

# Amphibian Monitoring on Mt. Mansfield, Vermont

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## Abstract

Populations of all amphibian species are monitored annually on Mount Mansfield to (1) document the occurrence of amphibian species in this area, (2) establish a baseline data set on their distributions and abundances for future analysis of changes in these species, and (3) monitor year-to-year changes in their status. Amphibians are targeted for this kind of study because their unique life-history characteristics, involving close association with both water and soil, as well as yearly breeding activity, makes them especially well suited as an indicator taxa of changes in environmental conditions in forest environments.

Highlights of our activities and results for 1994 include (1) continued abundance of spring peepers (*Pseudacris crucifer*), (2) an apparent increase in the density of redback salamanders (*Plethodon cinereus*), reversing a trend from 1992 to 1993, (3) an apparent decrease in wood frogs (*Rana sylvatica*), also reversing an earlier trend, (4) a continuation of the trend for poor reproduction in spotted salamanders (*Ambystoma maculatum*), with pH of vernal pools close to reported lethal limits, and (5) the start of measurements on size classes of individuals captured.

## Introduction:

Amphibians such as frogs and salamanders are ideal indicators of forest health and water quality because their survival depends on clean water and a narrow range of soil and water acidity. Changes in amphibian populations over time may indicate changes in environmental quality that might only be discovered after much longer periods of time and with more expensive monitoring procedures. Also, different species of amphibians are sensitive to different conditions. Therefore, comparing the changes in different species may identify exactly what kind of environmental changes are occurring in the study area. The following report describes our results for 1994 as well as the overall design for our continued monitoring activity.

The purpose of this study is to (1) document the occurrence of amphibian species in this area, (2) establish a baseline data set on their distributions and abundances for future analysis of changes in these species, and (3) monitor year-to-year changes in their status. On-going monitoring of key indicator species will aid in the assessment of changes in their abundance over time.

## Methods:

Since 1991, three techniques have been used to inventory the amphibian species in this area and to monitor their abundances. First, four drift fences have been built at three elevations on the west slope: 1200 feet (2 fences), 2200 feet (1), and 3200 feet (1). Each fence, with the exception of the fence at 3200 feet, is made of two 50-foot sections of 20-inch wide metal flashing buried 4 inches below the surface of the ground. The two sections are placed at right angles to each other, resulting in 100 feet of flashing set upright as a 16 inch high fence. Buckets are buried every 12.5 feet on both sides of the fence so that the top edges of the buckets are flush with the ground. The fence at 3200 feet is made of only one 50-foot section of flashing with buckets at 12.5-foot intervals. Amphibians that encounter a fence while moving through the forest will turn to one side and eventually fall into a bucket. The lids are taken off the buckets in the late afternoon on rainy days, and the captured amphibians identified and counted the following morning. The locations of these four sites are indicated on Figure 1.

Second, night-time road surveys are done on rainy nights in early spring to identify all amphibians seen on roads and calling in the vicinity of roads. By driving a set route at a constant speed (10 mph), standardized estimates of amphibian abundances and locations of breeding sites can be made throughout the entire area covered by roads. The roads used for these road surveys are indicated on Figure 2.

Third, selected breeding ponds in the area are searched during the breeding season for eggs and males calling for mates. The number of egg masses provide an index of the abundance of each species. In 1994, pools monitored for egg masses and water pH were the West Bank of Harvey Brook, the vernal pool below the PMRC, the pond behind the PMRC sugar shack, and the Lake of the Clouds.

In addition, active searches, involving turning over rocks and logs, are done irregularly during the day near the drift fences and other selected sites. The number of individuals of each species found in a given area in a given amount of time provide a direct measure of species presence and an index of species diversity and abundance. This technique is used when additional inventory is felt necessary for species or habitats not adequately inventoried by other methods. Furthermore, this year we began to measure the sizes of all amphibians handled at drift fences and on night-time road searches to begin developing a picture of changes in the age-class distributions of these species over time.

The distribution of the methods over the slope of Mount Mansfield is displayed in Figure 3.

### Results and Discussion:

We have so far identified 13 species of amphibians from this area, from a total possible of 24 species known from Vermont, 21 of which show evidence of breeding in recent years (Figure 4). The list of species inventoried has not changed since 1992, and we are therefore confident that all species present have been identified. Six of these 13 are generally common, being observed or heard on almost all visits wherever suitable habitat is found:

Red-spotted newt: adults found in streams and ponds and terrestrial juveniles on roads and in the forest up to 3900 feet.

