Small Mammals of the Guthrie-Bancroft Farm, Colby Hill Ecological Project, Lincoln and Bristol, Vermont

2000 Final Report

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Summary

For a small mammal inventory of the Guthrie-Bancroft Land, Colby Hill, in Lincoln and Bristol Township, Vermont, we sampled 10 of the 27 previously distinguished Ecosystems (ES). Fifteen nights of trapping (970 trap nights and 84 pitfall nights) yielded 213 captures belonging to ten species. The rodent *Peromyscus* sp. was the most commonly trapped species with 102 individuals captured and the masked shrew (*Sorex cinereus)* was the least commonly trapped species with four individuals captured. Whereas the highest number of species (6) and the highest mammalian biomass was obtained in well-drained northern hardwood forest with tall white pines (ES 2), the highest diversity indices (Simpson's 1-D and Shannon Wiener's Index H'), taking into account the evenness of species distributions, were attained along the edge of an alder swamp / sedge meadow (ES 20) and along the course of a small intermittent cold mountain stream (ES 25). None of the terrestrial species caught was particularly rare. An initial effort to sample bats (20 net nights) on this land yielded two individuals of Northern long-eared bat *(Myotis septentrionalis)*, although many more bats could be observed flying or could be picked up on an ultrasonic bat detector. Evidence of larger mammal species, including American black bears *(Ursus americanus)*, was also recorded.

Introduction

The objective of this inventory was to document the small mammal diversity of the Colby Hill area, surveying specific habitats especially for small mammal species that are relatively rare in Vermont and correlate small mammal abundance and diversity with the different ecosystems as delineated in the landscape ecosystem classification provided by M. Lapin (Lapin, 2000). This ecosystem classification is based on a specific multiscale and multifactor approach, striving to take into account climate, soils, physiography, vegetation and other factors, including animals (Barnes et al., 1998). Terminology may differ somewhat from other approaches, as for example that used in a recent guide to the natural communities of Vermont (Thompson and Sorenson, 2000).

We define "Small mammals" to include insectivores (= shrews and moles), bats and rodents. Hares and rabbits (Order Lagomorpha); weasels, canids, and cats (Order

Carnivora); and the Virginia Opossum (Order Didelphimorphia) may be considered medium-sized or "meso-mammals." The study focussed on small mammals but notes were taken on all meso and large mammals encountered.

Materials and Methods

Between 13 July and 9 September 2000, small mammals were sampled in 10 different ecosystems (ES; see Appendix I). In each ES between 20 and 59 traps were set for three nights with two traps per station and stations placed about 10 steps apart. About three quarters of the traps consisted of Sherman live traps and one quarter of Museum Special snap traps. Traps were set in the evening and checked in the early morning and left closed during the daytime. Bait consisted of rolled oats flavored with peanut butter. In addition, in each of four ES's, lines of 7 unbaited pitfall traps connected by a plastic drift fence were established for three nights.

Bat nets were set across travel corridors and in other locations where bats could be observed flying or picked up with a bat detector. Nets were monitored at intervals during the evening. Due to late availability of bat sampling equipment in the summer of 2000, bat netting was limited to six evenings (24, 25, 30, and 31 Aug.; and 6 and 7 Sept.) using one large and two smaller nets on different forest paths and near the small artificial pond in ES 21 (mowed meadow).

For a more detailed description of the microhabitats used by small mammals, square transparencies were taken with a tripod-mounted medium format camera (Rolleiflex SL66 and 2.8/80 mm Planar), covering an area of about 0.9 x 0.9 meters, centered on trap locations, and later evaluated (see Appendix II).

In order to assess habitat diversity not just based on number of species (species *richness*) but also on the abundance of each species (species *evenness)* the following diversity indices, which account for such *heterogeneity,* were used (Krebs, 1989):

Simpson's Index: $D = \sum p_i^2$

where D is Simpson's index and p_i is the proportion of species i in the community. This index describes the probability of picking two organisms that are the same species. More commonly used is its complement 1- D, which is the probability of picking two organisms that are different species.

Shannon-Wiener Index: $H' = -\sum_{i=1}^{s} (p_i)(\log_2 p_i)$

Derived from information theory this index is a measure of the amount of uncertainty in predicting what species an individual chosen at random from a sample will belong to. H' is the index of species diversity, s the number of species, and p_i is the proportion of the total sample belonging to the i-th species.

We also attempt to provide a measure of productivity in each ecosystem by estimating small mammal biomass obtained per 100 trapnights using published average adult weights of each species caught. Scientific names used follow Wilson and Reeder (1993) and common names follow new standards suggested by Wilson and Cole (2000), except where otherwise noted.

Results and Discussion

Small Mammals

A total of 1,054 trap nights (= number of traps and pitfall buckets set times number of nights) was accumulated. A total of 213 captures were made, consisting of three species of shrews (*Blarina brevicauda*, *Sorex cinerus* and *S. fumeus*) and seven species of rodents (*Peromyscus leucopus, P. maniculatus*, *Napeozapus insignis*, *Zapus hudsonius*, *Clethrionomys gapperi*, *Microtus pennsylvanicus* and *Tamias striatus*; see Table 1.1 and 2.1). Two additional species, the woodchuck (*Marmota monax)* and the red squirrel (*Tamiasciurus hudsonicus)* were confirmed through several observations.

Bats

In 20 net-nights (= 15-foot net units times number of nights) only two individuals of Northern long-eared bat (*Myotis septentrionalis*) were captured on 30 and 31 August 2000. This species is included as a subspecies of Keen's myotis (*Myotis keeni)* in Wilson and Reeder (1993) but we follow Whitaker and Hamilton (1998) in treating it as a separate species of the eastern United States. It can be distinguished from other *Myotis* species of the area, especially the Little brown bat *(Myotis lucifugus)*, by its long ears (14-18 mm) and a long and narrow tragus, the fleshly lobe projecting into the outer ear.

