Conducting a Biological Inventory in your Family Forest
27 Sept. 2003

Section: Assessing Mammal Diversity

1. Why assess mammals?

By obtaining information on mammal distributions, natural landscape elements, and human influences at any given site, many questions relevant to the understanding and conservation of mammal diversity can be addressed. Examples of such questions include the following (from: Wilson et al. 1996)

1. Is mammal diversity heterogeneous across the landscape?
2. If so, where are the centers of high diversity?
3. Do such centers correspond with particular patterns in the natural or human elements?
4. Is habitat-patch size or shape important to small mammal diversity?
5. Do vegetated corridors of natural habitat effectively join areas of high diversity?
6. Do mammals use vegetation corridors?
7. Do existing protected areas and reserves contain high diversity?
8. Which unprotected areas should be considered for future protection so that maximum biodiversity can be conserved?
9. How might changes in land-use practices affect mammal diversity?

Mammals make up an important part of the food web both as herbivores and carnivores. I did not yet find similar numbers for hardwood forests, but numbers computed for **1 acre** of grassland in California suggested a food pyramid of **5.88 million plants** to **359 herbivorous mice** to **0.14 carnivores** (Pearson, 1964).

A trap line (32 traps during 4 nights of trapping = 128 trap nights) in one "well-drained mesic red oak hardwood forest" site on the Guthrie-Bancroft parcel adjacent to the Lincoln Town Forest yielded 54 animals: 44 deer and white-footed mice (*Peromyscus* sp.) 5 short-tailed shrews (*Blarina*), 4 red-backed voles (*Clethrionomys*) and 1 chipmunk (*Tamias*). In the same year a "poorly drained spruce-fir northern hardwood forest" site nearby yielded 12 large short-tailed shrews, 1 tiny masked shrew (*Sorex*), 19 *Peromyscus*, 3 woodland jumping mice (*Napaeozapus*), 1 meadow vole (*Microtus*), and 13 red-backed voles in 120 trap nights. These numbers may give a hint how many small mammals we may expect per acre in our Vermont hardwood forests and what impact they may have on the vegetation, as predators (shrews) of invertebrates and as a food source to larger mammals (bobcat, foxes, weasels, fisher, etc.). It is because of this abundance and importance in the food web that this introduction focuses mostly on small mammal diversity, with some suggestions for medium (meso-) and large mammal surveys.

2. When and where to sample mammals?

When

- Summer: Small mammal trapping. Cold nights should be avoided to reduce mortality in live traps (esp. for shrews). However, some species (e.g. Flying squirrels) may enter traps more readily in fall or spring.
- Winter: Large and medium sized mammal tracking. For specific techniques and approaches check with your nearest *Keeping Track* chapter or learn more at the *Keeping Track* website (http://www.keepingtrackinc.org/) and from the tracking literature (Murie,1974; Rezendes, 1999; Stokes and Stokes, 1986).

• Anytime of the year: Camera traps, some tracking and other signs of mammals (feeding traces, scat).

Where
• In a representative or core section of a selection or all of the different ecosystems identified on your land. For the Lincoln Town Forest these are the 8 ecosystem types (and their Vermont Natural Community Type correlates) identified by Marc Lapin (2000).

3. Minimum equipment and time investment.

3.1 • field note book (tape recorder?)
• binoculars
• data sheets (see sample)

3.2 Traps and pitfalls (Sherman and Tomahawk live traps, eventually snap traps and pitfall buckets). Trapping should be conducted in collaboration with a licensed mammalogist or his/her students (see contacts in 7 below).

3.3 Camera traps and track plates for larger mammals
Film-based and digital camera systems are available starting at around $230 from hunting and forestry outfitters (e.g.: Cabelas: http://www.cabelas.com/ or Forestry Suppliers, Inc.: http://www.forestry-suppliers.com/).

3.4 Making time available for a survey. Short, repeated and regular survey work is better then one large one-time effort.

4. Recording and analyzing data.

4.1 Recording and Organizing Data.

Use field note book and datasheets to keep track of data in the field. Much of the information can be organized in tabular (spreadsheet) form without a lot of complicated statistics (see Table 1+2).

Table 1: Results of bat netting in the Lincoln Town Forest and adjacent Guthrie-Bancroft parcel.

Locality:	**Lincoln Town Forest**	**Guthrie-Bancroft**
Sampling Effort:	September 2003	Summers 2000-2003
Species		
Northern Myotis *(Myotis septentrionalis)*	1	2
Small-footed Myotis *(Myotis leibii)*		1
Little brown bat *(Myotis lucifugus)*		1
Hoary Bat *(Lasiurus cinereus)*		1

4.2 Indirect measures of species density - Example: Calculating deer density from scat counts

This survey of scat (pellets) involves searching a sample of plots where scat deposition period can be determined (e.g. time since autumns leaf -fall). An assumed daily rate of defecation is then used to derive an estimate of density. Eberhardt and Van Etten (1956) used estimated density of white-tailed deer as follows:

Deer/plot = average No. of pellet groups per plot / 12.7 pellet groups/deer/day x (days since leaf-fall)

Numbers of deer per plot were then converted to animals per unit area (e.g, km2) based on plot dimensions.