Redback salamander: found in the forest throughout most of the elevational range of the study area, but not observed above 3200 feet; extremely common.

Northern spring peeper: heard calling regularly from ponds throughout the area, mainly below 2000 feet.

Gray treefrog: heard calling regularly from ponds throughout the area, mainly below 2000 feet.

Wood frog: located up to tree line where breeding ponds occur.

Eastern American toad: concentrated below 2200 feet, but also occasionally found at elevations near 4000 feet.

Five species are locally common, being seen regularly in their limited appropriate habitat:

Spotted salamander: egg masses found in the spring in a few of the ponds in the area.

Northern dusky salamander: streams up to 2200 feet.

Northern spring salamander: streams up to 2200 feet.

Northern two-lined salamander: streams up to 3900 feet.

Green frog: heard calling regularly from ponds throughout the area, mainly below 2000 feet.

The pickeral frog is occasionally observed, but only below 2200 feet. The bullfrog is heard only rarely at a site along Pleasant Valley Road near 1200 feet.

We have only four years of data on these species (1991-94). It is too soon to draw any major conclusions on trends in their demography; however, the following summarizes what we have observed to date for the five best indicator species.

Spring peepers: commonly observed during both night-time road searches (Table 4) and surveys of breeding choruses (Table 3). They are by far the most common species observed on the roads and had many times the number of choruses (56) of any other species. Data from drift fences and choruses suggest a decrease from the previous year, but data from night-time road searches suggest a slight increase (Table 7). This is the opposite of the pattern reported in 1993.

Gray treefrogs: observed only four times during night-time road searches (Table 4), but this is expected due to their secretive behavior. Six choruses were noted (Table 3). Populations are probably too small to assess trends without many more years of data.

Redback salamanders: commonly found in drift fences (Table 1). There was a major increase in 1994 from the previous year (Tables 2 and 7) but this species is difficult to see on the roads at night, so our conclusions are based solely on numbers caught at drift fences.

Spotted salamanders: Fourteen individuals were found in drift fences (Table 1). Egg mass were located in all of the pools and the Lake of the Clouds, but we still don't know if any of them successfully hatched (Tables 5 and 6). Measurements of pH in these ponds indicate that most continue to be very close to the lethal pH for this species measured in other studies (4.0-4.5; Tables 5 and 6), suggesting a possible explanation for the low level of successful reproduction. The number of egg masses has shown a steady increase from 1992 (Table 6). This suggests an increase in the number of breeding adults over this three-year period; however, this is not supported by data at either drift fences (Table 1) or night-time road searches (Table 4).

Wood frogs: commonly observed on night-time road searches, surveys for choruses, and in drift fences (Tables 1, 3, and 4). Wood frogs successfully bred in at least two of the four ponds studied. Their populations appear to have decreased dramatically (Tables 2 and 7), reversing the trend noted in 1993.

#### Future plans:

We plan to continue monitoring the amphibian populations throughout this area following the techniques we have employed so far. We feel confident that we have a complete survey of the species in the study area; therefore, our efforts now focus exclusively on monitoring the populations, water quality, and breeding success of amphibians in vernal pools and lakes in the area.

#### Context:

This work on Mount Mansfield is part of a large survey and monitoring effort we are conducting throughout western Vermont. We have similar sites at several locations in the lowlands of the Champlain Basin, at Abbey Pond in the northern Green Mountain National Forest, and in the Lye Brook Wilderness Area of the southern Green Mountain National Forest. It is our hope that by conducting monitoring activity over a large geographic area over many years that long-term trends in the status of amphibian populations over regional spatial scales can be determined.

#### Acknowledgments:

Our work on Mt. Mansfield this year was helped a great deal by Mr. Robert Smith at Mt. Mansfield High School, and his students Jason McKnight, Ryan Walker, Joanne Cummings, and Rinda Gordon. We are extremely grateful for their interest in amphibians at Mt. Mansfield and all their hard work.