Small Mammal Diversity (Table 1.3) and biomass (Table 1.4)

Based on Sherman and Museum Special trap captures, diversity indices were highest in ES 20 (alder swamp/sedge meadow; 1-D = 0.72 and H' = 1.89) and lowest in ES 12 (moderately well-drained northern HW forest; 1-D = 0.4 and H' = 1.04), although the total

number of species (species richness, see above) was highest in ES 2 (5 species; well-drained northern hardwood forest with white pine).
Estimation of small mammal biomass obtained per 100 trapnights in the different ecosystems of this study resulted in ES 2 having the highest and ES 6 (seepy terrain, rich northern hardwood forest) the second highest biomass (see Table 1.4).

Other Mammals

White-tailed deer *(Odocoileus virginianus)* were often observed in groups of up to 5 individuals and most often in the northern part of the maintained hayfield (ES 21). American black bears *(Ursus americanus)* were observed on four occasions (10, 16, 24, and 26 August) in northern hardwood forest (ES 6 + 12) and on the maintained hayfield (ES 21). For locations see Figure 1. On one occasion (24 Aug.), a bear with a cub was observed. On 11 August three Sherman live traps were found severely damaged by a bear.

Remarks on small mammal species

***Blarina brevicauda* (Northern Short-tailed Shrew)**

Thirty-six individuals of the Northern short-tailed shrew were caught in 6 different habitats, most commonly in unmaintained, herbaceous old fields (16.7%, ES 22) and along a small intermittent stream (9.97%, ES 25). Based on these trapping results it is the most common and most widely distributed shrew. Sex cannot be determined easily in the field but two individuals prepared as specimens on 12 and 31 August were non-gravid females. *Blarina brevicauda* was often caught at the base of yellow birches, along dead fallen tree trunks, in dense ferns, in dense grass and on bare soil along a small stream (see Appendix II). Northern short-tailed shrews are semifossorial - digging small tunnels in leaf litter and grass layers. They are abundant in many areas with good cover and occur throughout the Northeast into Southern Ontario and Quebec, in woodland and grasslands (Wilson and Ruff, 1999).

***Sorex cinereus* (Masked or Cinereus Shrew)**

This tiny shrew was caught only in ES 12 (moderately well-drained yellow birch Northern HW forest; 1 individual) and ES 6 (seepy terrain rich northern HW forest; 3 individuals). Three out of the four individuals were caught in pitfall traps placed in dense fern areas. Masked shrews would stay alive in the pitfalls if they had another dead shrew or earthworms to feed on. They could then be transferred to a terrarium for observation (see Plate 1, Appendix III).

Masked shrews are not very habitat specific but seem to prefer fairly mesic conditions (Whitaker and Hamilton, 1998), and mossy and dense fern-covered areas. They have been reported from most counties in Vermont (Godin, 1977) and most of Québec (Prescott and Richard, 1996) and are "common in the coniferous and northern deciduous forest biomes up to the timberline" (Wilson and Ruff, 1999:20).

***Sorex fumeus* (Smoky shrew)**

The smoky shrew was caught in three different habitats (4 individuals in ES 14, 3 in ES 12, and 1 in ES 7). Two individuals were caught in Sherman traps and two in the pitfalls. In the case of the pitfall traps the microhabitat consisted of dense ferns. One Sherman-trapped individual was located on bare soil next to an upturned root ball of a fallen tree, with gravel, decaying leave litter and mosses (Appendix II).

Smoky shrews are reported from most counties in Vermont. They prefer moist conifer or hardwood forests using runways under the leaf litter and "under overhangs of banks along woodland roads or creeks" (Wilson and Ruff, 1999:22). Their overall distribution is more limited to the Appalachian area, southern Québec, and Ontario, than that of *Sorex cinereus* (Prescott and Richard, 1996).

A recent study comparing *S. cinereus* and *S. fumeus* in the southern Appalachian mountains also found *S. fumeus* to be more abundant with a broader niche breadth than *S. cinereus* "which may be indicative of its larger size and ability to utilize a greater variety of microhabitat and prey types" (Brannon, 2000).

***Peromyscus* sp. (White-footed and Deer Mouse)**

In much of the northeastern United States it is very difficult to distinguish between the two species of *Peromyscus*, the White-footed mouse (*Peromyscus leucopus*) and the Deer mouse (*Peromyscus maniculatus*), on morphological grounds. Although discriminant function analysis of skull characters can be used with some success to distinguish the two species (Rich et al., 1996) this method requires all animals to be kept as vouchers. More recently electrophoretic analysis of the genetic variation in the salivary amylase has been employed. Saliva samples can be taken from live animals in the field by rinsing the mouth with a few drops of distilled water (for details see: Aquadro and Patton, 1980). We obtained electrophoretic results from 55 individuals out of 102 individuals of *Peromyscus* caught on the Guthrie-Bancroft land (see Table 1.1). Results show that 68.5% of the mice sampled were *Peromyscus maniculatus* and 31.5% were *P. leucopus*. In Ecosystems 8, 25,

and 26 the White-footed mouse (*P. leucopus*) was the only species of the two captured. All other habitats contained either both species or just the deer mouse (ES 14 and 20).

The following table shows the distribution of the two species sampled in nine ecosystem based on the salivary amylase genetic markers:

Ecosystem	14	12	7	6	2	25	20	8	26	Total	%
No. caught	12	28	8	31	12	1	2	4	2		
No. sampled	11	14	6	9	5	1	2	4	2	54	100
P. maniculatus	11	10	4	7	3	-	2	-	-	37	68.5
P. leucopus	-	4	2	2	2	1	-	4	2	17	31.5

Since not all individuals of *Peromyscus* caught were identified to species level, we will continue to treat them only at the genus level in Figure 1 and in Tables 1 and 2 . *Peromycus* sp. was the most common genus in the study area (102 captures) and was present in every ecosystem. On the Guthrie-Bancroft land they can be found in a great variety of different microhabitat situations (cf. Appendix II). They most often co-occurred with the Red-backed vole and sometimes with the Northern short-tailed shrew at the same trap station, but they almost always were in traps set in more open and slightly elevated areas (base of trees, stumps), whereas the nearby traps containing voles or shrews were usually in lower lying, more vegetated areas.

