



United States Department of the Interior

NATIONAL PARK SERVICE
Philadelphia Support Office
200 Chestnut Street
Philadelphia, PA 19106-2878

IN REPLY REFER TO:

September 17, 2002

Ms. Marian Clark
Administration
USGS Patuxent Wildlife Research Center
12100 Beech Forest Road, Ste 4035
Laurel, MD. 20708-4035

Reference: Interagency Agreement No.F4520020040

Dear Ms. Clark:

Enclosed is your executed copy of subject Interagency Agreement.

Sincerely,

Susan D. Kurtz
Contracting Officer

Enclosure:

Cc: Beth Johnson w/enclosure

1. Fiscal Year 2002	2. IA # F4520020040	3. Other agency #	4. Type (<i>Check appropriate box</i>) ☒ Original ☐ Modification	5. Modification #
6. This agreement is entered into by the National Park Service: Park/Office NPS-Boston Support Office			7. Amount of this transaction \$75,000.00	
Location 15 State Street Boston, MA 02109			8. Previous amount, if applicable	\$0.00
			9. Total amount	\$ 75,000.00
☐ To perform work as described herein for the agency named in item 11 (NPS as Servicing / Billing Agency)			10. Under the authority of:	
☐ To have work performed for the NPS by the agency named in item 11 (NPS as Requesting / Paying Agency)			☐ Economy Act, 31 USC 1535 ☐ Reciprocal Fire Act, 42 USC ☒ Other (<i>Cite Authority</i>)	
11. Name of Participating Agency/Bureau/Office USGS-Biological Resources Division			16 USC 4601-1(g) (1994)	
Location Patuxent Wildlife Research Center, 12100 Beech Road , STEO35 Laurel, MD 20708-4035			12. Economy Act determination attached? ☐ Yes ☐ No	
			13. BPC approval ☐ Yes ☐ No	

14. Statement of work (See attached) Inventory of Mammalian Species in National Park Units of the Northeast Region: Northeast Temperate Network and Select Historical Sites: ACAD, MABI, MIMA, MORR, ROVA, SARA, SAGA, SAIR, WEIR, SAGA, MAVA

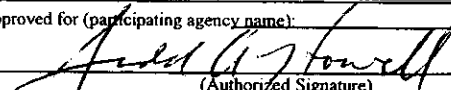
	REQUESTING (PAYING) AGENCY	SERVICING (BILLING) AGENCY
15. Agency Location Code	15a. 14-10-0099	15b. 14-08-0001
16. Fund account symbol/appropriation	16a. 14-02-1036	16b.
17. Period of fund availability	17a. 2002	17b.
18. Account/cost structure	18a. 2111-NII-253H-G-02	18b.
19. Procurement document number	19a.	19b.
20. Name of agency contract	20a. Cheryl Corbett/Michele Valenza	20b. Marian Clark
21. Contact's telephone number	21.a 617-223-5035/617-223-5162	21b. 301-497-5623

23. Billing frequency: ☐ Annually ☒ Quarterly ☐ Monthly ☐ Other (Identify)

24. Bill to (Name and address, including zip code):

National Park Service
Accounting Operations Center
P.O. Box 100000
2180 Foxmill Road, Suite 201
Herndon, VA 20171

Execution of this agreement constitutes an obligation against the requesting (paying) agency, and authority for the performing (billing) agency to proceed with the work and services to be performed.

25a. Approved for National Park Service:		26a. Approved for (participating agency name):	
(Authorized Signature)		(Authorized Signature)	
Typed name:		Typed name:	
Title:	Date:	Title:	Date:
25b. Approved for National Park Service:		26b. Approved for (participating agency name):	
 (Authorized Signature)		 (Authorized Signature)	
Typed name:		Typed name:	
SUSAN D. KURTZ			
Title:	Date:	Title:	Date:
CONTRACTING OFFICER	9/16/02		13 Sept 02

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE - BOSTON SUPPORT OFFICE
INTERAGENCY / INTRA-AGENCY AGREEMENT

INSTRUCTIONS FOR INTERAGENCY / INTRA-AGENCY AGREEMENT FORM

The following information should be used to complete the corresponding blocks on the face of this form:

1. Enter the current four-digit fiscal year (e.g. 1998).
2. Enter the NPS document number. (The standard 15-digit NPS Procurement Instrument Identification Number [PIIN] number is required for all agreement documents in accordance with NPS-20, Appendix A.. PIIN is assigned by the Contracting Officer.)
3. Enter the other agency's document number.
4. Check "Original" if first submission; "Mod" if modification to existing agreement.
5. Enter the sequential modification number (e.g. 0001).
6. Enter the NPS park or office name; City and State; and check appropriate box indicating whether NPS is the Servicing or Requesting Agency.
7. Enter the amount of this transaction including all direct and indirect costs required to provide the service.
8. If this is a modification, enter the previous aggregate amount.
9. Enter sum of Blocks 7 and 8.
10. Enter the legal authority under which this agreement is made.
11. Enter the name and location of the other agency.
12. Pursuant to FAR 17.503, an Economy Act determination is required by the Requesting Agency and approved by Requesting Agency's Contracting Officer. The determination shall state that the supply or service being provided by the other agency cannot be obtained as economically or conveniently by contracting directly with a private source and is in the best interest of the Government.
13. Approval by the NPS Bureau Procurement Chief (BPC) is required for actions when NPS is the Requesting Agency and the aggregate funds are expected to be \$250,000 or above.
14. Describe the work to be performed and attach to this form.
15. Enter the 8-digit Agency Location Code (ALC) for both agencies. The NPS ALC is 14-10-0099. Obtain other agency's ALC from that agency's Finance Office.
16. Enter the Treasury fund account symbol for the funds which will be used to pay for and/or reimburse the work for each agency.
17. Enter the period of fund availability of the designated funds. (NOTE: The period of availability of funds transferred pursuant to an Economy Act agreement may not exceed the period of availability of the source appropriation.)
18. Enter the account/cost structure for each agency used to pay for and/or reimburse the work.
19. Enter the procurement/document of the billing agency, if applicable.
20. Enter the name of a contact person for each agency.
21. Enter the telephone number of the contact person.
22. Check the appropriate box indicating billing method.
23. Check the appropriate box indicating the requested billing frequency.
24. If the NPS is the paying agency, type in the following billing address:
National Park Service
Accounting Operations Center
Dept. CDB-3, P.O. Box 4800
Reston, VA 22090
(NOTE: If the Requesting Agency is other than NPS, that agency must be signed by the authorized official(s) for the National Park Service respective approving official.
25. To be signed by the authorized official(s) for the National Park Service respective approving official.
26. To be signed by the authorized official(s) for the other agency respective approving official.