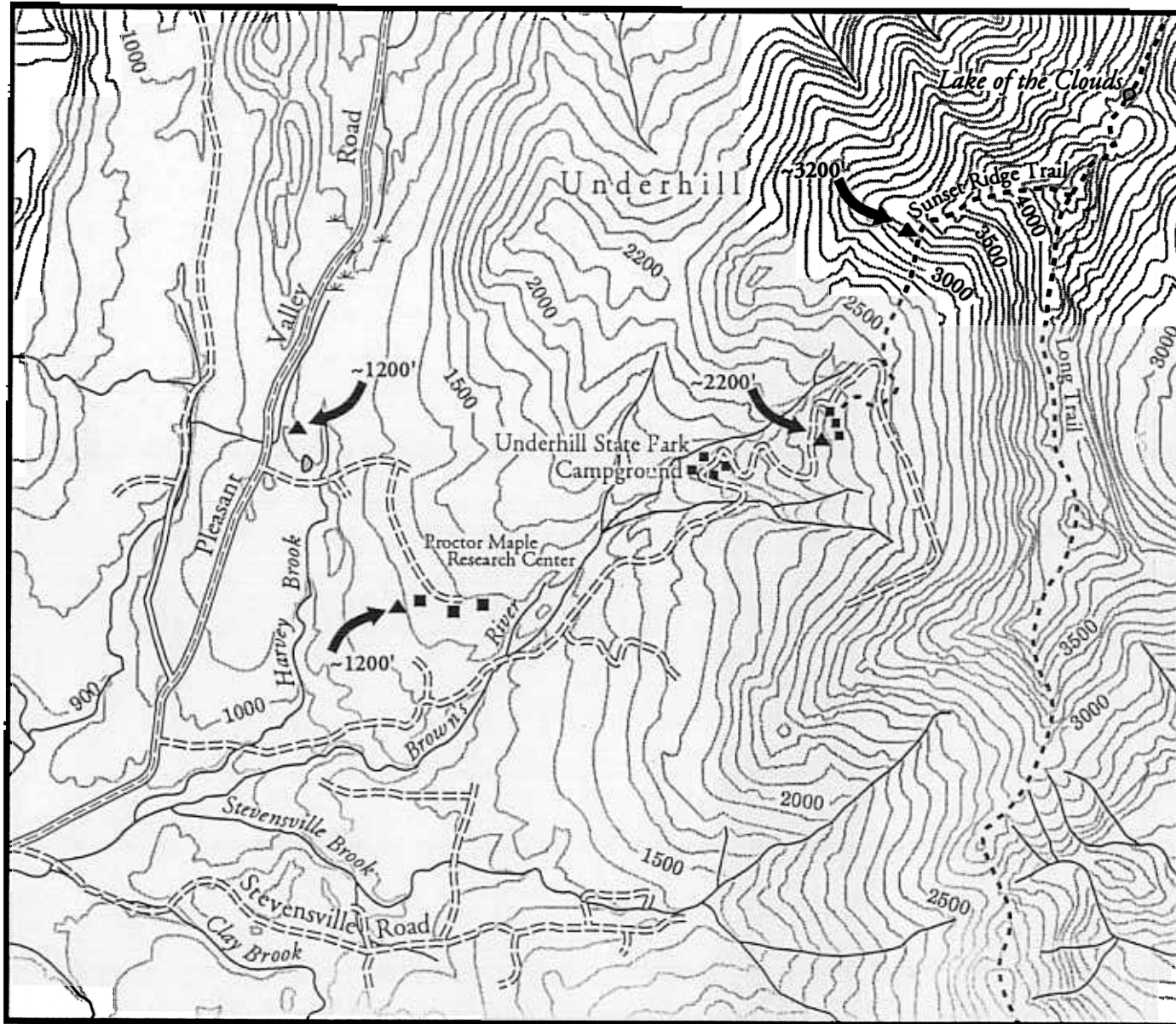


Figure 1.