Both *Peromyscus* species occur throughout the northeastern United States. The White-footed mouse barely reaches into southern Ontario and Québec (Prescott and Richard, 1996). It prefers forest edges and brushy areas and seems to be more of a habitat generalist especially in the absence of the Deer mouse (Kilpatrick *et al.*, 1994). The Deer mouse occurs in many types of woodlands, swamps and bogs, reaching north throughout the entire southern half of Canada and most of Québec (Prescott and Richard, 1996). The deer mouse is "more widespread geographically and ecologically than any other species of North American mouse" (Wilson and Ruff, 1999:575).

***Napaeozapus insignis* (Woodland Jumping Mouse)**

Woodland jumping mice were found in seven of the ten ES's (see Plate 2, Appendix III). Out of 15 total captures they ranged from transition hardwood limestone forest (ES 7; 1 capture) to oldfields (ES 22; 1 capture). In ES 25 (along intermittent stream) it was the second most common species (after *Blarina brevicauda)* occurring, for example, under the exposed roots of the creek bank. In only one habitat, the alder swamp/sedge meadow

("old beaver pond", ES 20), it was found to be sympatric with the Meadow jumping mouse *(Zapus hudsonius).*

The Woodland jumping mouse is widely distributed in "northern cool and moist woodlands" (Whitaker and Hamilton, 1998) of the northeastern United States along the Appalachian range into much of southern Québec (Prescott and Richard, 1996) but not in the coastal areas of New Hampshire, Massachusetts, Connecticut, and New York. A third of the diet of *Napeozapus* are subterranean fungi of the genus *Endogone*, but they also feed on caterpillars, beetles, and fruit (esp. blackberries), and they seem to favor seeds of *Impatiens* (Wilson and Ruff, 1999).

***Zapus hudsonius* (Meadow jumping mouse)**

Only three female Meadow jumping mice were captured in ES 20. The co-occurrence of this species with *Napeozapus* in this habitat closely confirms the description in Whitaker and Hamilton (1998:272) that "the two are particularly apt to occur together where touch-me-not (*Impatiens*) occurs along a stream running from the woods into a field" (except that the stream here ran in the opposite direction, from a wetland area into the forest). The other equally common species found alongside *Z. hudsonius* in ES 20 was *Microtus pennsylvanicus*.

The Meadow jumping mouse generally prefers more open grassy fields and successional brushland. It has a wider distribution than the Woodland jumping mouse especially in Canada and in the north-eastern United States, reaching to the coast in most northeastern states and also into the Midwest. The diet consists of seeds, fruits, invertebrates and ca. 12-15% fungi such as the subterranean *Endogone,* which they apparently find by smell and then dig up (Wilson and Ruff, 1999). Both jumping mouse species hibernate for about 6 months of the year.

***Clethrionomys gapperi* (Southern red-backed vole)**

The Southern red-backed vole was captured in six out of ten ecosystems sampled. With 32 individuals captured it was the third most common species after *Peromyscus* sp. and *Blarina brevicauda*. It was the most common species in "poorly drained spruce-fir northern hardwood forest" (ES 14; 10 individuals) and in "seepy terrain rich northern hardwood forest" (ES 6). It was also the most abundant species in the "steeply sloping hemlock, yellow birch and white ash forest" (ES 8). Red-backed voles were frequently captured in dense ferns and on bare or moss-covered soil at the base of turned-up root balls (see Appendix II). Most of the Red-backed voles captured were either juveniles or subadults.

The Southern red-backed vole occurs in much of Canada and the northernmost United States reaching further south only along the Appalachian mountains in the east and along the Rocky Mountains in the west. Except for the subspecies *C. g. rhoadsi* in southern New Jersey, it does not seem to occur in the coastal plains of Connecticut, New York, Delaware or the Carolinas. *C. gapperi* prefers mostly "mesic habitats in coniferous, deciduous and mixed forest with abundant litter of stumps, rotting logs, and exposed roots" (Wilson and Ruff, 1999:614). In winter Southern red-backed voles do not hibernate but forage using tunnels under the snow.

***Microtus pennsylvanicus* (Meadow Vole)**

Ten individuals of the meadow vole were caught in three of the ten ecosystems (ES 20, 22 and 25) all more open ecotone situations or successional habitats. In all cases the microhabitat consisted of spots dominated by dense grasses and sedges, goldenrod and milkweed (cf. Appendix II). In ES 20 and 25 capture was close to a small stream and the ground near the traps was quite swampy. All of the meadow voles caught were large adults:

ES 22: 2 females (lactating), 1 adult male

ES 25: 2 female (1 gravid), 2 males

ES 20: 3 males

The Meadow vole is the most widespread vole in North America covering the northern half of the United States and most of Canada and Alaska. It is associated chiefly with moist meadows, oldfields or other areas supporting dense grasses and sedges. Meadow voles are very prolific with some breeding females producing three to ten pups every three weeks. They do not hibernate and in harsh winter can do much damage to orchards by girdling trees (Wilson and Ruff, 1999).

***Tamias striatus* (Eastern Chipmunk)**

Three individuals of this common species were caught in Sherman traps in ES 2 (well drained northern hardwood forest with tall white pines), but it was also observed in other areas. All three captured chipmunks were immediately released.

Eastern chipmunks occur throughout the Eastern United States and southern Ontario and Quebec in a variety of habitats, favoring the edges of oak-hickory or beech maple forests (Whitaker and Hamilton, 1998), or other well-drained deciduous forests (Prescott and Richard, 1996). They construct underground burrows and hoard seeds, which they consume in winter between periods of hibernation.

