

## AMPHIBIAN MONITORING ON MOUNT MANSFIELD

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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 1993 include (1) the beginning of active searches at two new sites (Nebraska Notch and the orchard above the Proctor Maple Research Center), (2) the wood frog (*Rana sylvatica*) appears to have increased in the area and bred successfully at ponds that did not dry up early, (3) the spotted salamander (*Ambystoma maculatum*) appears to have increased in the area but reproduction was still not successful at breeding pools, (4) the pH of breeding pools increased over last year, (6) we began to measure the intensity of chorusing at frog breeding sites and make morphological measurements of individuals caught in drift fences and on roads, and (7) we have begun the development of a new set of maps for dissemination of species distribution and abundance data. Monitoring efforts have not yet gone on long enough to make any conclusive statements about population trends, but over the past three years there have been apparent increases in the spotted salamander and wood frog, an apparent decline in the redback salamander (*Plethodon cinereus*), and conflicting information on the red-spotted newt (*Notophthalmus viridescens*) and the spring peeper (*Pseudacris crucifer*). We have also begun long-term monitoring of amphibians at Abbey Pond and the Lye Brook Wilderness Area in the Green Mountain National Forest, which will offer is a regional context for our data from Mt. Mansfield.

## 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 1993 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:

Three techniques are 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 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 1993, 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, the Lake of the Clouds, and Bear Pond.

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.

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 (Table 1, Figure 4). Six of these 13 were 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 were 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 was occasionally observed, but only below 2200 feet. The occurrence of the bullfrog was confirmed by a record at the same site it was

heard at in 1991. However, these two observations may be of different individuals that were separately introduced into the area.

We have only three years of data on these species (1991-93). It is too soon to draw any conclusions on trends in their demography; however, the following summarizes what we have observed to date (Table 2-7).

**Spring peepers:** commonly observed during both night-time road surveys and surveys of breeding choruses. They are by far the most common species observed on the roads and had 15 times the number of choruses (78) than any other species. Data from drift fences and choruses suggest an increase from previous years, but data from night-time road surveys suggest a decline.

**Gray treefrogs:** observed only twice during searches, but this is expected due to their secretive behavior. Four choruses were noted. Populations are probably too small to assess trends without many more years of data.

**Redback salamanders:** commonly found in drift fences. There was a possible decline in 1993 from previous years 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:** Sixteen individuals were found in drift fences. Egg mass were located in all of the pools and the Lake of the Clouds. A large number of egg mass was seen in one vernal pool, but we don't know if any of them successfully hatched. Reproduction failed at the other sites. Measurements of pH in these ponds indicate that most are very close to the lethal pH measured in other studies (4.0-4.5), suggesting a possible explanation for the low level of successful reproduction. (Of note is that two ponds showed an increase in pH from 1992.) The number of egg masses increased from 1992, suggesting an increase in the number of breeding adults. This corresponds to increases seen in their numbers at drift fences and on night-time road surveys.

**Wood frogs:** commonly observed on night-time road surveys, surveys for choruses, and in drift fences. Wood frogs successful bred in at least 2 of the 5 ponds studied. Their populations appear to have increased.

We have also completed the development of a new mapping protocol that we will use to summarize and disseminate all data (see Figure 5 for an example of a draft of this map for one species). We plan to have these maps available for all species with current data by Fall 1994.

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 focus exclusively on monitoring the populations to build a picture of long-term trends in their distributions and abundances. We especially plan to expand our efforts to monitor 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 that trends in the status of amphibian populations over regional scales can be determined.