Location of Drift Fences  
on  
Mount Mansfield  
Underhill, Vermont

0 5 1  
kilometers

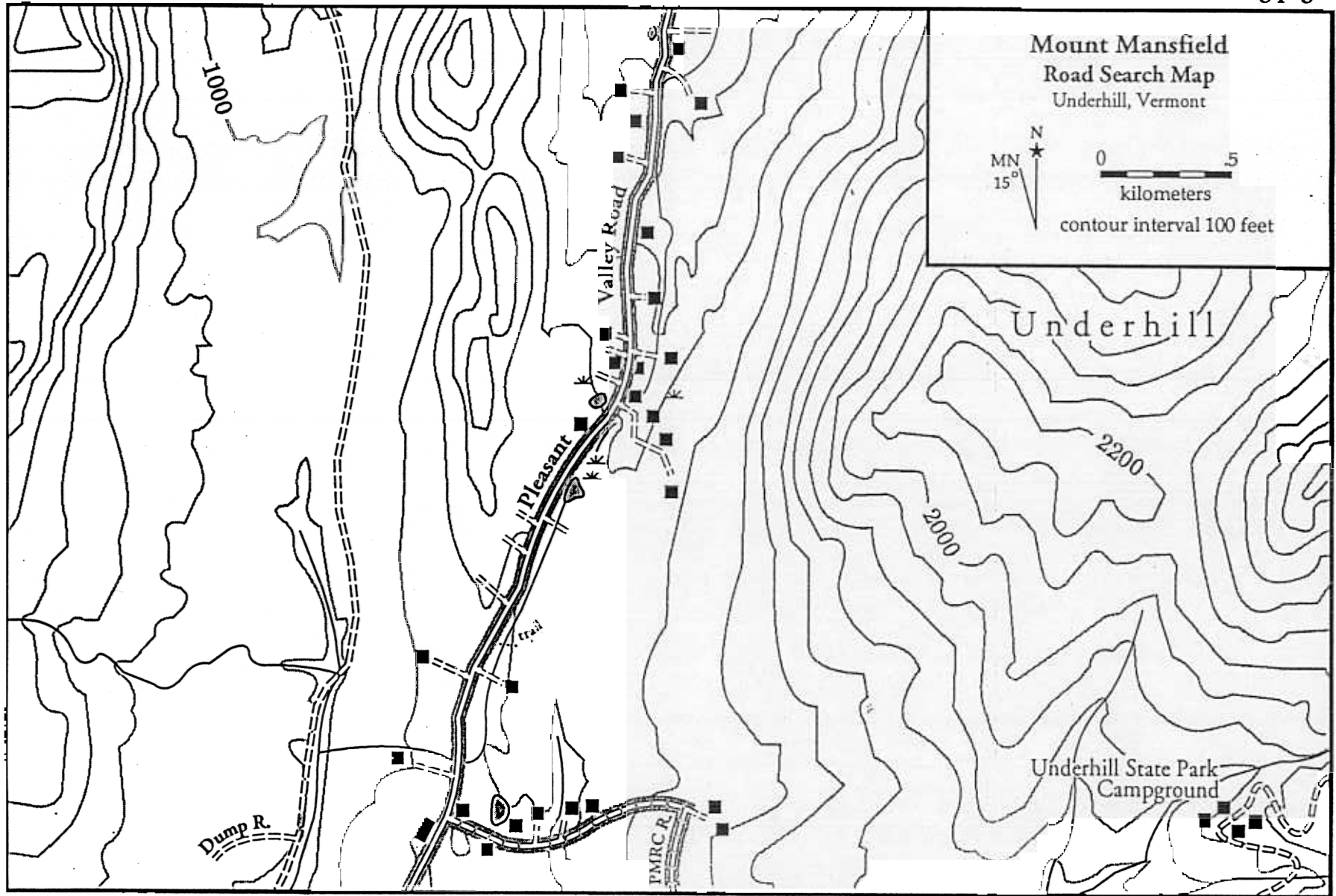
contour interval 100 feet

▲ Drift fence

N  
★  
MN  
15°

Figure 2.