SUBMITTAL

For Interagency Agreements authorized under the Economy Act, submittal will be assigned, the Economy Act Determination will be made, the BPC approval will be satisfied. The program office should provide support.

This form may be used to supplement the other agency's document.

After signature by both parties, a fully executed copy with original signature.

Allan O'Connell
NO
CA's for
either project
found
Signature for the
for the
the IA number
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etermination.
word purposes.

Study Plan for the Inventory of Mammalian Species in National Park Units of the
Northeast Region : Northeast Temperate Network & Select Historical Sites

- Acadia National Park (NP)
- Marsh Billings National Historical Park (NHP)
- Minute Man National Historical Park (NHP)
- Morristown National Historical Park (NHP)
- Roosevelt Vanderbilt National Historical Park (NHP)
- Saratoga National Historical Park (NHP)
- Saint Gaudens National Historical Site (NHS)
- Saugus Iron Works National Historic Site (NHS)
- Weir Farm National Historical Park (NHP)
- &
- Sagamore Hill National Historical Park (NHP)
- &
- Martin Van Buren National Historical Park (NHP)

Allan O'Connell, John Sauer, & James Nichols
USGS, Patuxent Wildlife Research Center
Laurel, MD

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Appendix 1. Brief synopsis of network parks and their significant resources.

Appendix 2. List of all mammal species whose known geographic range overlaps park units of the Northeast temperate network of the NPS.

Scientific names for all species are provided in this section - not in the text.

Appendix 3. Life-history strategies and major groupings of terrestrial mammals thought to reside in the Northeast temperate network parks.

Appendix 4. Travel routes and distance to national parks in northeast temperate network from Patuxent headquarters in Maryland.

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 will then be used to develop monitoring strategies for select species that will be conducted as part of a long-term monitoring program.

This study plan describes an inventory of terrestrial mammal species (does not include bats, although some limited reconnaissance will be conducted, or marine mammals) expected to occur within national park units of the Northeast Temperate Network (Johnson et al. 2000). Some parks within the network have had research or inventories of mammals, but these efforts usually have been limited in scope, focusing on either individual species or issues of concern to the NPS.

The network includes 12 units that offer a diversity of habitats and physiography throughout the northeastern United States (Figure 1).

The parks range from the boreal forest to mixed deciduous woodlands some of which lie along the transition zone between the two biomes, theoretically harboring a diverse flora and fauna. The parks vary greatly in size, ranging from 4 to 19,000 hectares. Most parks within the network were created to protect cultural resources but they include a variety of significant natural systems. Generally speaking, with the exception of Acadia NP in Maine, quantitative info on mammals throughout the network is lacking (Johnson et al. 2000). Information on the presence, abundance, and distribution of mammalian species is sorely needed and, except for white-tailed deer populations, is not available. A brief summary on the status of information on mammals throughout the network follows below. Acadia has had a variety of work done within the last decade, including some inventory efforts, notably for terrestrial mammals on Isle au Haut (Cole 1993), and carnivores (Harrison 1989) and small mammals (Hazen et al. 1993, O'Connell et al. 2000) on Mount Desert Island (MDI). Inventories were initially conducted on MDI by Manville (1942) but many of the voucher specimens were lost and are no longer available. Further, information collected for some of these studies is limited due to the subjective nature of the

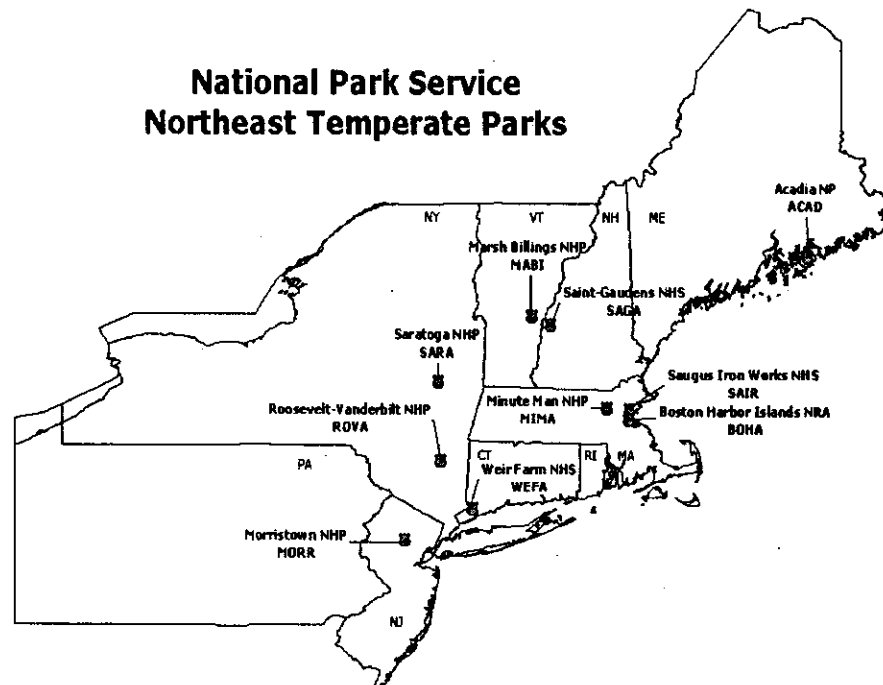


Figure 1. Map of northeastern United States showing national park units within the northeast temperate network. Boston Harbor Islands NRA and Martin Van Buren NHP (not shown) are part of the network but are not included in this project. However, Martin Van Buren NHS (in south central NY) will receive some brief reconnaissance work in preparation for a General Management Plan. Sagamore Hill NHP on Long Island is in the Coastal Network but will be sampled as part of this project.

