

**Appalachian Trail Mammal Inventory for Pennsylvania, New Jersey,
New York, and Connecticut: 460 trail miles.**

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Introduction

Phase I of the National Park Service (NPS) Inventory & Monitoring (I&M) program involves conducting inventories to document occurrence (presence/absence), and under certain circumstances, a variety of abundance categories for vertebrates and vascular plants (NPS 1999). Using existing verifiable data (e.g., voucher specimens) and field investigations, this effort will attempt to document 90% of the terrestrial mammal species expected to occur within park boundaries (NPS 1999). This information may be used to develop monitoring strategies for select species that will be conducted as part of a long-term monitoring program.

Small mammals (e.g., mice, voles, and shrews) comprise more than 50% of the at risk (i.e., rarity ranks of S1, S2, or S3) mammals in Appalachian Trail (AT) states. Small mammals will likely have strong habitat associations with the AT corridor, especially with high elevation areas and boreal relict forests. Management of the AT corridor could have direct impacts on the life history requirements of many small mammals because of their generally small home ranges.

Small mammal species, particularly those "at risk", have not been comprehensively surveyed within the AT corridor. The Natural Heritage surveys conducted on the AT from 1991 – 2000 identify Element Occurrences (EO) of some mammal species, but do not reflect the range of diversity nor the distributional extent of individual small mammal species. Since the monitoring of at risk species populations will likely become an important component of an AT Ecological Monitoring program, it is imperative to fill the gaps in knowledge for the most critically imperiled species likely to occur within the AT corridor. Given the dominance of this group of species, additional inventory efforts to document the presence of at risk small mammals within the AT corridor is warranted.

Detailed biological inventories have been carried out in several of the National Parks and National Forests associated with the AT corridor. Since 1,055 of the 2,100 AT miles (50%) are within other National Parks or National Forests, these inventories have significant relevance for large portions of the AT. The remaining AT corridor is held under easement or in fee by the Appalachian Trail Park Office.

To begin to address this goal, we will conduct inventory efforts that focus on expanding knowledge of at risk small mammal species identified during prior natural heritage inventory work. The areas of concern are those parts of the AT corridor that are outside of other federal lands such as National Forests and National Parks. Additionally, inventory work will be conducted within the 30 mile AT corridor in the Delaware Water Gap National Recreation Area.

The inventory will attempt to sample and identify the occurrences of as many species as possible even though the inventory methods and sampling procedures will be chosen to increase the likelihood of detecting the target species.

Objectives

Survey Appalachian Trail fee and easement lands (33,460 acres, 430 miles) occurring in Pennsylvania, New Jersey, New York, and Connecticut for S1, S2, or S3 mammals (Table 1). Survey the Appalachian Trail corridor (500' on either side of the 30 mile trail centerline) within the Delaware Water Gap National Recreation Area. A secondary objective is to document all mammals associated with the sites surveyed for focal species.

Table 1. Focal mammal species for survey of the Appalachian Trail fee and easement lands in Pennsylvania, New Jersey, New York, and Connecticut. State rarity rank codes: SX: Presumed Extirpated; SH: Possibly Extirpated; S1: Critically Imperiled; S2: Imperiled; S3: Vulnerable; S4: Apparently Secure; S5: Secure; SU: Unrankable; SNR: Not Yet Ranked (NatureServe, 2004)

Common Name	Scientific Name	PA Rank	NJ Rank	NY Rank	CT Rank
Least Shrew	<i>Cryptotis parva</i>	S1	SU	SH	S1
Long-tailed Shrew	<i>Sorex dispar</i>	S3	S1	S4	-
Maryland Shrew	<i>Sorex fontinalis</i>	S3S4	-	-	-
Northern Water Shrew	<i>Sorex palustris albibarbis</i>	S3	-	-	-
Bobcat*	<i>Lynx rufus</i>	S4	S3	S3S4	S2
Northern River Otter*	<i>Lontra canadensis</i>	S3	S4	S5	S5
Fisher*	<i>Martes pennanti</i>	SNR	SX	S4	S2
American Marten*	<i>Martes americana</i>	SX	-	S3	-
Least Weasel*	<i>Mustela nivalis</i>	S3	-	SH	-
American Black Bear*	<i>Ursus americanus</i>	S5	S3	S5	S3
Moose*	<i>Alces alces</i>	SX	-	SU	SX
Eastern Fox Squirrel	<i>Sciurus niger</i>	S5	SX	S3	SX
Northern Flying Squirrel	<i>Glaucomys sabrinus</i>	SU	SU	S5	-
Deer Mouse	<i>Peromyscus maniculatus</i>	S5	SU	S5	S3
Allegheny Woodrat	<i>Neotoma magister</i>	S3	S1	SH	SNR
Kittatiny Red-backed Vole	<i>Clethrionomys gapperi rupicola</i>	S3	-	-	-
Rock Vole	<i>Microtus chrotorrhinus</i>	S2	-	S4	-
Southern Bog Lemming	<i>Synaptomys cooperi</i>	S4	S2	S4	S3
New England Cottontail*	<i>Sylvilagus transitionalis</i>	-	SU	SH	S4
Snowshoe Hare*	<i>Lepus americanus</i>	S3S4	SX	S5	S4