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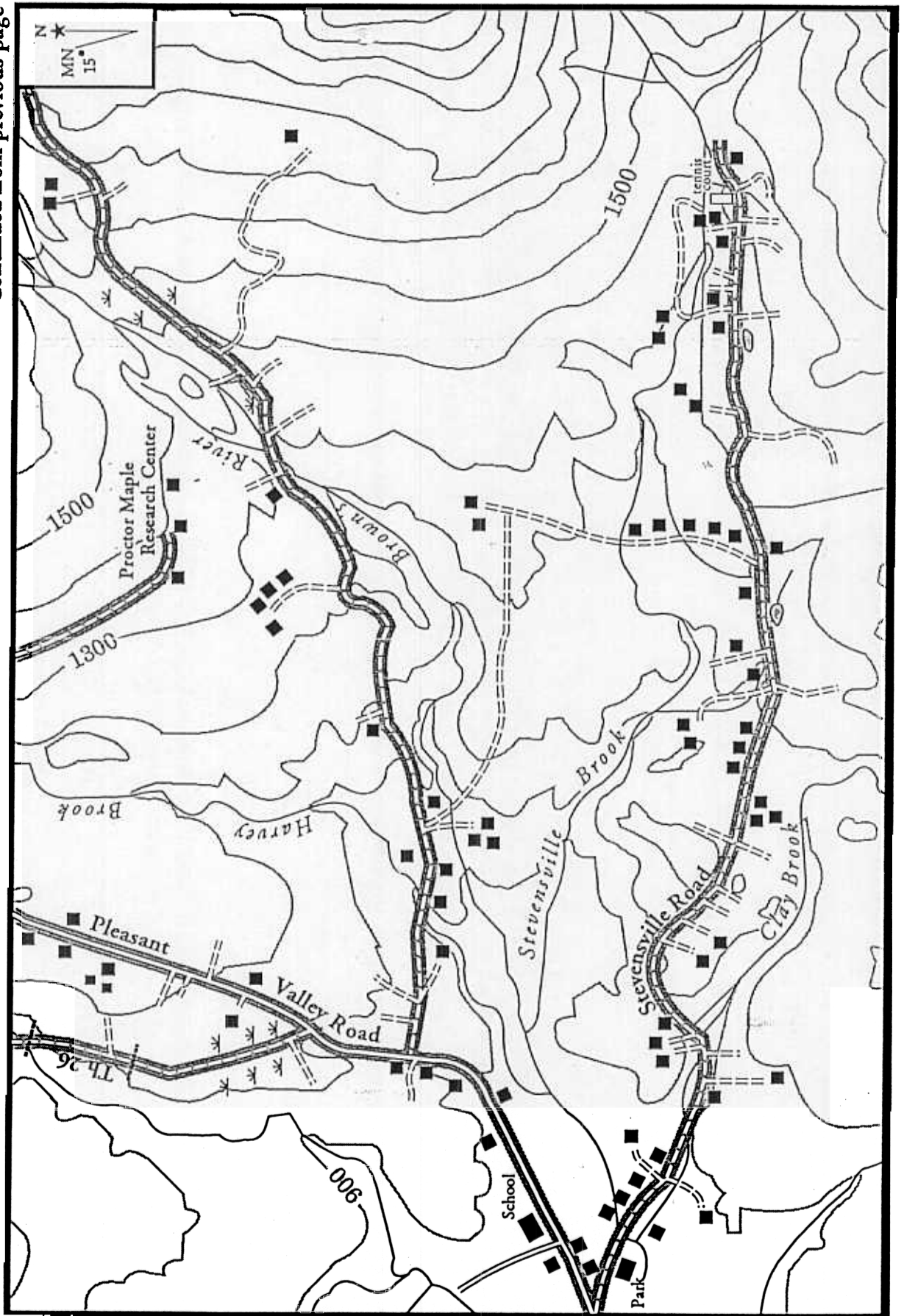
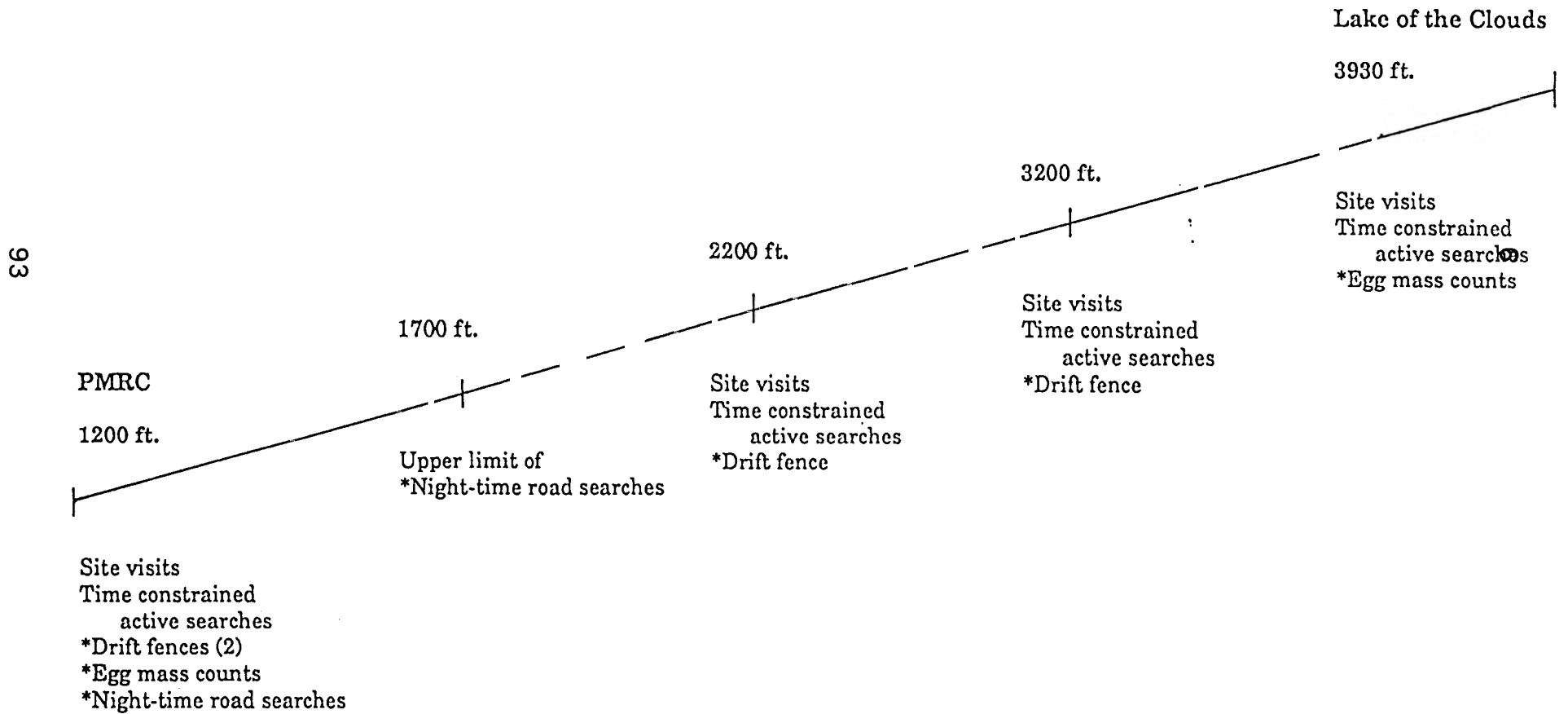