technique (i.e., interpretation of tracks in snow) and use of more objective methods (e.g., remote cameras) would be helpful to validate species occurrence. Marsh-Billings NHP is a relatively new unit and information is limited; resource managers have expressed interest on the occurrence of bats, particularly the endangered Indiana bat. Large mammal occurrence is well documented in Minute Man

NHP, but more information is needed on small mammals, including bats. Systematic inventory data on mammals at Morristown NHP is lacking because records are available only from wildlife observation cards and their correctness is questionable (Stohlgren and Quinn 1992). Morristown has high densities of deer and the population has been well-studied (Christie and Sayre 1989). A small mammal survey has been conducted at Saratoga NHP and a list of vertebrates exists for the Park, but whether it is complete or well documented for mammals is unclear. Saratoga also has had extensive research on the deer population (Underwood et al. 1994). Mammals were inventoried during the 1980's at St. Gaudens NHS as part of a larger effort to document vertebrates and other important resources (Cook 1987). Some voucher specimens and other forms of documentation (e.g., photos) exist and are currently located at the Park (R. Cook, pers. commun.). The status of mammal information was not reported for Saugus Iron Works NHS. Weir Farm NHP, another new park established in 1990, has little resource information available, and data on mammals are lacking. Information on mammal species located at Martin Van Buren NHP also is lacking; a reconnaissance of the area is needed to evaluate the resources, what species may occur, and the most suitable inventory techniques. The park is about to undergo planning for a General Management Plan and some reconnaissance will be conducted as part of this project, but formal sampling will not be conducted as part of this project. Roosevelt Vanderbilt NHP has had an inventory of small mammals but information on other taxonomic groups is lacking. Mammal data for Sagamore Hill NHP also is lacking.

Goals and Purpose

The principal goal of the NPS Inventory Program and this study plan is to document 90% of the extant mammal species found within park boundaries. Based on a review of taxonomic and geographic references, 62 terrestrial mammal species, including bats, theoretically could occur in parks of the northeast temperate network (Godin 1977, Degraff and Rudis 1986, Whitaker and Hamilton 1998) and Sagamore Hill. This number does not include marine mammals or those species long extinct in the region (e.g., woodland caribou, mountain lion, see Appendix 2). Therefore, documenting 90% of this number (on a network-wide basis) would require verification of 56 species, assuming at least one confirmation for each species somewhere in the network.

Secondary goals include developing a better understanding of mammalian communities and interactions with the local environment, and how the mammal community has been affected by NPS management activities. Compiling current information allows for a comparison to the historical record, thereby increasing our knowledge of how communities change, especially when subjected to management actions.

Objectives

This primary objective of this project is to produce occurrence information on terrestrial mammal species for the target groups within each park. Inventory priorities can be based on a variety of criteria that include: taxonomic group, legal status, endemism, indicator status, and rarity (Geissler 2002), all within a context of specific NPS resource management priorities. The project may include more focused efforts to gather distribution or abundance information on species that are uncommon, rare, of special concern to the NPS, or species considered locally or regionally enigmatic (e.g., southern bog lemming). Ubiquitous species or those that have been the subject of recent research will dictate a lower priority for gathering detailed information beyond presence/absence, as will species that are already well documented or have home ranges that are very large.

The list of species compiled during this project will represent both recent (within 10 years) work previously conducted and current field investigations. We will document as many mammal species as possible that currently reside within park boundaries. An historical list (work > 10 years old) will be compiled from voucher specimen data (A. O'Connell and A. Gilbert, unpubl. data) for comparative purposes. Primary objectives also include examination of unique habitats to determine their potential for harboring mammals, particularly rare, endangered (and threatened), or locally enigmatic species. Collection of distribution (i.e., across habitats) and abundance information on species of concern that may serve as indicators of ecosystem health.

Secondary objectives involve estimating species richness based on the accumulation of previously unrecorded species (Cam et al. 2002). Spatial variation in species richness is important in understanding ecological patterns (Nichols et al. 1998) and future biodiversity inventories need to be designed around estimates of species richness, particularly in 'park-sized units' where most land-use decisions are made, often with great impact (Coldwell and Coddington 1994).

Methodologies

Prior to sampling, resource managers from each park will be interviewed to to prioritize information needs for mammal species in each park. This information will provide criteria for determining the need to collect abundance or distribution information on select species.

Because this plan is attempting to study mammals within several different taxonomic categories, no one technique will work for all groups, nor will a single technique be equally effective for all species within a group. As a result, multiple techniques have

been proposed, and to the extent possible (constraints are imposed by the amount of personnel and logistics), will be implemented simultaneously and repeatedly at sampling locations to permit use of statistical estimators of species diversity (Conroy 1996), which is typically thought of in terms of species richness and species evenness (Williams et al. 2002:555). Collection of presence/absence information in animal inventories can be used to estimate species richness, thus allowing for a community-wide perspective of biodiversity.

Sampling methods have two primary components: *protocols* (methods of sampling at selected sites) and *sample frames* (spatial dispersion of sites). Many of the methods proposed here have well-established protocols, but their uses are often focused on estimation of abundance for a single species (e.g., capture-recapture techniques, Williams et al. 2002: 289). Here, we propose use of these methods for documenting species in the context of estimating species richness. Because the composite estimate of species richness is the variable of interest, only general guidelines for sample size can be developed. Pilot data is available for some of the methods from recent efforts to evaluate protocols techniques for mammal inventories in coastal parks (A. O'Connell and N. Talancy, unpubl. data, Cape Cod National Seashore), allowing guidelines to be established for needed numbers of traps and trapping sessions when estimation of abundance is the goal of the trapping. For species richness estimation, general guidelines available in Otis et al. (1996) and elsewhere can be applied to determine the needed number of trapping occasions and sample sites. Each park has its own sampling constraints and species pools, and until the proposed techniques are implemented in this network, these general guidelines will be followed. Following collection of data during the first sampling session, revised needs for samples will be evaluated. Geographic information data available for each park will be used in the development of sample frames using a geographic information system (GIS). This approach will insure an effective design with respect to NPS management needs.