Table 2: Results for two nights of small mammal trapping in three ecosystems in the Lincoln Town Forest compared to more extensive sampling in similar ecosystems on the adjacent Guthrie-Bancroft parcel:

	Lincoln Town Forest rapid assessment			**Guthrie-Bancroft Parcel - for comparison**			
Ecosystem No.	**6**	**5**		**20**			**2**
M. Lapin Ecosystem Description (and Vermont Natural Community Type Correlate)	Gently sloping, poorly drained red maple-yellow birch-red spruce forest (Red maple black ash swamp)	Concave Basin, moderately rich, well-drained, HW Forest (Sugar maple-white ash north. HW Forest)		Very poorly drained alder-willow shrub swamp/dege meadow (Alder swamp/sedge meadow complex)			Well-drained, gently to moderately sloping north. HW forest (Northern HW Forest)
Months & Year sampled	**Sept 2003**	**Sept 2003**		**Sept 2000**	**June 2001**	**August 2002**	**Aug/Sept 2001**
No. of Days trapped	2	2		3	3	3	3
No. of Traps	30	30		20	28	24	26
Trapnights	60	60		60	84	72	78
Species *(Scientific names)*							
Shrews:							
Short-tailed shrew *(Blarina brevicauda)*	1	5			6	5	2
Smoky shrew *(Sorex fumeus)*							
Masked shrew *(Sorex cinereus)*							
Rodents:							
Deer & White-footed mice (*Peromyscus* sp.)	1	9		2	13		12
Woodland Jumping mouse *(Napeozapus insignis)*				1		1	2
Meadow Jumping mouse *(Zapus hudsonius)*				3			
Meadow vole *(Microtus pennsylvanicus)*				3	3	3	
Red-backed vole *(Clethrionomys gapperi)*					3		1
Eastern chipmunk *(Tamias striatus)*							3
Red squirrel *(Tamiasciurus hudsonicus)*					1		
Southern Flying squirrel *(Glaucomys volans)*							
Northern Flying squirrel *(Glaucomys sabrinus)*							
Small Carnivores:							
Short-tailed Weasel or Ermine *(Mustela erminea)*						1	
No. of Species	**2**	**2**		**4**	**4**	**4**	**5**
No. of Captures	**2**	**14**		**9**	**26**	**10**	**20**
% Trap Success	**3.3**	**23.3**		**15.0**	**31.0**	**13.9**	**25.6**

4.3 Measuring Diversity

We can assess habitat diversity not just based on number of species (= species *richness*) or on the abundance of each species (= species *evenness).* Often more complex indices are used. One is *Simpson's Index:* $D = \sum p_i^2$

where D is denotes the index and p_i 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. Another index commonly reported is the *Shannon-Wiener Index:* $H' = - \sum_{i=1} (p_i) (\log_2 p_i)$.

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. The formulas can be easily generated in a spreadsheet. For more information and good examples how to calculate these and other indices from actual survey numbers contact me or see especially Krebs (1989) and also Wilson *et al.* (1996).

5. Mapping Results

• Topographic Maps

Much of the mapping can be done by hand on photocopies or in a computer drawing program on scans of standard topographic maps (see Figure 1). A compass may be helpful for orientation in the woods.