Figure 2 (cont).

**Figure 3.**  
**Mt. Mansfield Inventory Methods by Elevation**



\*method to be continued for long-term monitoring



Table 1. A comparison of drift fence data from the 1993 and 1994 field seasons at Mt. Mansfield, Vermont using all data from the 1,200 ft. and 2,200 ft. drift fences.

Species name	Common name	# of ind.		# per trapping <sup>1</sup>		% of total catch	
		93	94	93	94	93	94
<b>Caudates (Salamanders)</b>							
<i>Ambystoma maculatum</i>	Spotted salamander	25	14	1.7	1.0	12	10
<i>Desmognathus fuscus</i>	Northern dusky salamander	5	4	0.3	0.3	2	3
<i>Eurycea bislineata</i>	Northern two-lined salamander	8	2	0.5	0.1	4	1
<i>Gyrinophilus porphyriticus</i>	Spring salamander	1	0	< 0.1	0.0	< 1	0
<i>Notophthalmus viridescens</i>	Red-spotted newt	20	17	1.3	1.2	10	12
<i>Plethodon cinereus</i>	Redback salamander	18	59	1.2	4.2	9	40
<b>Anurans (Frogs and Toads)</b>							
<i>Bufo americanus</i>	Eastern American toad	11	8	0.7	0.6	5	5
<i>Pseudacris crucifer</i>	Northern spring peeper	26	15	1.7	1.1	13	10
<i>Rana clamitans</i>	Green frog	1	3	< 0.1	0.2	< 1	2
<i>Rana palustris</i>	Pickereel frog	2	0	0.1	0.0	1	0
<i>Rana sylvatica</i>	Wood frog	84	24	5.6	1.7	42	16
<b>Totals</b>		<b>201</b>	<b>146</b>	<b>13.4</b>	<b>10.4</b>	<b>100</b>	<b>99</b>

<sup>1</sup>Number per trapping are rounded to the nearest 0.1. All other figures are rounded to the nearest whole number. There were a total of 15 trappings counted in 1993 and 14 in 1994. Trappings counted are those nights where at least two of the three lower traps were opened under appropriate weather conditions for amphibian movement.

