-successional habitat networks in landscapes currently occupied by NEC.

Based on the status of NEC populations in New Hampshire, habitat restoration and translocations are essential. If such efforts were undertaken, initial efforts would be most effective by expanding existing populations. The majority of NEC-occupied habitats occur on private lands, but several are near public land (figures 5 and 6). Indeed, cottontails for translocations may come from private lands that undergo development. Remaining populations also are associated with rapidly expanding human populations and associated developments (Sundquist and Stevens 1999). Additionally, remaining populations are associated with disturbance-generated habitats. As such, they have a finite period of suitability (figure 1). Unless active management programs develop, the long-term viability of these populations is unlikely. Habitats with a greater than 0.5 probability of NEC occurrence (according to model predictions) totaled 34,061 ha (figure 5). Approximately 21% (7,222 ha) occur on existing conservation lands or easements. Some of these lands may become suitable habitat with only modest intervention. Although modeled habitats do not reveal any information about the suitability of specific patches of habitat, the model does provide a landscape context within which suitable patches could be managed. Additionally, the habitat model provides insight into important landscape features that likely facilitate demographic exchanges among populations of NEC in human-dominated landscapes. For example, classes I and II roads were associated with NEC sites because the roads often have a brushy corridor associated with them. In southern Maine (included in model development), Litvaitis et al. (2003) encountered extensive stretches of Interstate 95 that had shrub-dominated margins more than 10 m wide. Additionally, rest areas and exit ramps had sufficient disturbance-generated habitats to support 1 to 2 cottontails (J. Litvaitis, personal observation). Although Interstate 95 poses a formidable barrier (up to 7 or 8 lanes of vehicle traffic) to east–west movement, the substantial habitat associated with this corridor may facilitate north–south movement.

In southern New Hampshire, one of the most expansive populations was associated with railroad corridors. Here, the strip of brushy vegetation also may be functioning as an important dispersal corridor. Management of habitats exclusively along the corridor of multi-lane highways, however, may create some unexpected problems. Specifically, enhancing habitats in these areas may benefit local NEC populations but create a potential "ecological trap" for wide-ranging predators of NEC by exposing them to elevated risks of vehicle collisions. A more prudent approach may be to rely on brushy edges of roads or utility rights-of-way as movement corridors but enhance habitats some distance (circa 0.5 km) from these corridors.

Predation is clearly the most common mortality factor among NEC in New Hampshire, especially by coyotes (*Canis latrans*) and foxes (*Vulpes vulpes*) (Barbour and Litvaitis 1993, Brown and Litvaitis 1995, Villafuerte et al. 1997). Populations of these carnivores have increased in southern New Hampshire as forest-dominated landscapes are converted into agricultural fields or suburban developments (Oehler and Litvaitis 1996). NEC occupied patches in southeastern New Hampshire ranged from 0.2 to greater than 15 ha, but very small patches (less than or equal to 2 ha) were inherently vulnerable because of intense predation (Barbour and Litvaitis 1993, Villafuerte et al. 1997). As a result, any effort to manage habitats of NEC in human-dominated landscapes should be directed toward larger patches of habitat (Litvaitis 2001).

As populations of NEC respond to restoration, additional management should occur. In less developed landscapes, management activities may shift toward developing a network of patches that compliment native shrublands and land uses that provide early-successional forests or old-field habitats. In regions where the historic abundance of shrublands and barrens was limited, timber harvests will provide a practical approach to diversify stand age distributions. Here, a "sliding scale" approach would be appropriate in mid-successional forests where natural disturbances are rare (Litvaitis 2003). Initially, the size of timber harvests would be larger than natural disturbances to offset the shortfall in early-successional habitat that currently exists. Once established, some of these openings could be maintained by active management (e.g., cutting, mowing, or control fires). As forests mature, management efforts (especially timber harvests) could be patterned after canopy gaps (Runkle 1991) or modified to specific silviculture practices of a region (Seymour et al. 2002) if other forms of NEC-suitable habitats (e.g. native shrublands and beaver impoundments) are adequately represented. Such an approach may be most appropriate on public lands or industrial forests where road networks and elevated populations of generalist predators may not be a concern (Litvaitis et al. 2005).

Element 5: References

5.1 Literature

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Element 6: List of Figures

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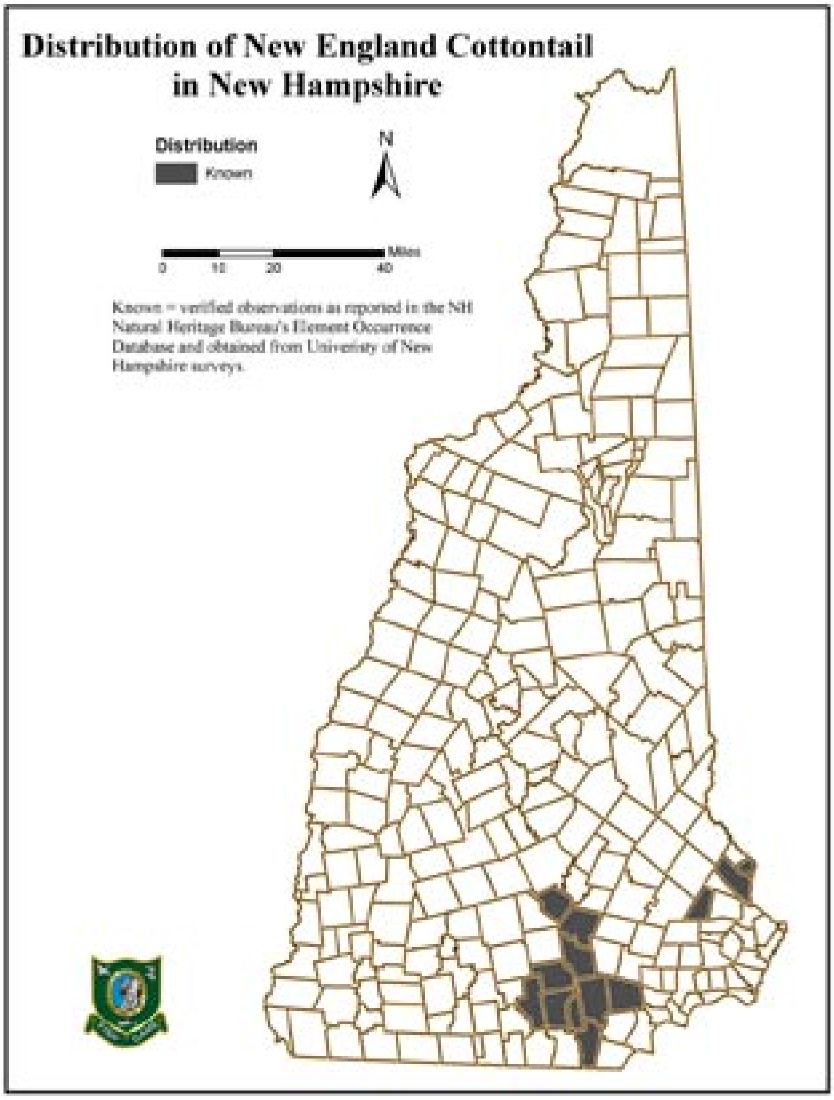
Distribution of New England Cottontail
in New Hampshire
Distribution
Known
N
Miles
0
10
20
40
Known = verified observations as reported in the NH
Natural Heritage Bureau's Element Occurrence
Database and obtained from Univeristy of New
Hampshire surveys.