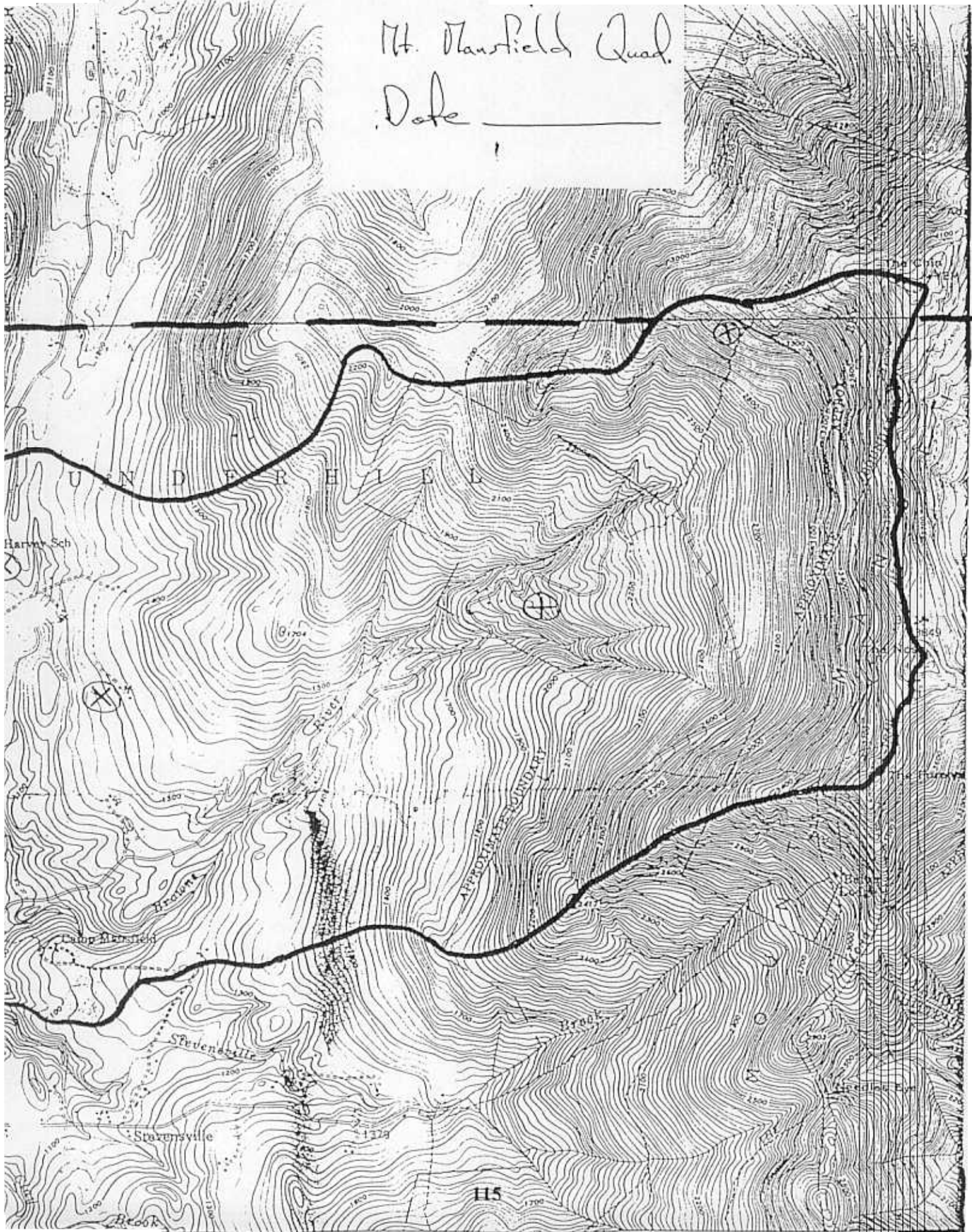
Acknowledgments:

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, and Christian Shawn Ohmland. We are extremely grateful for their interest in amphibians at Mt. Mansfield and all their hard work.

