

SPECIES PROFILE

Indiana Bat

Myotis sodalis

Federal Listing: Endangered

State Listing: S1

Global Rank: G2

State Rank: SNA

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ELEMENT 1: DISTRIBUTION AND HABITAT

1.1 Habitat Description

During winter, Indiana bats require cave or mine habitat that provides adequate characteristics for successful hibernation. Such characteristics mainly include proper microclimate (i.e. temperature stability) and low levels of human disturbance. Within the hibernaculum, Indiana bats often form tight clusters (Griffin 1940). They prefer roost temperatures between 1°C - 10°C and relative humidity in excess of 75% (Menzel et al. 2001, Tuttle 2003). Indiana bats generally enter the hibernacula during late October and begin leaving in March, with over 50% of the hibernating population usually emerging by mid-April (Richter et al. 1993). Male Indiana bats are often found either using caves or mines during the summer months or are captured in adjacent habitat (Whitaker and Brack 2002).

The summer habitat requirements of Indiana bats in New Hampshire are unknown; in fact, there is only one summer record of an Indiana bat in New Hampshire (Krusic 1996). Elsewhere in the summer, Indiana bats roost in trees with exfoliating bark or, rarely, in cavities. This habitat provides females with a physical space for forming maternity colonies where young are reared. Ideal habitat includes a roost tree and proximity to food and water.

1.2 Justification

Indiana bats are listed as federally endangered due to severe population declines at major hibernacula in the Midwest. Indiana bats have experienced a range-wide decline of approximately 57% in the last 50 years (Clawson 2002). In the 1930s, Indiana bats were the most abundant wintering bat species in Vermont. Of the 24 historic hibernacula known in the Northeast, at least ten have not been used by Indiana bats since 1980 (Hicks and Novak 2002). Massive deforestation in the 1880s was the primary cause of their decline in the Northeast (Trombulak et al. 2001). Currently, most hibernating Indiana bats in the northeast are found in New York (Hicks and Novak 2002).

Bats have a unique life history compared with other small mammals. Individuals are relatively long-lived and have a low reproductive rate, usually giving birth to a single young (Thompson 1982). Their slow reproductive rate contributes to a slow recovery time following population losses. Indiana bats are found in relatively rare, at-risk habitats during winter (caves/mines) and are thus particularly vulnerable to habitat loss or degradation. Indiana bats are of conservation concern in New Hampshire for the above reasons and because so little is known about the species' population status. Indiana bats have not been found hibernating in any of the 7 known hibernacula in New Hampshire, although there may exist unsurveyed mines that serve as hibernacula.

One male Indiana bat was captured in Bartlett (Krusic 1996), indicating that the species occurs in New Hampshire. It is possible that additional Indiana bats reside in New Hampshire during the summer, but few surveys have been completed. Some females that hibernate in New York currently form maternal colonies in Vermont's Green Mountain National Forest, which is approximately 65 km from the New Hampshire border.

3.3 Protection and Regulatory Status

No additional laws, ordinances, or rules, beyond those outlined in the Endangered Species Act (ESA), regulate the take, transport, or use of this species in New Hampshire. Scientific collection or research requiring capture of individuals requires a permit through NHFG (NHFG). Possession of live bats requires a permit under NHFG FIS 800.

1.4 Population and Habitat Distribution

Too little is known about the historic or current distribution of Indiana bats to assess regional distribution in New Hampshire. There are no winter records of Indiana bats hibernating in New Hampshire, and only one adult male was collected in the summer. A single summer record (adult male) is known from Albany, Carroll County.

1.5 Town Distribution Map

Not completed for this species.

1.6 Habitat Map

1.7 Sources of Information

Distribution information was compiled by examining New Hampshire Natural Heritage Inventory – Bat Hibernaculum Record data sheets, and by examining the collection dates of specimens deposited in museum collections and university teaching collections, and from published and gray literature on bats in New Hampshire.

1.8 Extent and Quality of Data

Data on the distribution of the Indiana bat in New Hampshire are extremely limited and of limited quality. A University of New Hampshire Master's student identified the lone summer record, and since identification of Indiana bats is difficult and requires experience, the record should be considered tentative. More research should be aimed at determining distribution patterns for this species.

1.9 Distribution Research

Surveys of previously un-surveyed mines that may

serve as bat hibernacula are needed to determine the winter distribution of Indiana bats in New Hampshire. A long-term, statewide mist-netting survey (with a protocol that meets the *de minimus* standards set out in the Indiana Bat Recovery Plan (USFWS 1999)), accompanied by echolocation surveys (e.g. use of Anabat acoustic survey methods when mist-netting), is needed to determine summer distribution. Initial mist-netting surveys should focus on bottomland forest and riparian corridor habitat in southwest New Hampshire. Mist-netting surveys should incorporate banding into the capture protocol and record all banding records in the Northeast Banding Database developed by the Northeast Working Group on Bats (NEWGB).