Table 2. An examination of the 1993 and 1994 trapping success of *Rana sylvatica* and *Plethodon cinereus* broken down by time period.

Species and Time Periods	Number of Trappings		Total Number Caught	
	1993	1994	1993	1994
<i>Rana sylvatica</i>				
April-May	4	4	29	7
June-August	5	5	6	5
Sept.-Nov.	6	5	49	12
<b>Total</b>	<b>15</b>	<b>14</b>	<b>84</b>	<b>24</b>
<i>Plethodon cinereus</i>				
April-May	4	4	4	10
June-August	5	5	4	3
Sept.-Nov.	6	5	10	49
<b>Total</b>	<b>15</b>	<b>14</b>	<b>18</b>	<b>62</b>

Table 3. A comparison of the number of choruses and calling anurans surveyed during night-time road searches April through June 1993 and 1994. In 1993 six searches took place during this time period: April 16, May 6, May 15, May 25, June 8, and June 18. In 1994 during this time period five searches took place: April 25, May 6, May 31, June 6, and June 13.

Species name	Common name	# of total choruses <sup>1</sup>		size of choruses <sup>2</sup>		# per NTRS <sup>3</sup>		% of total choruses	
		1993	1994	1993	1994	1993	1994	1993	1994
<i>Bufo americanus</i>	American toad	0	1	C-4 O-0 L-0 M-0 H-0	C-2 O-0 L-1 M-0 H-0	0	0.2	0	1
<i>Hyla versicolor</i>	Gray tree frog	4	6	C-7 O-0 L-3 M-1 H-0	C-6 O-0 L-0 M-0 H-0	0.7	1.2	5	8
<i>Pseudacris crucifer</i>	Northern spring peeper	73	56	C-38 O-5 L-27 M-37 H-4	C-15 O-6 L-12 M-33 H-5	12	11.2	89	74
<i>Rana clamitans</i>	Green frog	0	0	C-3 O-0 L-0 M-0 H-0	C-2 O-0 L-0 M-0 H-0	0	0	0	0
<i>Rana sylvatica</i>	Wood frog	5	13	C-0 O-0 L-5 M-0 H-0	C-6 O-2 L-7 M-4 H-0	0.8	2.6	5	17
Totals		82	76	C-52 O-5 L-35 M-38 H-4	C-31 O-8 L-20 M-37 H-5	13.6	15.2	100	100

<sup>1</sup>not including calling individuals

<sup>2</sup>C = a calling individual

O = a chorus with occasional vocalizations

L = a continuous chorus of low intensity

M = a continuous chorus of medium intensity

H = a continuous chorus of high intensity

<sup>3</sup>Number per NTRS are rounded to the nearest 0.1. All other figures are rounded to the nearest whole number.

Table 4. Night-time road search data from Mt. Mansfield, Vermont, based on surveys from April through June in 1993 and 1994. All calling anurans are excluded from this table. Six searches took place during this time period in 1993 and five during 1994.

Species name	Common name	# of ind.		# per NTRS <sup>1</sup>		% of total catch	
		1993	1994	1993	1994	1993	1994
<b>Caudates (Salamanders)</b>							
<i>Ambystoma maculatum</i>	Spotted salamander	6	3	1.0	0.6	4	2
<i>Gyrinophilus porphyriticus</i>	Spring salamander	0	1	0.0	0.2	0	1
<i>Notophthalmus viridescens</i>	Red-spotted newt	24	9	4.0	1.8	14	7
<b>Anurans (Frogs and Toads)</b>							
<i>Bufo americanus</i>	Eastern American toad	25	38	4.2	7.6	15	28
<i>Hyla versicolor</i>	Gray treefrog	3	4	0.5	0.8	2	3
<i>Pseudacris crucifer</i>	Northern spring peeper	44	52	7.3	10.4	26	38
<i>Rana catesbeiana</i>	Bullfrog	1	0	0.2	0.0	1	0
<i>Rana clamitans</i>	Green frog	5	3	0.8	0.6	3	2
<i>Rana palustris</i>	Pickerel frog	3	2	0.5	0.4	2	1
<i>Rana sylvatica</i>	Wood frog	60	26	10.0	5.2	35	19
<b>Totals</b>		171	138	28.5	27.6	102	101