***Tamiasciurus hudsonicus* (Red Squirrel)**

Although not captured, this species was heard and observed in several of the habitats especially in habitats that included some conifers. Red Squirrels are common throughout the northeastern United States and most of Canada and Alaska, in many different forest types, but primarily in coniferous forest. Two different subspecies were described for Vermont: *T. h. loquax* in the western and *T. h. gymnicus* in the eastern half of the state (Hall, 1981). Red squirrels use tree cavities for nests or construct spherical nest of lichens, grass and twigs.

Discussion

Whereas species richness was highest in well-drained northern hardwood forest with tall pine trees (ES 2), diversity based on Simpson's Index and Shannon Wiener Index, taking into account the evenness of species distributions, is shown to be highest on the edge of the alder swamp/sedge meadow (ES 20) - a former beaver pond in the process of ecological succession. Second highest diversity was along the intermittent cold-mountain stream (ES 25) - again a habitat with ecotonic character (transition between several different habitats: forest- wetland - riparian).

As one measure of a forest's productivity, mammalian biomass may be a better faunistic indicator of habitat quality or forest health than species diversity, even though it may be based on fewer species (Decher and Bahian, 1999). Interestingly enough, estimated biomass per 100 trapnights is highest (659.7g) in the ecosystem that also had the most species (ES 2), certainly aided by the high body mass contributed by the three chipmunks trapped at this location. The location with the second highest biomass (591g) was in ecosystem (ES 6), which also yielded the most captures (47 individuals).

None of the rarer species of Vermont's small mammals, long-tailed shrew *(Sorex dispar)*, pygmy shrew *(Sorex hoyi)*, Southern bog lemming *(Synaptomys cooperi)*, Woodland or pine vole *(Sorex pinetorum)*, or Rock vole *(Microtus chrotorrhinus)* have yet been captured. However, from the cumulative number of species (Figure 2) there is no reason to assume that additional species could not be present on the Guthrie-Bancroft land, since the curve has not yet reached a plateau phase. We particularly still expect the Pygmy shrew (*Sorex hoyi*), the Water shrew *(Sorex palustris)*, the Hairy-tailed mole (*Parascalops breweri*), the Star-nosed mole (*Condylura cristata*), and the Northern flying squirrel (*Glaucomys sabrinus*) to occur on this land.

In the summer of 2001 sampling should be continued for bats and if possible also for terrestrial small mammals in selected ecosystems not yet covered (e.g. mesic red-oak hardwood forest, ES 1). Also, some larger Tomahawk traps or baited, self-triggered camera stations could be employed to verify the occurrence of meso-mammals such as Gray and Red fox, Bobcat, Ermine and Long-tailed weasel, Mink, River otter, Striped skunk and Fisher.

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Figure 2.--Cumulative Increase in Number of Small Mammal Species trapped on the Guthrie-Bancroft Land over the 2000 Study Period.