Sampling Protocols

Sampling will be partitioned according to life history strategies of the target species that include novel physical characteristics (e.g., mode of locomotion). Using these criteria, mammals found within this network can be divided into several different groups:

small mammals (voles, mice),
 insectivores (shrews),
 small carnivores (weasels and mink),
 medium-sized carnivores (raccoons, skunks, coyotes, foxes, opossum),

fossorial (moles),
 semi-fossorial (groundhogs),
 medium sized herbivores (lagomorphs, squirrels),
 aquatic rodents and carnivores (otter, beaver, muskrat)
 large herbivores (deer)
 large omnivores (bear)

Trapping devices proposed for use in this study and those species likely to be captured:

Remote Cameras: medium-sized carnivores, aquatic rodents, lagomorphs, and large herbivores

Live-Trapping: small mammals, squirrels, lagomorphs, small and medium-sized carnivores, aquatic rodents

Pit-fall traps: insectivores (shrews), small mammals

Cubby boxes: small and medium-sized carnivores, small mammals, lagomorphs (i.e., tracks)

Hair Catchers: small and medium-sized carnivores (hair samples)

Direct Searches: All Species

Personal Observations: All species

Physical Sign: All species (for some groups may not allow exact species Identification)

We will use a trap array that will consist several different trap types to capture as many target taxa as possible. Traps will include remote cameras and infrared sensors, small and medium-sized live traps, pitfalls with drift fences, track plates within a cubby box (i.e., sooted track plates with covers on the top and sides, one end open for entrance)¹, and hair catchers. The number and spacing design (see next section) is dependent on the type and size of the community sampled (Jones et al. 1996). Over two-years each park will receive 5 sessions of sampling in the major vegetation communities, one during each season, and one additional session during that season accumulating the smallest number of captures during the previous four. Upon sampling each area 5 times, we will have accumulated a minimum of 500 trap nights for each community. Unique habitats also will receive trapping that will be repeated at least 5 times or until 500 trap nights have been accumulated. A minimum of 500 trap nights are recommended for sampling in a preliminary inventory of a

habitat (Jones et al. 1996). We will follow these guidelines and our unit of effort for sampling will be a two-week period during which time remote cameras, hair catchers, and live-traps in trees (see below) will be operable. Some traps (i.e., live-traps and pit-falls) will be limited to shorter-trapping sessions within the two-week period to realistically meet logistics and expenses. This approach also will allow for multiple (2-3) habitats to be sampled simultaneously as well as providing for the opportunity to sample unique species requiring different techniques (see below). Two individuals will comprise a team with individual teams working in different parks.

For other species, we will modify our techniques to insure the most effective sampling protocol to capture a species. For example, we will use a modification of a Victor trap for moles (Jensen 1982) and moles will be trapped in areas where sign is evident. It is not easy in some areas to live-trap moles, however. In such cases, standard victor traps may have to be used. These traps will be left operable for 3 consecutive nights during each sampling session. The exact number of traps used is unknown until specific sites reside are first evaluated. For flying squirrels, inventory efforts should trap for 14 consecutive days (O'Connell et al. 2000) to insure maximum coverage in attracting individuals. For this group, traps set in tree boles will be left operable for the full two-week period.

Directed searches will be undertaken in the major vegetation communities to determine physical sign of animals not likely to be trapped by the techniques proposed or for species not sampled or missed by these trapping sessions but for whom circumstantial evidence suggests that they occur in an area. Cursory inspections will be conducted at each park unit to assess the potential for parks documenting other mammalian species like bats that are not sampled as part of this investigation, and rare species missed by the techniques used during this work.

Incidental observations are often an important means of obtaining sightings of mammal species that are difficult to encounter in standard surveys (Yahner et al. 1997). We will attempt to standardize the collection of incidental sightings of wildlife, using only park personnel, by instituting area-specific checklists within the parks. This information is not to be confused with wildlife observation cards, routinely used by the NPS to record sightings by staff and the general public. Although some have suggested that these cards can be of value in recording species occurrence (Yahner et al. 1997), they are poorly scrutinized and their validity is questionable (Stohlgren and Quinn 1992). Sightings of mammals will be voluntarily recorded by park personnel and reviewed by investigators to insure authenticity. Cards will be used with other data to determine species richness estimates.

Although inventories of bats will not part of this inventory work, a brief

reconnaissance effort will be conducted at each park to offer guidance on future work for this taxa. Anabat® recorders will be used to record some information in spots where bats are likely to reside and provide the NPS information from which to pursue a network wide bat inventory.

Sampling Design (i.e., Sample Frames)

Exact sampling points and the schematic under which the traps are laid out will be dependent on the configuration of the community being sampled. Furthermore, estimation of species richness can be troublesome when the number of species is < 15 (J. Nichols, pers. commun.). It is unlikely that any one group of mammals in the subject parks approaches that number. Therefore, mammal species documented will be compiled into a single group that will be used to estimate species richness. The general goal of the sampling design is to establish a series of sample sites at which multiple sampling procedures can be implemented. Although estimates of population size or percent of area occupied can be calculated from information at individual sites, the primary sampling will involve documenting species occurrence and estimation of species richness over the sites. The sample sites will be established using randomly selected cells from a grid (Fancy 2000).

We will establish a framework of sampling sites that encompass entire park units (Fancy 2000). Using this approach, the design will include several levels of sampling (Fancy 2000), design #1), will allow for flexibility with respect to future studies, as well as provide the opportunity to examine habitats or resources of special interest. The drawback to this approach restricts sampling and subsequent inferential statements about areas that cannot be sampled. These sessions will sample an area using grid cells and within each grid cell employ live traps (sizes to accommodate small and medium-size species), pit-falls, remote cameras, track plates (cubby boxes), and hair catchers.

Traps will be laid out in a shape that accommodates the configuration of the vegetation community to be sampled. The number of traps should be dependent on the type and size of the community sampled (Jones et al. 1996). At a minimum, representative vegetative associations (based on physiognomy) will be sampled within each park: forest (deciduous and boreal), woodland, shrub/thicket, and grassland (Whitaker 1975) in addition to unique habitats. Information on major habitat types, physical features, and structures will be used to define strata relevant for sampling for each of the sampling methods. These features can be categorized as (1) unique habitats; (2) sets of specific locations (such as specific fields or other features that can be individually located); and (3) widespread habitats (such as habitats that cover significant areas of the park). All of these habitats need to be sampled, if we want

to develop a sample frame that covers the entire park.