p. 1. Location of drift fences (

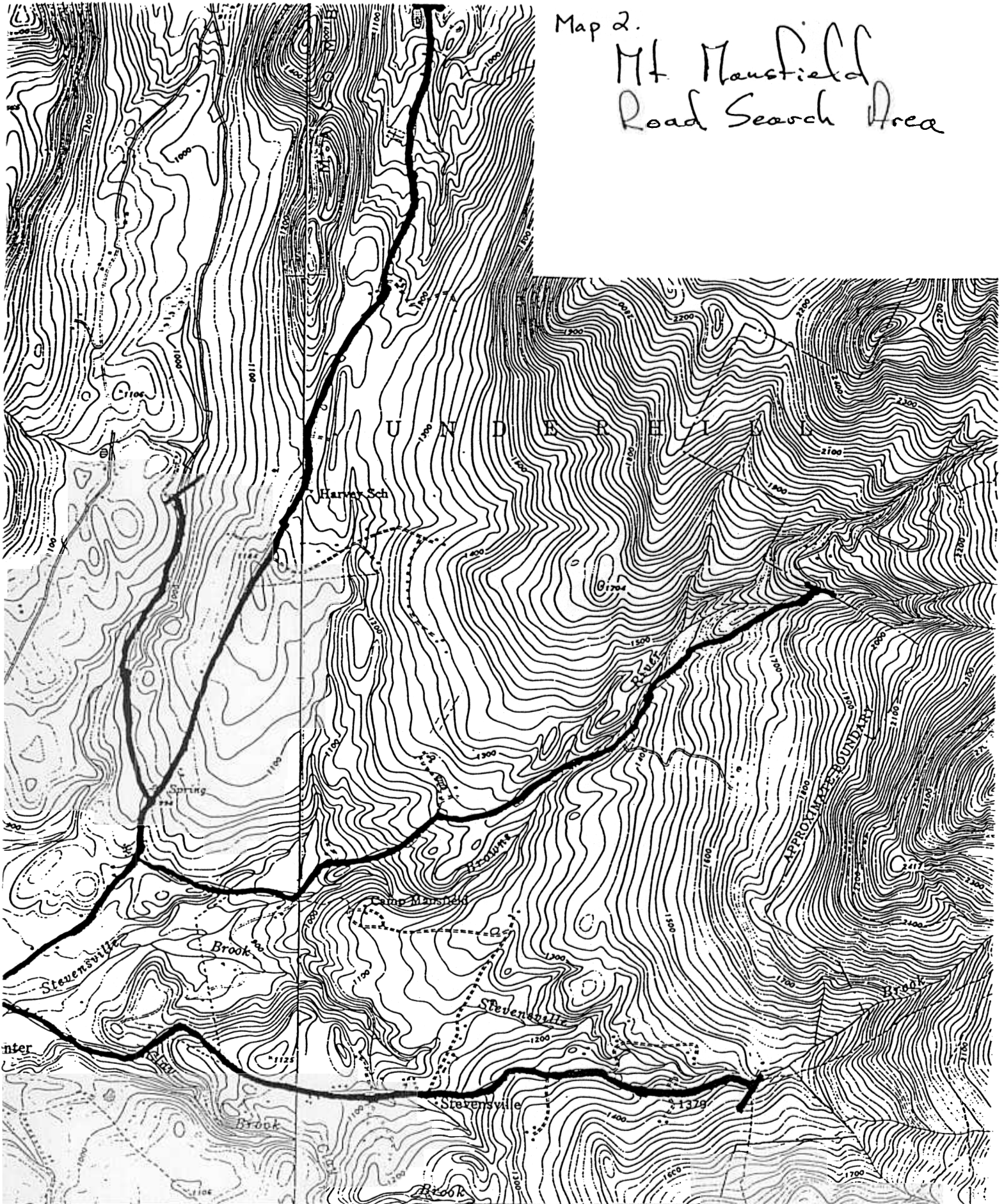
Mt. Mansfield Quad.

Date \_\_\_\_\_



Map 2.