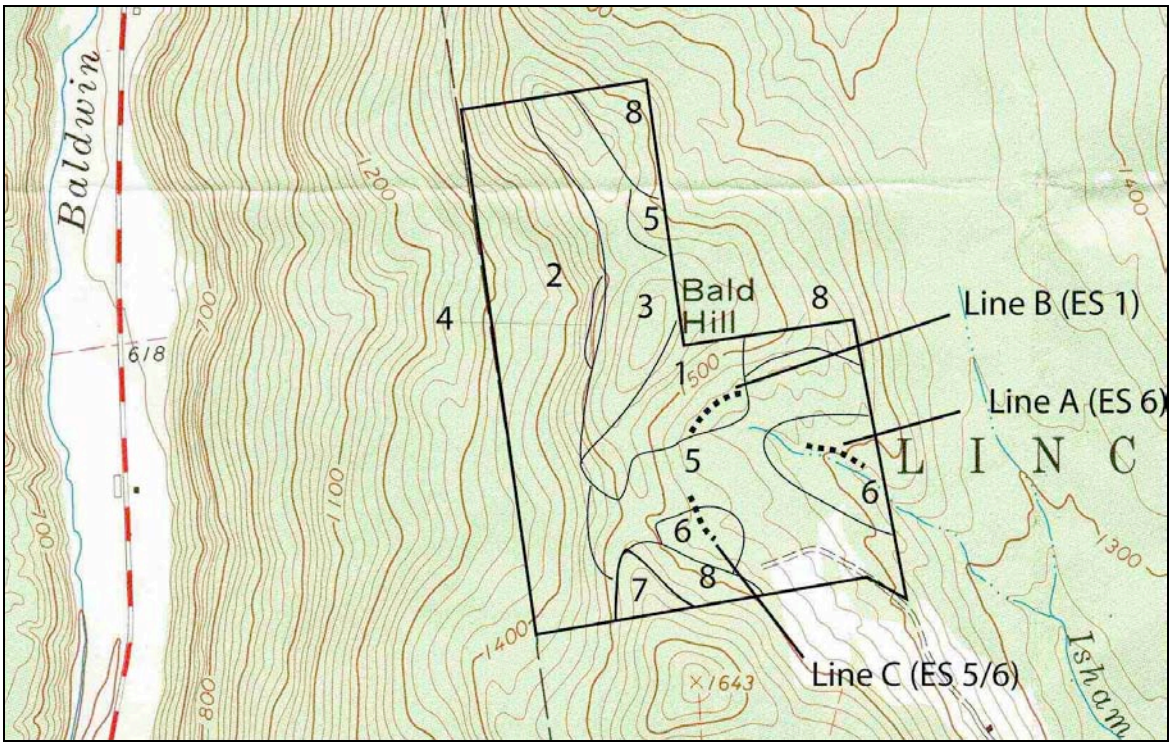


Figure 1: Small mammal trap lines and ecosystem boundaries on scan of Bristol topographic sheet.

• GPS Receivers
For more accurate mapping and orientation a GPS unit (e.g. Garmin) may be useful. Results can be imported into a geo-referenced mapping program (e.g. *iMap* a free program for the Macintosh http://www.kuleuven.ac.be/bio/sys/imap/). The receivers also work like a compass if you need to return to particular spots in the woods previously marked in the GPS unit.

6. Legal & Health issues for working with mammals.

6.1 Legal Issues

A scientific collection permit is required by Vermont state law to trap mammals as part of an inventory. Any state or federally listed species (threatened or endangered) would also require a state endangered species permit (plus federal authorization if listed federally such as Indiana bat, *Myotis sodalis*). For questions contact Mark Fergusson at the Vermont Department of Fish and Wildlife ((802) 241-3667 *mark.ferguson@anr.state.vt.us)* and see Section 7 below.

6.2 Health precautions

- Rabies: Immunization against rabies are recommended for people who have regular contact with bats or other high risk mammals (carnivores).
- Lyme disease: In the Northeast the disease is maintained by the white-footed mouse (*Peromyscus leucopus*) and the deer tick (*Ixodes dammini*). Deer ticks can be found wherever white-tailed deer, on which the adults feed, are found. Because the deer population has exploded in recent years, the risk of Lyme disease has increased (Wilson *et al.* 1996).
- Hantavirus Pulmonary Syndrome (HPS). This is not a very serious problem in the Northeastern US, but outbreaks occurred in 1993 in the Southwest and there has been at least one confirmed case from Rhode Island. Carriers are rodents, esp. *Peromyscus maniculatus*.

7. Involving your local mammalogist & students

If you want to do a small mammal assessment on your land using trap lines and bat nets, you can also contact one of the following local mammalogists with collecting permits for assistance:

Dr. C. William Kilpatrick, Professor of Zoology, Department of Biology, University of Vermont, Burlington, VT 05401-0086, *(wkilpatr@zoo.uvm.edu)*
http://www.uvm.edu/~biology/Faculty/Kilpatrick/Kilpatrick.html

Dr. Stephen Trombulak, Brofessor of Biology and Environmental Studies, Middelbury College, Department of Biology, Middlebury, VT 05753. 802-443-5439 *(trombula@middlebury.edu)*
http://community.middlebury.edu/~trombula/Trombulak.html

Jan Decher, PhD, Zoologist & Research Associate, Department of Biology, University of Vermont, Burlington, VT 05401-0086, *(Jan.Decher@uvm.edu)*
http://www.uvm.edu/~jdecher/

Recommended Reading

Eberhardt, L., and R. C. Van Etten. 1956. Evaluation of the pellet group count as a deer census method. Journal of Wildlife Management, 20:70-74.

Krebs, C. J. 1989. Ecological Methodology. Harper Collins Publishers, Inc., New York, xii + 654 pp.