Widespread Habitats: For most habitats, it will be possible to sample using a systematically developed grid of sampling locations. Sample sites can be selected from the grid cells, and these "cells" form the replicates for the sampling. In each cell selected for sampling, an array of sampling methods will be implemented. At the selected grid cells, we will implement sampling methods for most taxa that occur in the park. To implement estimation procedures for species richness, "capture histories" must be collected for each species at each site, in which the presence or non-detection of a species is indicated by a string of "1's" and "0's." Consequently, each grid cell will have to be sampled for 5 trapping occasions, and at each trapping occasions the presence or non-detection of each species will have to be noted by checking traps. Logistical effort has to be allocated between more intensive sampling within sites and increasing the sample size of sites.

For each park, GIS data will be obtained and used in develop a complete sampling frame. Depending on the site, it may be possible to conduct all sampling within the grid cell framework, implementing unequal probability sampling to ensure adequate sampling of unique habitats and specific locations. However, it may be more efficient in some cases to sample unique habitats separately for particular species, allowing a simpler sampling design for the grid cell samples (Fancy 2000). That can only be determined after evaluating maps and making site visits.

Unique Habitats: Often, unique habitats exist in parks, and may require specialized sampling. These sites should be viewed as their own strata, and sampled if thought to contain unique resources that would not be encountered elsewhere in the park. Some species are only found in specific habitats, and specialized sampling can be conducted at these habitats to assess the occurrence of these species. Unique habitats often exist in parks that are of special interest to managers. Examples include: sensitive or unique habitats, and any habitat identified as an area requiring special management. In these sites a remote video camera/recorder will be used to record animal activity at baited stations.

Sets of Specific Locations: These represent spots that are localized in nature, and may be missed in a general sample. Examples might include fields used for agriculture where a particular species may reside or edge or transitional areas that may harbor a particular species but are representative of more than one habitat.

Small mammal trap arrays will consist of 10 stations containing 2 live-traps and at stations 1, 5 and 10 pitfall traps with drift fences will be placed between the

live-traps (Yahner et al. 1997). A trapping session for small mammals will involve 3 nights of trapping trap nights. All small mammal trap stations will be separated by 30 m (Jones et al. 1996) with a maximum of 30 traps in any one sampling cell. Within each grid or along each transect (i.e., sample cell) 3 medium/large live-traps will be employed to capture larger mammals expected to be in an area. For example, in forested areas, larger traps (Havahart® or Tomahawk®, dimensions: 50 x 50 x 180 cm) are likely to be set to accommodate flying squirrels and will be set on the ground and in the bole of a tree (O'Connell et al. 2001). Two sets (each set contains two devices) of hair catchers, three cubby boxes, and two remote cameras will complete the array. Live traps and cubby boxes will operate for 4 nights and remote cameras the entire two-week period. With the exception of the small mammal live traps, all other devices will be separated by at least 100 m. This approach also will allow for simultaneous operation of different types of traps. The techniques, exclusive of the live-traps and pitfalls will be used simultaneously for a period of two weeks.

Data Collection and Analysis

Collection of presence/absence data from repeated sampling of communities will be used to calculate species richness (Nichols and Conroy 1996, Nichols et al. 1998). To determine species richness, we propose to use program CAPTURE (Otis et al. 1988), and other capture-recapture-based models that use capture history information. This quantity will be estimated at the scale of the grid-cell sample sites. The program COMDYN (Hines et al. 1999), will be used to estimate change in species richness and community composition between grid cell sampling locations. Use of this program allows for subdividing the total area (i.e., park) into "secondary sampling units of consistent habitats, and for evaluation of change in species composition among habitats and more generally among sampled areas within the park (Nichols et al. 1998).

GPS data - GPS coordinates will be recorded at all trap sites and for all specimens recorded, that can be downloaded to and compatible with ArcView®.

Metadata - Will be provided in the Dataset Catalog format (nonspatial data) or in Federal Geographic Data Committee format for spatial data (www.fgdc.gov/metadata/metadata.html)

Electronic Specimen Data - All data collected will be stored in a Microsoft Access database file that will be compatible with NPS templates and companion projects collecting inventory data within other regional networks. Information recorded from voucher specimens during this project also will be stored in a Microsoft Access file.

Voucher Specimens - All species, unless threatened or endangered at either the state or federal levels, for which no previous verification exists will be documented via the collection of a voucher specimen via preparation of a study skins and skeletal material. If opportunistic collecting results in dead individuals of the desired species, additional voucher specimens will not be necessary and under this scenario individuals subsequently trapped will not be sacrificed. All specimens will be entered into Microsoft Access database file established for the project. All specimens collected as part of this project will be placed into the natural history collection at Acadia National Park in Maine. Data collected from all specimens will follow NPS curatorial guidelines.

Animal Use and Care - The ethical treatment of mammals is an important aspect of mammalian inventory and monitoring projects (Rudran and Kunz 1996). All work involving the handling and use of vertebrate animals must comply with the Animal Welfare Act, as amended (& U.S. C. §§ 2131). Therefore, this study plan will be submitted to Patuxent's Institutional Animal Care and Use Committee (IACUC) for review and approval. In addition, the most current guidelines as set forth by the American Society of Mammalogists (1998) and recommended practices for euthanasia (American Veterinary Medical Association 2000) will be followed accordingly.

Hazard Assessment - Human safety is paramount in all research activities. Handling of wild mammals can result in the transmission of a variety of zoonotic diseases. All personnel will receive a pre-rabies vaccination (3 shots) and if they have received the vaccination previously, will have their titer tested to insure an adequate level of immunity. Additional immunity testing will be evaluated every 24-month period (Maryland Department of Human Health Services). Additional precautions will be taken to guard against Hanta virus, Lyme disease, human ehrlichiosis, and other vectorborne zoonoses (Gage et al. 1995, Mills et al. 1995).