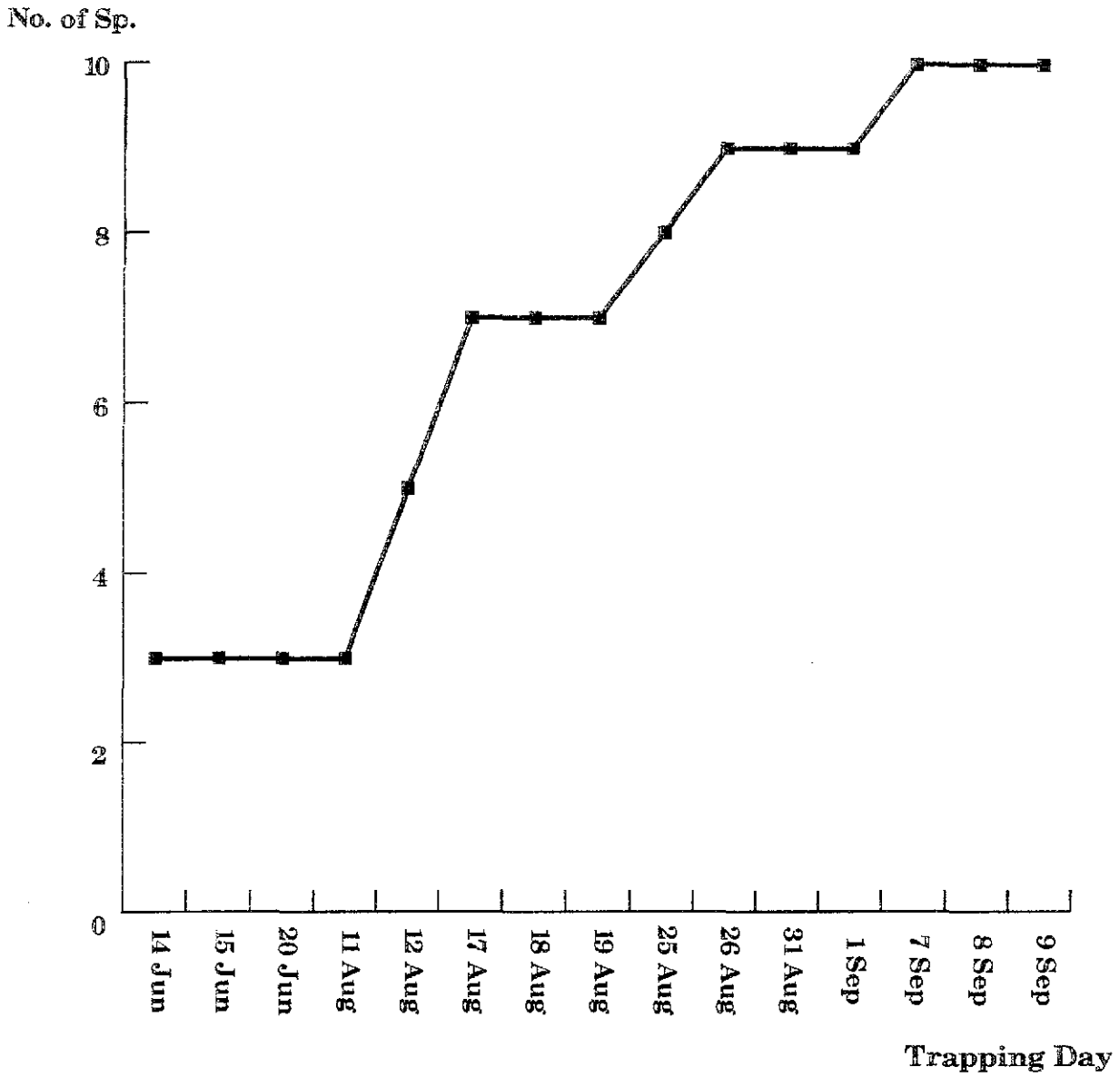

Table 1.1-- Overview: Small Mammal Sherman and Museum Special trap captures on Guthrie-Bancroft Farm, Lincoln, Vermont (Summer 2000). For description of the Ecosystems, see Appendix I.

Trapline	1	2	3	4	5	6	7	8	9	10	
Ecosystem No.	**14**	**12**	**7**	**6**	**22**	**2**	**25**	**20**	**8**	**26**	Totals
No. of Days trapped	3	3	3	3	3	3	3	3	3	3	15
No. of Traps	52	52	20	52	20	26	26	20	32	20	
Trapnights	156	156	60	156	60	78	78	60	96	70	970
Shrews:											
Blarina brevicauda		4	2	8	10	2	7				33
Sorex fumeus	2		1								3
Sorex cinereus				1							1
Rodents:											0
Peromyscus sp.	12	28	8	31	1	12	1	2	4	2	101
Napeozapus insignis			1		1	2	6	1	2	2	15
Zapus hudsonius								3			3
Microtus pennsylvanicus					3		4	3			10
Clethrionomys gapperi	10	5		7		1			5	3	31
Tamias striatus						3					3
No. of Species	3	3	4	4	4	5	4	4	3	3	9
No. of Captures	24	37	12	47	15	20	18	9	11	7	200

Table 1.2-- Small mammal trapping success expressed in percent of trapping effort.

Ecosystem No.	**14**	**12**	**7**	**6**	**22**	**2**	**25**	**20**	**8**	**26**
					% trapping effort					
Shrews:										
Blarina brevicauda		2.56	3.33	5.13	16.67	2.56	8.97			
Sorex fumeus	1.28		1.67							
Sorex cinereus				0.64						
Rodents:										
Peromyscus sp.	7.69	17.95	13.33	19.87	1.67	15.38	1.28	3.33	4.17	2.86
Napeozapus insignis			1.67		1.67	2.56	7.69	1.67	2.08	2.86
Zapus hudsonius								5.00		
Microtus pennsylvanicus					5.00		5.13	5.00		
Clethrionomys gapperi	6.41	3.21		4.49		1.28			5.21	4.29
Tamias striatus						3.85				
% Trapping Success at Site:	15.38	23.72	20.00	30.13	25.00	25.64	23.08	15.00	11.46	10.00

Table 1.3-- Calculation of Diversity Indices based on Proportions of Small Mammal Captures on the Guthrie-Bancroft Land (Sherman and Museum Special traps only).

Ecosystem No.	14	12	7	6	22	2	25	20	8	26
	Proportional Abundance of Species									
Shrews:										
Blarina brevicauda		0.11	0.17	0.17	0.67	0.10	0.39			
Sorex fumeus	0.08		0.08							
Sorex cinereus				0.02						
Rodents:										
Peromyscus sp.	0.50	0.76	0.67	0.66	0.07	0.60	0.06	0.22	0.36	0.29
Napeozapus insignis			0.08		0.07	0.10	0.33	0.11	0.18	0.29
Zapus hudsonius								0.33		
Microtus pennsylvanicus					0.20		0.22	0.33		
Clethrionomys gapperi	0.42	0.14		0.15		0.05			0.45	0.43
Tamias striatus						0.15				
Number of Species	3	3	4	4	4	5	4	4	3	3
Simpson's Index D *	0.43	0.60	0.49	0.49	0.49	0.41	0.31	0.28	0.37	0.35
1-D **	0.57	0.40	0.51	0.51	0.51	0.60	0.69	0.72	0.63	0.65
Shannon-Wiener H' ***	1.33	1.04	1.42	1.36	1.38	1.73	1.77	1.89	1.49	1.56

* = Probability of picking two organisms that are the same species.

** = Probability of picking two organisms that are different species.

*** = Average degree of uncertainty in predicting to what species an individual chosen at random from a sample will belong.

Table 1.4-- Estimated small mammal biomass obtained per 100 trapnights in each ecosystem, based on average adult weight of species caught.

Ecosystem No.	14	12	7	6	22	2	25	20	8	26	Indiv. Weight (g)*
Shrews:											
Blarina brevicauda		41.8	54.3	83.6	271.7	41.8	146.3				16.3
Sorex fumeus	9.9		12.8								7.7
Sorex cinereus				2.3							3.6
Rodents:											
Peromyscus sp.	153.8	359.0	266.7	397.4	33.3	307.7	25.6	66.7	83.3	57.1	20.0
Napeozapus insignis			44.2		44.2	67.9	203.8	44.2	55.2	75.7	26.5
Zapus hudsonius								107.5			21.5
Microtus pennsylvanicus					128.0		131.3	128.0			25.6
Clethrionomys gapperi	153.8	76.9		107.7		30.8			125.0	102.9	24.0
Tamias striatus						211.5					55.0
L Biomass/ES (in gram):	317.6	477.7	378.0	591.0	477.2	659.7	507.1	346.3	263.5	235.7	

*= Average adult weight taken from Whitaker & Hamilton, 1998

Table 2.1-- Small Mammal Pitfall Captures on Guthrie-Bancroft Farm, Lincoln, Vermont (Summer 2000).