ELEMENT 2: SPECIES/HABITAT CONDITION

2.1 Scale

Due to the small number of mines in New Hampshire that may provide habitat for this species, each mine has been treated as a conservation planning unit under the habitat profile.

2.2 Relative Health of Populations

There is no known population of Indiana bats in New Hampshire. High priority conservation actions include the winter survey of the previously un-surveyed mines that may provide adequate winter habitat.

2.3 Population Management Status

Indiana bats are not currently managed in New Hampshire. Too little distribution data is available to develop conservation or management strategies.

2.4 Relative Quality of Habitat Patches

Indiana bat hibernacula in the Northeast tend to be large and thermally stable mines and caves with low ambient temperature, proximity to riparian habitat, and freedom from disturbance (Tuttle and Kennedy 2002, Tuttle 2003). Mascot Lead Mine is likely the only known hibernaculum that meets these characteristics. It is within 0.9 km of riparian habitat and located on land managed by the Department of Resources and Economic Development (DRED). Yuhus Mine

#2 in Alstead (Sullivan County) is within 0.8 km of riparian habitat, but total adit length could not be determined (Table 1). Because New Hampshire is in the northeastern periphery of the Indiana bat's range (Evans et al. 1998), it will be important to assess any potential hibernacula in Hillsborough, Merrimack, Cheshire, and Rockingham counties that meet these characteristics.

2.5 Habitat Patch Protection Status

2.6 Habitat Management Status

Bat gates have been installed at hibernacula for the last 35 years to reduce or eliminate disturbance to bats (Tuttle 1976). Bat gates are steel-welded structured installed in the entrance to a mine or cave to restrict human access while causing minimal impact on air flow and flight behavior of bats. Because many caves and mines are found in remote locations, bat gates have been described as "the only means available for protecting these [colonies of Indiana bats]" (Pierson et al. 1991: 31).

In New Hampshire, Mascot Lead Mine is the only known hibernaculum that is likely to have a microclimate conducive to Indiana bats, and it is the only hibernaculum where bat habitat is managed. This mine could potentially support Indiana bats, if the species were to overwinter in New Hampshire.

2.7 Sources of Information

To determine the winter distribution at known hibernacula, New Hampshire Natural Heritage Survey – Hibernacula Survey Data Sheets were examined. To determine habitat patch protection status, each hibernaculum, whether known or potential, was mapped on the Conservation Lands GIS data layer (GRANIT – 2003 data). Information about the summer habitat needs for Indiana bats is available from Menzel et al. 2001 and Clawson 2002.

2.8 Extent and Quality of Data

The data on known and potential hibernacula were collected in the summer of 2004 by Veilleux and Reynolds (2005).

2.9 Condition Assessment Research

Scientists need to determine the distribution and importance of mines that serve as winter roosts in New Hampshire. This requires establishing a monitoring program that will assess the physical attributes of potential hibernacula and document whether Indiana bats use any of these mines.

Research priorities for summering Indiana bats include the initiation of a state-wide mist-netting survey to document state-wide distribution, telemetry studies to determine habitat use (roosting and foraging habitat), life history studies to determine breeding status and reproductive patterns (e.g. timing of birth, weaning of young), and food habit analyses to determine prey preference.

ELEMENT 3: SPECIES AND HABITAT THREAT ASSESSMENT

3.1.1 RECREATION

See Caves and Mines habitat profile.

3.1.2 Development (Habitat Loss and Conversion)

(A) Exposure Pathway

Industrial or residential development and forest cutting may affect Indiana bats and other species that rely on trees for summer roosting habitat. Individual bats may experience direct mortality (especially non-volant young) if the disturbance occurs during the parturition or lactation period (late May through mid-July; Thomson 1982). The cumulative results of habitat loss, degradation, and possibly direct mortality could lead to a corresponding reduction in population size.