* S1, S2, or S3 species to be surveyed opportunistically

Methods

Inventory Methods

This inventory will concentrate on mammals that are listed as S1, S2, or S3 in Pennsylvania, New Jersey, New York, and Connecticut (Table 1), although all mammals that are observed or captured from along the AT will be included. The primary objective of the inventory is to list each target species as *present* or *not recorded* along the designated section of the AT (Pennsylvania through Connecticut). If sufficient data are available, abundance categories for each species will also be determined (common, rare, etc.).

Sampling Design

A thorough literature review will be used to identify preferred habitats and known geographic distributions for the target species. Many of the target species are habitat specialists, with spotty distributions and specific habitat requirements, and the inventory will concentrate on these specific habitats along the AT. Based upon known distributional records, some target taxa are likely to be encountered only along restricted sections of the AT. For example, the Maryland Shrew and the Kittatiny Red-backed Vole have very limited geographic distributions (Merritt, 1987; Whittaker and Hamilton, 1998), and inventories for these taxa will be conducted only within or near their known ranges. In contrast, the Long-tailed Shrew and the Northern Flying Squirrel could be found almost anywhere along this section of the AT (Merritt, 1987; Whittaker and Hamilton, 1998), and study areas for these species will be distributed accordingly.

After determining habitat preferences and geographic distributions for each target species, geographic information data and aerial photographs will be used to identify possible study areas for each species. In some cases, several target species may be inventoried in the same habitat (e.g., the Rock Vole and the Long-tailed Shrew both prefer moist, forested talus). For many taxa, we will be able to identify many more appropriate study areas along the AT than logistical constraints will permit us to sample. In this case, we will determine a reasonable number of study areas for each target taxon based upon available time and personnel. Some potential areas may be eliminated if they would be very difficult to access. From these potential areas, the areas to be sampled will then be randomly chosen, with provision to ensure adequate geographic coverage of the length of the trail.

Sampling Procedures

Because of the taxonomic, ecological, and morphological diversity of the target species, multiple inventory techniques will be necessary, and the inventory procedures will vary according to the target species (Jones et al., 1996). For the purposes of this study, the different target species can be grouped into several inventory groups that will be sampled by similar sets of procedures, although different taxa in an inventory group may be found in different habitats.

Shrews: Shrews tend to avoid both live traps and snap traps, but are often captured in pitfall traps (Pucek, 1969; Williams and Braun, 1983). Therefore, the target species of shrews (Least Shrew, Long-tailed Shrew, Maryland Shrew, and Northern Water Shrew) will be sampled primarily with pitfall traps and associated drift fences. The pitfall traps will be plastic buckets approximately 15 cm in diameter and 20 cm deep. Drift fencing will be constructed from plastic sheeting supported by wood or wire stakes. If possible, the standard pitfall arrays recommended by Kirkland and Sheppard (1994) will be used. If the terrain does not permit these arrays, then simple lines of pitfalls and associated drift fencing will be used. Non-target organisms (e.g., invertebrates and amphibians) captured in the pitfall traps will be collected and preserved with date and locality information, and transferred to the National Park Service for future identification.

Special procedures will be used for sampling Northern Water Shrews. British Columbia's Resource Inventory Committee (1998a) recommends that water shrews be inventoried using index lines of 20 pitfall traps set within 5 – 10 cm of the stream edge; short (1.3 m) sections of drift fence are set across the mouth of each pitfall, oriented perpendicular to the stream. In addition, Museum Special or Victor snap traps may be set along streams in an attempt to capture water shrews.

Microtine Rodents: This inventory group, which includes the Kittatinny Red-backed Vole, the Rock Vole, and the Southern Bog Lemming, will be surveyed by trapping. Numerous studies have established that trap type is a significant variable when sampling small mammal populations: different species are most effectively caught by different trap types (Cockrum, 1947; Sealander and James, 1958; Wiener and Smith, 1972; Jones et al., 1996). Therefore, a combination of Sherman live traps and Museum Special snap traps will be used for inventorying the three target species of microtines. Pitfall arrays set for shrews may also capture species in this inventory group.