Trapline	1	2	4	6	
Ecosystem No.	**14**	**12**	**6**	**2**	
Ecosystem Description	poorly drained spruce-fir northern HW forest	moder. well drained yellow birch North. HW forest	seepy terrain rich northern HW Forest	well-drained north. HW forest with white pine	
					Totals
No. of Days	3	3	3	3	12
No. of buckets	7	7	7	7	28
Pitfall nights	21	21	21	21	84
Shrews					
Blarina brevicauda		2		1	3
Sorex fumeus	2	3			5
Sorex cinereus		1	2		3
Rodents					
Peromyscus sp.		1			1
Clethrionomys gapperi			1		1
No. of Species	1	4	2	1	5
No. of Captures	2	7	3	1	13

Table 2.2-- Pitfall capture success as percent of trapping effort.

Ecosystem No.	**14**	**12**	**6**	**2**	
Shrews					
Blarina brevicauda		9.5		4.8	3.6
Sorex fumeus	9.5	14.3			6.0
Sorex cinereus		4.8	9.5		3.6
Rodents					
Peromyscus sp.		4.8			1.2
Clethrionomys gapperi			4.8		1.2
% Trapping Success	9.5	33.3	14.3	4.8	15.5

Appendix I

Ecosystems (ES's) sampled in 2000.

Terminology based on M. Lapin (Approximation 2000), with some additional comments on habitat elements.

ES 2 = Well-drained northern HW forest with white pine.

ES 6 = Seepy terrain rich northern HW forest.

ES 7 = Well-drained transition HW limestone forest.

ES 8 = Very steeply sloping hemlock, yellow birch & white ash forest. Along the trapline hemlock made up only about 10% of the canopy, yellow birch about 50%. Others were butternut, red oak and American beech, with abundant hobble bush in the understory.

ES 12 = Moderately well-drained yellow birch northern HW forest.

ES 14 = Poorly drained spruce-fir northern HW forest.

ES 20 = Alder swamp /sedge meadow. Edge of former "beaver pond" with abundant touch-me-not (*Impatiens*), goldenrod (*Solidago* sp.), and willows (*Salix* sp.).

ES 22 = Unmaintained oldfields, herbaceous. With goldenrod, high bush cranberry *(Viburnum trilobum)* and service berry (*Amelanchier* sp.).

ES 25 = Along small-sized intermittent cold-mountain stream

ES 26 = Along moderately sized permanent cold mountain stream. The trapline here was right along the edge of Baldwin Creek often on rocks or mud or under the overhanging roots of the river bank.

Appendix II: Small Mammal Microhabitat Photography Analysis

(* = plant species also mentioned in Lapin 2000 for this ES)

Slide	Mammal Species	Line	Stn	ES	Date	Ground Cover	Plant Species
1	*Peromyscus* sp.	3	3	7	11 Aug	Ca. 70% bare soil moss and rotting wood. Maple seeds.	*Carex* sp.; Mountain Aster (*Aster acuminatus*); Large-flowered bellwort* (*Uvularia grandiflora*); Pale touch-me-not (*Impatiens capensis*)
3	*Peromyscus* sp.	3	10	7	11 Aug	60% lichen-covered rock and bare soil, dead wood and moss.	Unidentified non-flowering herbs.
4	*Peromyscus* sp.	2A	5	12	11 Aug	ca. 80% dense ferns over dry grass and leaves.	Sensitive fern* (*Onoclea sensibilis*), Lady's fern* (*Athyrium Filix-femina*); Cinnamon fern* (*Osmunda cinnamomea*), Dwarf raspberry* (Rubus pubescens)
5	*Peromyscus* sp.	2A	9	12	11 Aug	Base of yellow birch, ca. 60 % dry leaves, mosses and dead wood.	seedlings of Black Cherry (*Prunus serotina*), Dewberry (*Rubus* sp.); Woodfern (*Dryopteris* sp.)
7	*Peromyscus* sp.	4 A	3	6	18 Aug	ca. 80 % fern cover over decaying leaves.	Intermediate Woodfern* (*Dryopteris* var. *intermedia*), Canada mayflower (*Maianthemum canadense*); New York Fern* (*Thelypteris noveboracensis*)
9	*Peromyscus* sp.	4A	10	6	18 Aug.	60-70% large rock with moss and rotting leaves.	Intermediate fern (*Dryopteris* var. *intermedia*)
12+13	*Peromyscus* sp.	1B	13	14	20 Jul	60% Moss cover, 40 percent decaying wood and leaves.	mosses & lichens
14	*Peromyscus* sp.	1B	12	14	20 Jul	20% sedges, 30 % moss cover, 50% Downed and dry conifers.	sedges & mosses
17	*Peromyscus* sp.	1A	1	14	20 Jul	Beech tree base. 40% decaying wood and leaves; mosses.	beech seedling (*Fagus americana*); Marginal Woodfern (*Dryopteris marginalis*);
21	*Peromyscus* sp.	1A	5	14	20 Jul	60% open mosses, dead leaves, fallen tree stump	Near young Sugar maple (*Acer saccharum*)
2	*Sorex fumeus*	3	8	7	11 Aug	On large rock covered with moss. Ca. 80% bare soil and rotting leaves and wood.	mosses, Blue-stemmed Goldenrod* (*Solidago caesia*), Sharp-lobed hepatica* (*Hepatica acutiloba*); Marginal Woodfern* (*Dryopteris marginalis*), [Bedstraw (*Galium* sp.)?]