Lapin, M. 2000. Ecosystems and ecological significance of Lincoln Town forest on Bald Hill, Lincoln, Addison County, Vermont. Marc Lapin Ecological and Botanical Consulting.

Martin, R. E., R. H. Pine, and A. F. DeBlase. 2001. A manual of mammalogy: with keys to families of the world. 3rd ed. Wm. C. Brown Co., Dubuque, Iowa, xii+436 pp.

Murie, Olaus Johan, 1974. A field guide to animal tracks. 2nd ed. The Peterson field guide series No. 9. Boston, Houghton Mifflin, xxi+375.

Pearson, O. P. 1964. Carnivore-mouse predation: an example of its intensity and bioenergetics. Journal of Mammalogy, 45:177-188.

Rezendes, Paul. 1999. Tracking & the art of seeing : how to read animal tracks & sign. 2nd ed. New York: HarperCollins, 336 pp.

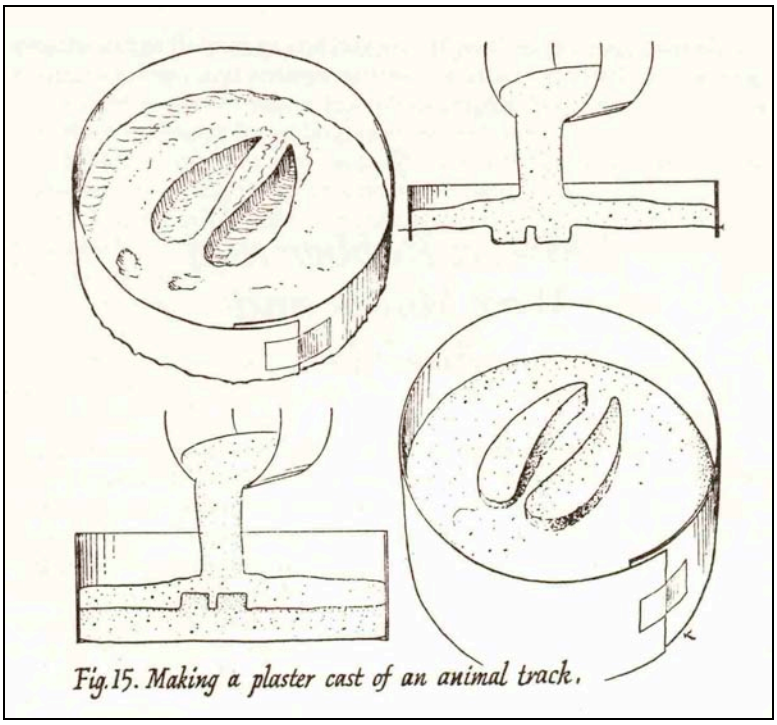
Stokes, Donald W and Lillian Q. Stokes. 1986. A guide to animal tracking and behavior. Boston, Little, Brown. vi+418 p.

Wilson, D. E., F. R. Cole, J. D. Nichols, R. Rudran, and M. S. Foster. 1996. Measuring and monitoring biological diversity. Standard methods for mammals. Smithsonian Institution Press, Washington, xxvii + 409 pp.

Wolkomir, R. 1997. Following the footsteps of fox and bear [article on *Keeping Track* founder Susan Morse]. Smithsonian Magazine, 27:34-43.

Getting Children Involved in Assessing Small Mammal Diversity

Example: Copying and Preserving Animal Tracks



First you find a place where animals have left tracks, such as on the muddy shore of a stream or pond. You fix with tape or a stapler a round rim of cardboard about an inch wide and big enough to surround the track you are going to make a copy of. This you place around the track. Into this form (as shown in Figure 15) you pour a mixture of plaster of paris and water, made like a thick cream. This hardens enough within half an hour to take up from the ground.

You have at this stage only the negative or mold of your track. To make the positive, or final, model, you must first thoroughly wash, clean and dry your negative. Dry by putting in a hot place in the sun or in a small box directly under a 40-Watt light bulb for several hours. Following this, paint the upper surface of the plaster negative with a film of white shellac or liquid soap (made by mixing soap chips in hot water). This coating should be allowed to dry and will help prevent the new plaster of paris you are going to pour from sticking to the old.

Again place a circular rim of cardboard around your negative to hold in the cast plaster. You now pour over the negative a smooth, thick creamy mixture of plaster of paris and water. When this hardens, it can be easily taken away from your negative, and there you have your final copy or model of the animal track.

Each copy of track made this way should be painted with a dark paint, probably brown. This makes the track stand out against the white plaster and produces a very pleasing display.

Illustration and (modified) text from: Brown, V. 1984. Building your own nature museum: for study and pleasure. Arco Publishing Inc., New York. xii + 161 pp.