Project Coordination

The principal investigator will secure permits, ACUC authorization and will make an on-site initial assessment at each park prior to sampling to delineate the exact number of habitat associations and configuration of sample layouts. This individual will also meet with NPS resource managers to evaluate park priorities. Additional investigators will construct direct sampling regime using GIS information and guide data analyses. Field staff will consist of four individuals, research associate, graduate student, and two interns. The GIS specialist at Patuxent will prepare sampling schematics using park maps; field staff will generate output for data analyses. Research Associate will coordinate field sampling and work with GIS

individual to insure proper input of field data. The investigators will prepare a species checklist for use by park staff.

Project Timetable

August 2002 - Apr 2003

August & September 2002

- Initiate Research Associate Hiring Process & Hire
- Design Mammal/Habitat Observation Card
- Transfer Money to CESU
- Lay groundwork for graduate student to begin in January
- Contact all resource managers re:sampling
- Order equipment
- Advertise for Interns
- Secure GSA Vehicles

October & November 2002

- Visit all parks and meet with NPS resource managers
- Hand out observation Cards to Parks
- Design template for Microsoft Access Template and Data Collection Cards
- Hire Interns
- Secure GSA Vehicles
- Map sampling sites on GIS system

December & January 2002/3

- Commence Sampling session #1- in southernmost parks
- Graduate Student begins at CESU

April 2003 - May 2004 Sampling and data collection continues, preliminary data analysis, preparation of 2003 progress report

May - Aug 2004 Continue inventory sampling

Final data analysis and preparation of thesis; preparation of final reports and recommendations to NPS;

March 2005 Submit individual draft final report

May 2005 Submit individual final reports for each of the three

Parks and all other deliverables.

Deliverables

Species data

- Copies of capture and habitat data as recorded on field data sheets will be provided to the NPS I&M Program.
- 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. All data will be entered by the Research Associate hired for this project and verified by the principal investigators. The investigator is responsible for implementing and documenting quality assurance/quality control (QA/QC) measures used to assure 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 in the following three file formats ASCII text, HTML and SGML on CD-ROM.
- Graduate student thesis that will compare the species assemblages throughout the network, and using habitat variables collected in the major communities sampled, quantify and evaluate factors affecting the observed differences.

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 locations overlaid with habitat type coverages. Each location will have an associated data table containing a list of species captured. At a minimum, all spatial data is to be supplied as an ArcInfo coverage and ArcInfo interchange file, e00, compatible with the current version of ArcInfo for the MS Windows operating system, both electronically and on CD-ROM.
- 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 in the following three file formats ASCII text, HTML and SGML on CD-ROM.

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 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 needs to be collected, study skins will be prepared and skeletal remains archived. These samples will be deposited in the natural history collection at Acadia NP in Maine.
- All data associated with voucher specimens will be provided to the Service in the NPS NPSpecies database format.

Reports

- Progress reports will be submitted quarterly in MS-Word format both electronically and on CD-ROM.
- Final reports will be written and reviewed by the NPS to insure compliance. Drafts of these reports will be submitted digitally, in MS-Word format, on CD-ROM to the Northeast Region I&M Program Coordinator.
- The graduate student thesis emanating from this project will be submitted in hard copy (2 copies).
- Investigator's Annual Reports will be completed on or before December 31 of each calendar year that this Agreement is in effect, including the year of completion.

Budget

Personnel	\$\$\$
GS-401-7/9 + per diem (~250 days)	99,945

Interns (2 @1600/monthx12 months)	38,400
Patuxent GIS Specialist - 3months (term position @PWRC, paid by project shares)	10,369
Patuxent Investigators	Covered by USGS
Grad student assistantship and tuition waiver (two years) - \$27,200 + 15% overhead for Cheseapeake CESU @Frostburg	31,350
Personnel Subtotals	180,064
Housing (4 people in NPS housing for 250 nights)	15,000
Vehicle Rental (GSA) - (4-wheel Pickups) - \$4,630/year (current GSA pricing) for 15,000 miles: 2 year cost for two vehicles	9,275
Equipment and Supplies - Trailmaster cameras and infrared sensors (8 active units, 4 passive units), - Photographic supplies and data loggers - Handheld GPS - Digital camera - Remote video recorder (to provide remote video documentation of secretive species or those not captured by cameras - Taxidermy supplies for voucher specimens - Tomahawk traps - Misc. trapping and field operational supplies: animal holding cage, scales, bait, lures, fatty acid disks, bedding, binoculars, compasses, trap replacement parts, aluminum and wood supplies for track plates, and hair catchers, and cubby boxes, sample bags, ear tags and applicator, shipping expenses for supplies, flagging, plastic stakes, USGS quad maps, measuring tapes and rulers, permanent markers, dyes, pitfall fencing materials	- 10,000 800 800 800 2,500 500 3,220 4,480
Equipment and supply sub-totals	23,100
Desk-top computer	2,500
Rabies Vaccinations	1,200
Cell Phones (2 phones and 2 year contract)	1,000
Foul Weather gear and safety equipment	750

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Total: \$232,889

These costs do not reflect overhead because the USGS is not charging DOI agencies overhead. In addition, investigator salaries are covered by the USGS. It is not clear as to the charges covered by the CESU at Frostburg State relative to graduate student costs. This amount listed here may be reduced upon further review of the CESU Master Cooperative Agreement.

Personnel costs for the GS hire and GIS specialist include benefits under the FERS system. Investigator salaries are covered by the USGS.

We have calculated housing at the current rate (\$15.00/person/night) charged by Acadia NP for visiting research personnel (David Manski, Chief, RM, pers. commun. 6/28/02). Using this calculation, we expect that each park will provide facilities for temporary housing. This cost will vary depending on the amount charged by individual park units. The principal investigator will negotiate with each park unit for accommodations.

Four-wheel drive pick-ups are not easily rented from GSA on a short-term basis. It is more cost effective to rent these vehicles long-term and either absorb monthly rental fees when not in use, or charge costs to another project when mammal project does not need them. Mileage estimates are based on park localities and distances between parks - refer to Appendix 4. We propose to use one vehicle rental from GSA and one PWRC vehicle that is currently assigned to the investigator.