Appendix II continued

Slide	Mammal Species	Line	Stn	ES	Date	% Ground Cover	Plant Species
15	*Sorex fumeus*	1B	8	14	20 Jul	90% bare soil, and gravel under turned-over root ball.	mosses
8	*Blarina brevicauda*	4A	3	6	18 Aug	Along rotting downed log. Ca. 50 % decaying leaves and moss cover. 50% ferns.	Intermediate fern (*Dryopteris* var. *intermedia*), Oak fern (*Gymnocarpium Dryopteris*).
29	*B. brevicauda*	7	4	25	26 Aug.	Near intermittent mountain stream stream. 30% water, 20% rock. 30% bare soil.	Spotted Touch-me-not (*Impatiens capensis*), Common wood sorel (*Oxalis montana*) , gill-over-the-ground (*Glechoma hederacea*)
16	*Clethrionomys gapperi*	1B	1	14	20 Jul	80% fallen trees and rotting wood.	Young birch (*Betula* sp.)
18	*C. gapperi*	1A	2	14	20 Jul	60% bare soil, rock and mosses. 30% ferns. base of turned-over root ball.	Ostrich fern *(Matteuccia Struthiopteris)*, New York fern (*Thelypteris noveboracensis).*
19	*C. gapperi*	1A	3	14	20 Jul	90% dense fern and seedling cover, 10% sedges.	white ash *(Fraxinus americanus)*, New York fern (*Thelypteris noveboracensis)*
20	*C. gapperi*	1A	5	14	20 Jul	80% dense fern cover. 20% rotting wood and leaves.	New York fern (*Thelypteris noveboracensis)* and sensitive fern (*Onoclea sensibilis*).
22	*C. gapperi*	4B	1	6	18 Aug	50% moses, dead wood (stump) and decaying leaves, coral fungi. 50% plant cover	Sensitive fern (*Onoclea sensibilis*), birch (*Betula* sp.)
26	*Microtus pennsylvanicus*	5	5	22	26 Aug	100% grass and herb cover.	Milkweed *(Asclepias* sp.); [Wrinkled?*] Golden rod (*Solidago*) , Horsetail (*Equisetum*sp.), Vetch (*Vicia* sp.); Bedstraw (*Galium*sp.).
27	*M. pennsylvanicus*	5	7	22	26 Aug	60% dense herb and grass cover, 40% moss-covered rock.	Meadowsweet (*Spirea* sp.), [Purple leaved ?] Willow Herb (*Epilobium* sp.), Goldenrod (*Solidago* sp.)
28	*Napaeozapus insignis*	6	1	2	26 Aug	50% fern & herb cover, 50% dry leave, needle (white pine) and moss cover.	Intermediate Woodfern (*Dryopteris* var. *intermedia*), young sugar maple, ash.

Appendix III
Photographs

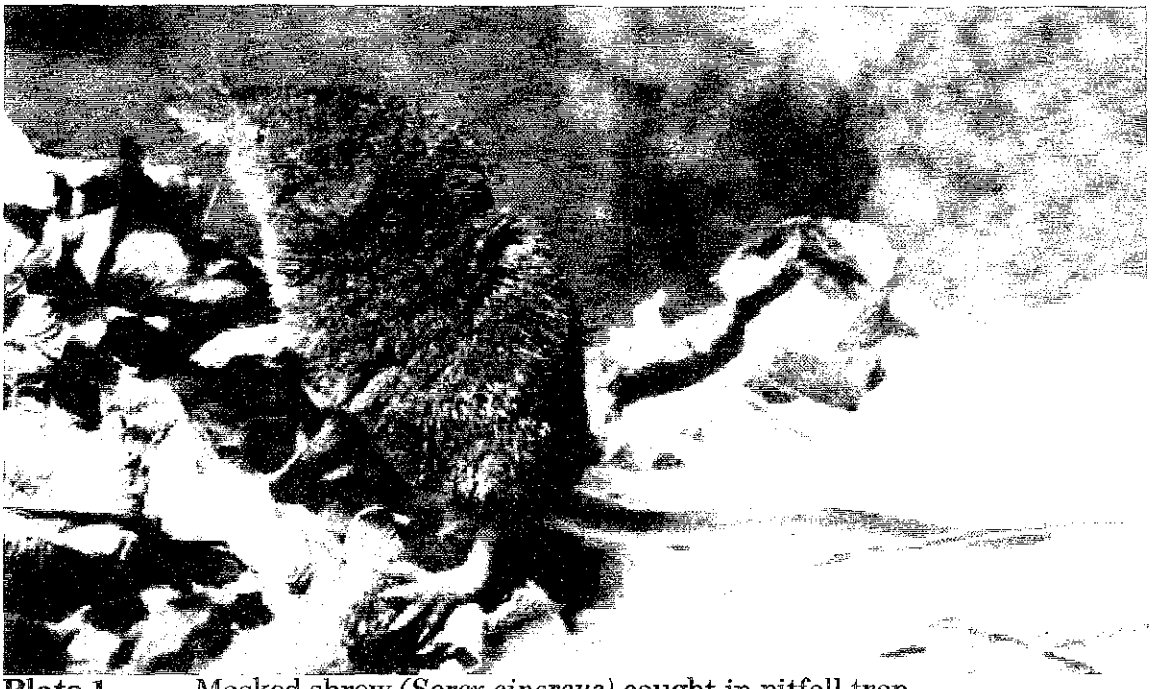

Plate 1. Masked shrew *(Sorex cinereus)* caught in pitfall trap.