Trapping procedures will be based upon the biodiversity inventory methods for small mammals recommended by the Resource Inventory Committee (1998a). Traplines of 20 or more stations will be set along transects, with stations at 15 m intervals and two or more traps per station. Traps will be baited with a mixture of peanut butter and oats and placed in microsites likely to be attractive to small mammals. Non-absorbent polyester batting will be added to each trap to provide bedding material and to act as insulation during cold weather. Each trapline will be run for a minimum of

three consecutive nights, with traps set in late afternoon or early evening and then checked and closed the following morning.

Northern Flying Squirrel: Inventories for this species will be based on the recommended procedures in the U.S. Fish & Wildlife Service's Recovery Plan for Appalachian Northern Flying Squirrels (U.S. Fish & Wildlife Service, 1990). In each study area, traps will be set in lines of 10 – 20 traps spaced 25 – 50 m apart, with the number and spacing of traps determined according to the particular study area. Traps will be mounted at a height of 2 – 3 m on the sides of mature trees and baited with peanut butter and oats. Non-absorbent polyester batting will be added to each trap to provide bedding material and to act as insulation during cold weather. Active traps will be checked daily, and digital photographs will be taken of all flying squirrels captured in the traps. If necessary to confirm species identification, a voucher specimen may be taken from each study area.

Live trapping for flying squirrels will be supplemented with nest box monitoring. Approximately 10 – 20 nest boxes will be mounted at a height of 2 – 3 m on the sides of mature trees in each flying squirrel study area. The nest boxes will be checked regularly to see if they are being used by Northern Flying Squirrels.

Fox Squirrel: Because this species is both conspicuous and distinctive, the most appropriate inventory procedure is direct observation in appropriate habitats (Resource Inventory Committee, 1998b). This species is likely to be found only in south-central Pennsylvania, where it prefers open deciduous woods with sparse ground cover (Merritt, 1987; Whittaker and Hamilton, 1998). If necessary to confirm the presence of this species, it will be trapped with Havahart live traps.

Allegheny Woodrat: Because this species produces distinctive and conspicuous physical signs (Resource Inventory Committee, 1998c), it will be inventoried by searching appropriate habitats for its distinctive houses and deposits of urine and feces. If necessary to confirm the continued presence of this species in an area, it may be trapped with Tomahawk live traps; this would be done only after consultation with state wildlife personnel.

Hares and Rabbits: This inventory group, which includes the New England Cottontail and Snowshoe Hare, will be surveyed opportunistically through direct observation and observation of sign such as tracks, scats, and cuttings. If necessary to confirm the presence of these species, or to identify which cottontail species is present in an area, hares and rabbits may be trapped with Havahart live traps.

Carnivorans: This inventory group, which includes the Marten, Least Weasel, River Otter, Bobcat, and Black Bear, will be surveyed opportunistically through direct observation and observation of sign such as tracks and scats. If time and resources permit, we may also employ hair snares made of barbed wire or sticky tape. These will be used together with scent lures to attract carnivorans. Any hairs that are snared will then be identified by using published keys to hair identification or by comparison with hairs from reference specimens.

Moose: This species will be surveyed opportunistically, either through direct observation or by noting presence of its distinctive tracks.

Team Qualifications

Please see attached curriculum vitae.

Timetable

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|---------------------------------|--|
| 30 June – 31 August 2004: | <ul style="list-style-type: none">- advertise position for graduate student- purchase equipment & reference materials- apply for state and federal permits- obtain final approval from ESUACUC |
| 1 September – 31 December 2004: | <ul style="list-style-type: none">- evaluate habitat preferences for T&E species- use GIS to identify potential study sites- build & install flying squirrel nest boxes |
| 1 January – 15 May 2005: | <ul style="list-style-type: none">- field check potential study sites- prepare for summer surveying- hire field assistants for summer surveying- begin field surveying- monitor flying squirrel nest boxes |
| 16 May – 15 August 2005: | <ul style="list-style-type: none">- majority of field surveying & data collection- preparation of voucher specimens- monitor flying squirrel nest boxes |
| 16 August – 30 December 2005: | <ul style="list-style-type: none">- organize field data- enter specimen data into NPS databases- QA/QC databases- generate tabular and spatial metadata- monitor flying squirrel nest boxes |
| 30 December 2005: | <ul style="list-style-type: none">- submit draft final report for review |
| 15 January – 15 March 2006: | <ul style="list-style-type: none">- revise report |
| 30 March 2006: | <ul style="list-style-type: none">- submit final report |