Cost comparison: mammal inventories conducted at four parks in the northeast region by Yahner et al. (1997) cost about \$224,000. This effort sampled four or five major habitat associations during one season at four different parks. Multiple techniques were used (e.g., small mammal live-traps and pit falls, scent posts, vehicular road surveys) and as such are comparable to this work, only on a much smaller geographic and operational scale.

The following equipment will be used on this project; the investigator and NPS-staff purchased it for projects at Acadia:

- 100 Havahart cage traps (squirrel size)
- 15 Trailmaster remote cameras, active and passive systems with infrared sensors
- 300 Sherman traps (mice, vole size)
- 6 Tomahawk cage traps (fox size)
- 3 Pesola scales

-1 Anabat Recorder

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Appendix 1. Brief synopsis of network parks and the significant resources.

Acadia National Park (Bar Harbor, ME). One of the first national parks to be legislated, this unit consists of nearly 40,000 acres along the central Maine coast. Located at the interface between the deciduous and boreal forest biomes, the park.

Marsh-Billings-Rockefeller NHP (Woodstock, VT). This unit is a recent addition to the NPs. Donated by the Rockefeller family, this historical park has little more than 500 acres of actively managed forestland and includes northern hardwoods, conifer plantations, cliff/rocky outcrop communities, open fields, streams, ponds, vernal pools, and seeps.

Minute Man NHP (Concord, MA). This park, has a total of 967 acres divided among three units, and was established to preserve the historic landscapes, structures and sites. Habitats include approximately 1/3 wetlands (forested wetland, shrub swamp, emergent wetlands, river/stream, ponds, vernal pools), 1/3 upland forests, and 150-200 agricultural lands and other managed types.

Morristown NHP (Morristown, NJ). This historic park is located within north central New Jersey. Of the 1,685 acres within park boundaries, 80% is forest, 10% wetlands, and 5% fields.

Roosevelt-Vanderbilt NHP (Hyde Park NY). This park is comprised of three separate sites: Vanderbilt Mansion NHS (211 acres), Home of Franklin D. Roosevelt

NHS (290 acres), Eleanor Roosevelt NHS (180 acres). In total, these parks are comprised of 55% forests and 30% wetlands (open water, Hudson River, and freshwater tidal marshes).

Saratoga NHP (Stillwater, NY). This historic park is 3,406 acres in area. Forest cover nearly two-thirds of the area and managed grasslands nearly one-third. Grasslands are maintained by prescribed fire and mowing. Brush/shrub areas (416 acres) and wetlands (45 acres) make up the rest of the park landscape. The park occurs in a transition zone of two biome types (Oak-Chestnut region, Hemlock-White Pine-Northern Hardwoods region), which increases habitat complexity. Also, unique habitats occur on the Hudson River floodplain.

Saint-Gaudens NHS (Cornish, NH). This historic site is 150 acres of forest, wetlands, riparian areas and fields. The region in which this park occurs is dominated by hemlock and hemlock-beech transitional forest. Much of the forest is adjacent to the Connecticut River. The site contains terraced slopes with rich mesic forests. Vernal pools are present.

Saugus Iron Works NHS (Saugus, MA). This is a small (9 acres) historic site located in East central Massachusetts (due north of Boston) and includes wetlands, riparian woodlands, and riverine habitat.

Weir Farm NHP (Wilton, CT). This is a small park (60 acres). It is located in the Southwest Hills Ecoregion in southern Connecticut. It has a number of wetland complexes (palustrine scrub shrub and forested), intermittent and ephemeral surface streams, and a 3.7 acre pond.

Martin Van Buren NHP (Kinderhook, NY). This park's acreage recently increased with the addition of a 126-acre farm that was part of Van Buren's original estate.

Sagamore Hill NHS (*Oyster Bay [Long Island], NY*). This 60 acre park is the former home of Teddy Roosevelt and includes fields, forest, and both fresh and salt water wetlands. Established in the early 1960's, the site is located on Long Island Sound.

Appendix 2. List of mammalian species whose known geographic range overlaps Park units of the Northeast Temperate network of the NPS.

ORDER - MARSUPIALIA

FAMILY DIDELPHIDAE

Virginia Opossum *Didelphis virginianus*

ORDER - INSECTIVORA

FAMILY SORICIDAE

Masked Shrew *Sorex cinereus cinereus*

Water Shrew *Sorex palustris albibarbis*

Smoky Shrew *Sorex fumeus*

Long-tailed Shrew *Sorex dispar dispar*

Thompson's Pygmy Shrew *Microsorex thompsoni thompsoni*

Short-tailed Shrew *Bierina brevicauda*

Least Shrew *Cryptotis parva*

FAMILY TAIPIDAE

Hairy-tailed Mole *Parascalops breweri*

Eastern Mole *Scalopus aquaticus aquaticus*

Star-nosed Mole *Condylura cristata*

ORDER - CHIROPTERA

FAMILY VESPERTILIONIDAE

Little Brown *Myotis myotis lucifugus*

Keen's *Myotis keenii septentrionalis*

Indiana *Myotis sodalis*

Eastern Small-Footed *Myotis leibii*

Silver-haired Bat *Lasiurus noctivagus*

Eastern Pipistrelle *Pipistrellus subfiavus obscurus*

Big Brown Bat *Eptesicus fuscus*

Red Bat *Lasiurus borealis*
 Hoary Bat *Lasiurus cinereus*

ORDER - LAGOMORPHA

FAMILY LEPORIDAE

Eastern Cottontail *Sylvilagus floridanus*
 New England Cottontail *Sylvilagus transitionalis*
 Snowshoe Hare *Lepus americanus*
 Black-tailed Jackrabbit *Lepus californicus melonotis*
 European Hare *Lepus europaeus*

ORDER RODENTIA

SUBORDER SCIUROMORPHA

FAMILY SCIURIDAE

Eastern Chipmunk *Tamias striatus*
 Woodchuck *Marmota monax*
 Gray Squirrel *Sciurus carolinensis pennsylvanicus*
 Red Squirrel *Tamiasciurus hudsonicus*
 Southern Flying Squirrel *Glaucomys volans*
 Northern Flying Squirrel *Glaucomys sabrinus*