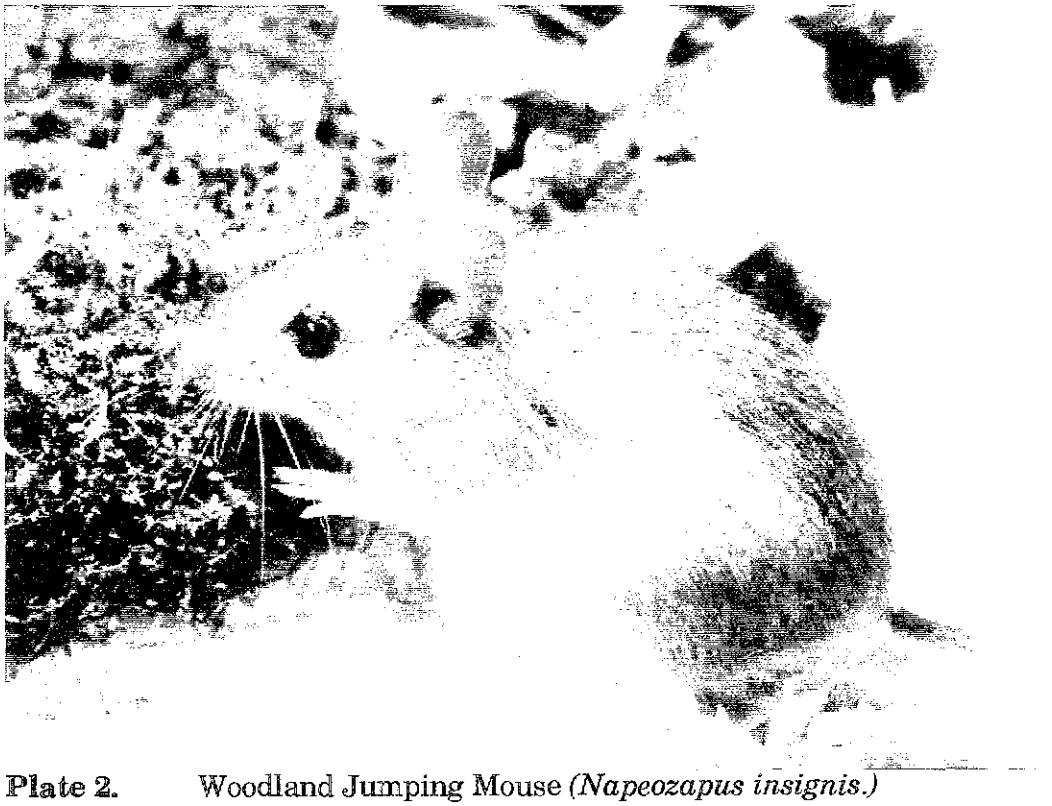

Plate 2. Woodland Jumping Mouse *(Napeozapus insignis.)*

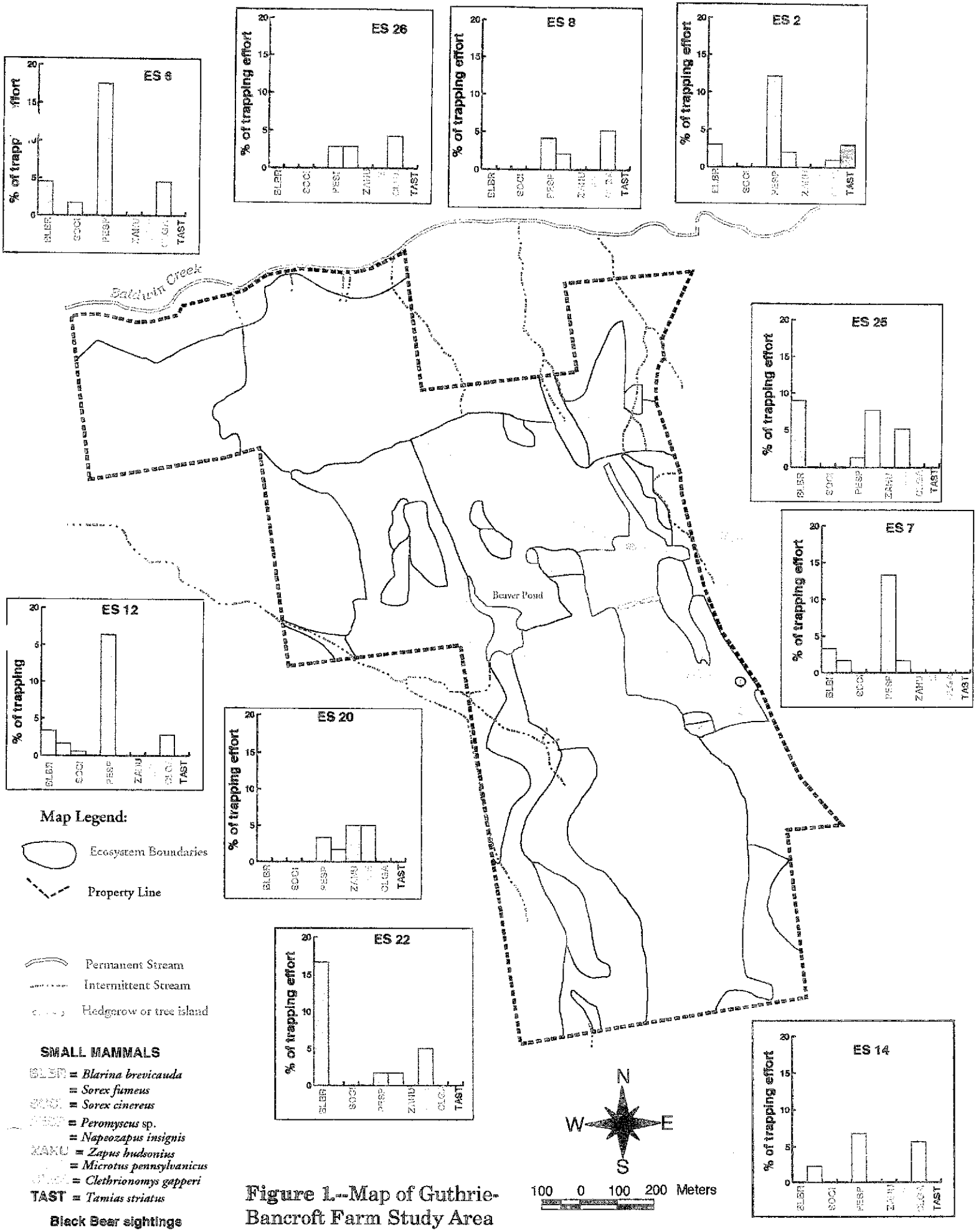

Figure 1.--Map of Guthrie-Bancroft Farm Study Area