Project Budget

Item	Amount Requested
<i>Personnel</i>	
- Graduate student, assistantship & tuition	\$14,000.00
- Field workers, summer 2005 (3 @ \$4500.00)	13,500.00
- Principal investigator, summer 2005	4,000.00
<i>Travel</i>	
- Travel/Lodging (mileage, hotels, camping)	6,375.00
- Worker per-diem (meals: 56 days X 4 people X \$20)	4,480.00
<i>Equipment and Supplies</i>	
- Tomahawk livetraps (80 @ \$26.00)	2,080.00
- Sherman livetraps (50 @ \$15)	750.00
- Materials for flying squirrel nest boxes (130 @ \$10)	1300.00
- Digital camera & memory card	400.00
- Garmin GPS V (2 @ \$450)	900.00
- Backpacks (3 @ \$100)	300.00
- Reference materials (maps, trail guides, etc.)	200.00
- Miscellaneous supplies (pitfalls, notebooks, etc.)	500.00
- Computer and printer	2,500.00
- Computer software	600.00
ESU overhead (22%)	11,414.70
Total funds to be transferred from NPS to ESU	\$63,299.70

Deliverables

Study design and permitting

Conduct a thorough literature review to identify preferred habitats and known geographic distributions for the target mammal species associated with the Appalachian Trail (AT) Corridor.

Develop a robust study design to detect as many mammal species as possible along the AT in PA, NJ, NY, and CT, with emphasis on S1, S2, and S3 species. The study design must be approved by the animal care committee of East Stroudsburg University.

Obtain all necessary state and federal permits to conduct this inventory.

Species data in database template, ANCS+ and NPSpecies

Copies of capture and habitat data as recorded on field data sheets will be provided to the NPS I&M Program as part of the archives for the project.

Data will be submitted electronically and on CD-ROM in Microsoft Access using the NPS I&M database template or one specifically developed for this particular project by an I&M Data Manager. A data dictionary describing field names and values must accompany each database. The investigator is responsible for implementing and documenting quality assurance/quality control

(QA/QC) measures used to ensure the accuracy of their data. QA/QC documentation will be provided to the NPS with all databases in MS Word format.

Metadata for all biological data sets will be provided following the Federal Geographic Data Committee (FGDC) Metadata Biological Data Profile. All metadata will be parsed following the NPS GIS guidelines and provided on CD-ROM in the following three file formats: ASCII text, HTML and SGML.

GIS data

Differentially corrected GPS coordinates (UTM NAD83) for all sampling locations will be provided as an ArcInfo coverage. The investigators will provide GPS coordinates of all captures. GIS coverages will include all sampling localities overlaid with habitat type coverages. Each locality will have an associated data table containing a list of species captured. At a minimum, all spatial data is to be supplied both electronically and on CD-ROM as an ArcInfo coverage and ArcInfo interchange file, e00, compatible with the current version of ArcInfo for the MS Windows operating system.

Federal Geographic Data Committee (FGDC) compliant metadata for all spatial data sets will be created. All metadata will be parsed following the NPS GIS guidelines and provided on CD-ROM in the following three file formats: ASCII text, HTML and SGML.

Voucher specimens

Photo documentation will be the primary voucher source, except for those species not previously documented in the park or for those species whose identification can be questionable without physical evidence (e.g., flying squirrels). All voucher photos, including reference to the date and location of capture, will be submitted to the NPS in JPEG or TIFF format on CD-ROM with accompanying documentation in MS Word. In the event a voucher specimen is collected, study skins will be prepared and skeletal remains archived. These samples will be documented and deposited in the natural history collection at Acadia NP in Maine. Duplicate voucher specimens from Pennsylvania and New Jersey may be documented and deposited at East Stroudsburg University. Specimens deposited at East Stroudsburg University must be affixed with tags that state: "Contact the National Park Service if collection is slated for destruction or removal."

All data associated with voucher specimens will be provided to the Service in ANCS+ and NPSpecies database format.

Reports

Investigator's Annual Reports report will be submitted on 15 October to be included in the Annual Administrative Report. Additional progress reports will be submitted quarterly in MS-Word format both electronically and on CD-ROM.

Final Reports will be written by the Principal Investigator, reviewed by the NPS, and then peer reviewed by experts selected by the NPS to ensure compliance. Drafts of these reports will be submitted digitally on CD-ROM, in MS-Word format, to the Northeast Region I&M Program Coordinator.

Final Reports and all data and products will be submitted to the NPS Northeast Temperate Network Coordinator on or before 30 March 2006.

Literature Cited

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