<sup>1</sup>Number per NTRS are rounded to the nearest 0. All other figures are rounded to the nearest whole number.

Table 5. Spring 1994 egg mass data from Mt. Mansfield, Vermont.

Location/Date	Number of <i>A. maculatum</i> egg masses	Number of <i>R. sylvatica</i> egg masses	Mean pH N = 3	Site Notes	Water test results from Vermont DEC (J. Kellogg) <sup>1</sup>
<b>West bank of Harvey Brook</b>					
May 3	1	0		beaver dam	not tested
May 20	not	checked		broken and	
June 7	not	checked		deserted <sup>2</sup>	
<b>Vernal pool below PMRC</b>					
May 3	29	60	5.1 <sup>3</sup>		conductivity 24.8
May 20	38	72 (all hatched)	5.0		color 35
June 7	25	0 (tadpoles)	4.6	water level up	alkalinity 0.09
June 30	9	0 (tadpoles with legs)		two puddles remaining ~ 20 cm deep	
July 19	0	0		dry	
<b>Pond behind sugar shack at PMRC</b>					
May 3	6	150	5.6 <sup>3</sup>		conductivity 19.1
May 20	6 (~75% nonviable)	63 (many had hatched)	5.5		color 25
June 7	0	0 (many tadpoles)	5.2	water level up	alkalinity 0.57
June 30	0	0 (many tadpoles)		1 cm deep, almost dry	
July 19	0 (no larvae)	0 (no tadpoles)		1 cm deep	
<b>Lake of the Clouds</b>					
May 19	0	3	4.9 4.8 <sup>3</sup>	snow patches	conductivity 19.2
June 6	14	6	4.7	no snow remaining	color 30
June 30	1	0	not sampled		alkalinity -0.60

<sup>1</sup>Conductivity (umhos/cm), total visual color (Pt.-co.), and alkalinity (mg/L) were measured by the Biomonitoring and Aquatic Studies Unit, Vermont Agency of Natural Resources, Department of Environmental Conservation.

<sup>2</sup>*Rana sylvatica* egg masses were found in a new dam immediately downstream of the old one.

<sup>3</sup>pH measurements from Vermont DEC

Table 6. A comparison of egg mass and pH data from 1992-1994 on Mt. Mansfield.

Site	Ambystoma maculatum			Rana sylvatica			Range of mean pH		
	1992	1993	1994	1992	1993	1994	1992	1993	1994
West Bank, Harvey Brook	7	9	1	0	0	0	----	6.9	----
Vernal Pool below PMRC	18	12	38	36	36	72	----	4.3-5.1	4.6-5.1
Sugar Shack Pond at PMRC	3	6	6	----	82	150	4.4	4.8-6.2	5.2-5.6
Lake of the Clouds	2	12	14	22	46	6	4.6	4.9-5.0	4.7-4.9

Table 7. Summary of population changes of selected species, between the 1993 and 1994 field seasons as suggested by three indicators at Mt. Mansfield, Vermont. Species shown are only those species whose index changed by 1.0 or greater by any one method.

Species	Drift fences	NTRS choruses	NTRS individuals
<b>Caudates (salamanders)</b>			
<i>P. cinereus</i>	up 3.0	n/a	n/a
<i>N. viridescens</i>	down 0.1	n/a	down 2.2
<b>Anurans (Frogs and Toads)</b>			
<i>B. americanus</i>	down 0.1	up 0.2	up 3.4
<i>P. crucifer</i>	down 0.6	down 0.8	up 3.1
<i>R. sylvatica</i>	down 3.9	up 1.8 <sup>1</sup>	down 4.8

<sup>1</sup>Egg mass counts of *R. sylvatica* at the same elevation as the night time road searches showed a mean increase of 91%, N = 2.