FAMILY CASTORIDAE

Beaver *Castor Canadensis*

SUBORDER MYOMORPHA

FAMILY CRICETIDAE

Deer Mouse *Peromyscus maniculatus*
 White-footed Mouse *Peromyscus leucopus*
 Eastern Woodrat *Neotoma floridana magister*
 Gapper's Red-backed Mouse *Clethrionomys gapperi*
 Meadow Vole *Microtus pennsylvanicus*
 Beach Vole *Microtus breweri*
 Rock Vole *Microtus chrotorrhinus*
 Pine Vole *Microtus pinetorum scalopsoides*
 Muskrat *Ondatra zibethicus*
 Southern Bog Lemming *Synaptomys cooperi*
 Northern Bog Lemming *Synaptomys borealis sphagnicola*

FAMILY MURIDAE

Black Rat *Rattus rattus*
 Norway Rat *Rattus norvegicus*

House Mouse *Mus musculus*

FAMILY ZAPODIDAE

Meadow lumping Mouse *Zapus hudsonius*

Woodland Jumping Mouse *Nopaeozapus insignis*

SUBORDER HYSTRICOMORPHIA

FAMILY ERETHIZONTIDAE

Porcupine *Erethizon dorsatum dorsatum*

ORDER CARNIVORA

FAMILY CANIDAE

Coyote *Canis latrans*

Red Fox *Vulpes vulpes*

Gray Fox *Urocyon cinereoargenteus*

FAMILY URSIDAE

Black Bear *Ursus americanus*

FAMILY PROCYONIDAE

Raccoon *Procyon lotor*

FAMILY MUSTELIDAE

Marten *Martes americana americana*

Fisher *Martes pennanti pennanti*

Ermine *Mustela erminea erminea*

Long-tailed Weasel *Mustela frenata*

Mink *Mustela vison*

Striped Skunk *Mephitis mephitis nigra*

River Otter *Lutra canadensis*

FAMILY FELIDAE

Lynx *Lynx canadensis*

Bobcat *Lynx rufus*

FAMILY CERVIDAE

White-tailed Deer *Odocoileus virginianus borealis*

Moose *Alces alces americana*

Species extinct or not known to have viable breeding populations in the northeast

-
Eastern Timber Wolf *Canis lupus*
Wolverine *Gulo luscus luscus*
Sea Mink *Mustela vison macrodon*
Mountain Lion *Felis concolor*
Wapiti or American Elk *Cervus elaphus*
Eastern Woodland Caribou *Rangifer tarandus*

Appendix 3. Life-history strategies and major groupings of mammals that reside in the northeast temperate network parks.

Arboreal small mammals--Several species of squirrels are thought to occur in these parks including two species of flying squirrels, the northern, *Glaucomys* and southern, *G. volans* (DeGraaf and Rudis 1986). Wire cage traps will be used to capture this group. We will modify the technique to capture flying squirrels in Maine (O'Connell et al. 2001) to determine occurrence and relative abundance. Distribution of traps and intensity of the trapping effort will be dependent on the potential habitat.

Fossorial small mammals--There are several species of fossorial and semi-fossorial small mammals occur in the northeast region that include moles, pine voles, and woodchucks/groundhogs. Woodchucks also are considered semi-fossorial species in that they are. Searches of potential habitat will be conducted to identify activity centers, and traps will then be placed in the appropriate areas. We will make every attempt to live-trap moles (Jensen 1982); however, because moles are not easily captured with live-traps we will utilize standard methods for capture to verify occurrence of a species in a particular area.

Small mammals--This group a variety of taxa including insectivores and herbivores. These range in abundance from ubiquitous habitat generalist to rare habitat specialists (DeGraaf and Rudis 1986, Whitaker and Hamilton 1998). We propose to focus our sampling effort and strategies on the uncommon species, and expect to document the occurrence of the common species in the process. We will identify potential habitat for uncommon species from the literature and using existing habitat information for each park. Site selection will be based on a randomized design if there is substantial habitat present. Sampling will be conducted using live-traps and pit-falls on grids.

Large aquatic and terrestrial rodents-- This group primarily includes the muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), and porcupine (*Erithizon dorsatum*). The presence of these species will be determined by systematic searches for evidence of activity.

Rabbits and hares (lagomorphs) --Three species may potentially occur in this network of parks including the eastern cottontail, New England cottontail, and snowshoe hare. Each species may be rare or uncommon in one or more parks. The priority for inventorying each of these species in each park will be determined by the status of each species in the region of the park, the potential habitat available, and the need for additional information. Sampling for documentation will be conducted by live-trapping; pellet counts can be used to estimate relative abundance.

Carnivores (medium) -- This group includes the species that in size from opossums to coyotes. This group includes some members of the families Mustelidae, Canidae,

Felidae, and Ursidae. Many species in this group have home ranges larger than many of these parks. These species will be documented by multiple methods that include remote photography, physical sign, and scent stations.

Carnivores (small) - These species include the mink and weasels. Detection of is often difficult due to their small size, body shape and secretive habits. Although some techniques used to detect larger carnivores can be used on this group, modifications expressly for this group are sometimes necessary. For example, weasels are typically "captured using a "cubby box" covering a smoked track plate constructed of a thin sheets of aluminum. Mink spend much of their time around water and photography and live trapping will focus on station around aquatic environments.

Appendix 4. Travel routes and distance to national parks in northeast temperate network from Patuxent headquarters in Maryland.

Start: Morristown, NJ

- 1 Oyster Bay, NY
- 2 Wilton, CT
- 3 Hyde Park, NY
- 4 Saratoga Springs, NY
- 5 Woodstock, VT

- 6 Concord, NH
- 7 Bar Harbor, ME
- 8 Saugus, MA

End: Concord, MA

Total Distance: 1068.20 miles (#1 to #8/end) + 215 miles from Laurel, MD to Morristown, NJ + 420 miles from Concord, MA to Laurel, MD



¹: Open, sooted track plates have proved to be ineffective during inclement weather and N. Talancy, unpubl. data).