(B) Evidence

Recent data indicate that Indiana bats rely on multiple roost trees (up to 18 trees by one colony) within a single season (Kurta and Whitaker 1998). Indiana bats appear to choose tree characteristics (such as tree width and roost height) rather than tree species (Kurta and Rice 2002, Miller et al. 2002, Lacki and Baker 2003). Radiotelemetry studies have shown that roost trees are usually clustered, with most trees within 1.0 km of each other (Kurta et al. 2002). Maternity colonies of Indiana bats show some degree of site fidelity

and often occupy the same roost trees for multiple seasons (Kurta et al. 2002). These data suggest that strong fidelity to roost trees and core roosting allows individuals to relocate colony mates after emerging from hibernation in the spring. The removal of roost trees below a critical density (estimated at 42 trees per hectare in bottomland forest and 67 trees per hectare in upland forests: Garner and Gardner 1992), or the loss of roost trees within the core roosting area, may disrupt colony formation. If individuals are unable to form a colony, it is likely that a corresponding reduction in individual fitness, and therefore population recruitment, will occur.

3.2 Sources of Information:

Much of the information on the biology of Indiana bats in caves and mines comes from the published literature and experts such as Alan Hicks of the New York Department of Environmental Conservation. Information on the biology of the summer foraging and roosting habitat of Indiana bats comes from the published literature.

3.3 Extent and Quality of Data

There are no data on the potential impact of wind resource development (Element 3.1.2) on Indiana bats. Habitat preference and fidelity of Indiana bats to specific roost areas (Element 3.1.3 and 3.1.4) is fairly well documented, but data on whether the removal of roost areas will negatively affect bats by disrupting colony dynamics is not available.

3.4 Threat Assessment Research

ELEMENT 4: CONSERVATION ACTIONS

4.1.1 Gating, Habitat Protection

See caves/mines habitat profile.

4.1.2 Site-Selection and Pre-Construction Regulations, Regulation and Policy

See caves/mines habitat profile.

4.1.3 Documenting roosting habits, Habitat Protection

(A) Removal of summer roosting habitat due to de-

velopment, removal of summer roosting habitat due to logging.

(B) Justification

- 1) Identifying summer roost habitat for Indiana bats and determining whether individual bats return to specific roost areas each year will allow managers to better assess the impact of habitat disturbance.
- 2) The lack of data on the summer distribution and population demographics of Indiana bats in New Hampshire prevents informed management decisions on the impact of development and forest cutting on this species.
- 3) Research on Indiana bats in other states suggests that the core roosting habitat of a maternity colony encompasses up to 150 ha (Miller et al. 2002) and that the foraging area is often substantially larger (Evans et al. 1988, Callahan et al 1997). Since development activity, and especially logging, can disrupt forested habitat at similar scales, it is appropriate to plan management actions at this scale. By focusing on smaller scales, key habitat features such as preferred roost trees are more likely to be identified and protected.
- 4) As new information is gathered that refines our understanding of summer habitat use by Indiana bats, managers can inform development or logging interests about conservation action that may be required.

(C) Conservation Performance Objective

Integrate critical roosting habitats into a wildlife database. Better summer range data of Indiana bats may allow managers to make informed decisions about the limiting or mitigating development and logging activities within critical habitat.

(D) Performance Monitoring

Managers can monitor habitat use by Indiana bats over long periods (perhaps periodic monitoring over a 10-year period) to determine whether modified development and logging activities result in the maintenance of summer populations at specific sites.

(E) Ecological Response Objective: Maintain popu-

lations in delineated areas

The habitat protection response objective is to maintain the current number of Indiana bats roosting during summer within their core roosting habitat. Since there are virtually no data on the current Indiana bat population within the state, the minimal ecological response should be to maintain any populations located by biologists.

(F) Response Monitoring: Identify more specific monitoring parameters

If populations are identified, critical habitats will need to be surveyed (for example, every three years). Monitoring should provide data on whether Indiana bats show roost or habitat fidelity during the summer. These data will allow managers to make better-informed decision about the maintenance of Indiana bat populations in areas threatened by development or logging.

(G) Implementation

Preliminary data on the location of Indiana bats must be gathered. If summer habitat areas are identified, the state could consider more intensive population and habitat studies.

(H) Feasibility

The technical competence to determine general summer habitat areas of Indiana bats (mist-netting), as well as the detailed methods of evaluating their roosting habits (radio-telemetry), are available in the region.

4.2 Conservation Action Research

The conservation action research objective for Indiana bats is to document their existence within the state and protect critical habitats and resources. Documentation of Indiana bats' distribution and abundance will require extensive research at both the landscape level (for example, summer surveys within riparian and bottomland forest habitat) and habitat level (roost tree surveys within these habitats). If Indiana bats are found, research should move toward radio-telemetry in order to document core foraging and roosting habitat. Additional effort should then be concentrated on conserving and managing these critical resources.

ELEMENT 5: REFERENCES

5.1 Literature

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Distribution of the Indiana Bat in New Hampshire

Distribution
■ Known



0 10 20 40 Miles

Known = confirmed summer observations obtained from mistnet surveys conducted by professional wildlife biologists.