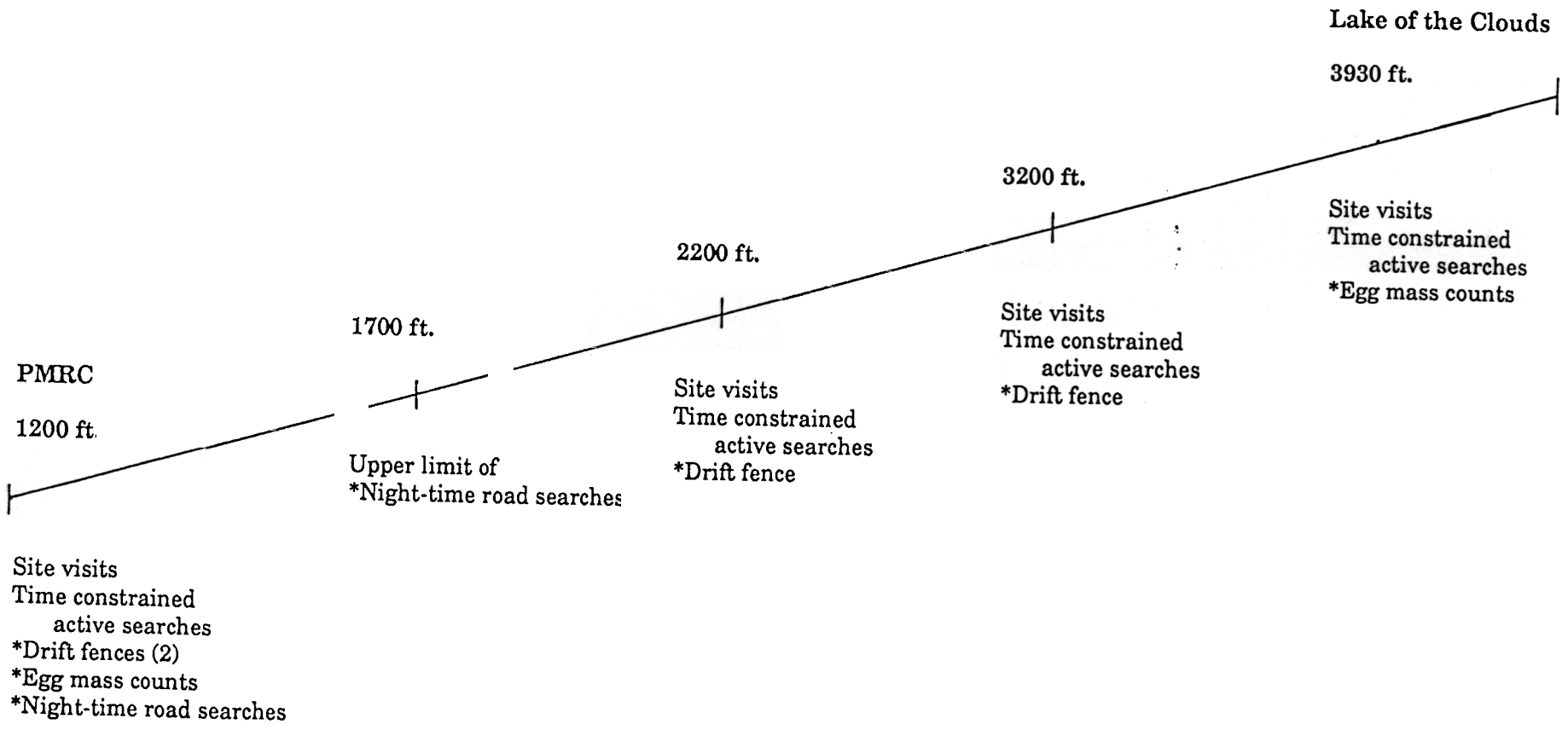
# Mt Mansfield Road Search Area



TERMINAL—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1990 4680000 E 72°52'30" 1670 410 000 FEET 1672 50'



Figure 3.  
Mt. Mansfield Inventory Methods by Elevation



\*method to be continued for long-term monitoring

**Table 1. Amphibians of Mt. Mansfield, Vermont, based on surveys from Spring 1991 to Fall 1993, relatively to the known amphibian fauna of Vermont.**

Species name	Common name	S <sup>a</sup>	C <sup>b</sup>
<u>Necturus maculosus</u>	Mudpuppy	U	
<u>Ambystoma jeffersonianum</u> complex	Jefferson salamander complex	U	
<u>Ambystoma laterale</u> complex	Blue-spotted salamander complex	U	
<u>Ambystoma maculatum</u>	Spotted salamander	K	LC
<u>Ambystoma opacum</u>	Marbled salamander	U	
<u>Notophthalmus viridescens</u>	Red-spotted newt	K	A
<u>Desmognathus fuscus</u>	Northern dusky salamander	K	LC
<u>Desmognathus ochrophaeus</u>	Mountain dusky salamander	U	
<u>Plethodon cinereus</u>	Redback salamander	K	A
	Slimy salamander	U	
<u>Hemidactylium scutatum</u>	Four-toed salamander	U	
<u>Gyrinophilus porphyriticus</u>	Northern spring salamander	K	LC
<u>Eurycea bislineata</u>	Northern two-lined salamander	K	LC
<u>Hyla versicolor</u>	Gray treefrog	K	A
<u>Pseudacris crucifer</u>	Northern spring peeper	K	A
<u>Pseudacris triseriata</u>	Western chorus frog	U	
<u>Rana catesbeiana</u>	Bullfrog	K	R
<u>Rana clamitans</u>	Green frog	K	LC
<u>Rana septentrionalis</u>	Mink frog	U	
<u>Rana sylvatica</u>	Wood frog	K	A
<u>Rana pipiens</u>	Northern leopard frog	U	
<u>Rana palustris</u>	Pickerel frog	K	O
<u>Bufo americanus</u>	Eastern American toad	K	A

<u>Bufo woodhousei</u>	Fowler's toad	U	
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**Key**

a: Status

- U = unlikely
- K = known
- S = suspected, based on published range maps

b: Commonality

- A = abundant, present in most appropriate habitats and observed on most visits
- LC = locally common, found regularly but in only a few areas
- O = occasional, found uncommonly
- R = observed only once or twice

Figure 4

Results of Mt. Mansfield Inventory 1991-1992  
(Data Combined from all Methods)

Lake of the Clouds

3930 ft.

3200 ft.

2200 ft.

PMRC

1200 ft.

*Ambystoma maculatum*  
*Bufo americanus*  
*Desmognathus fuscus*  
*Eurycea bislineata*  
*Gyrinophilus porphyriticus*  
*Hyla versicolor*  
*Notophthalmus viridescens*  
*Plethodon cinereus*  
*Pseudacris crucifer*  
*Rana catesbeiana*  
*Rana clamitans*  
*Rana sylvatica*  
*Rana palustris*

*Eurycea bislineata*  
*Gyrinophilus porphyriticus*  
*Plethodon cinereus*  
*Bufo americanus*  
*Notophthalmus viridescens*  
*Rana sylvatica*

**Found at 1200 ft. but not located  
at this elevation.**

{  
*A. maculatum*  
*D. fuscus*  
*H. versicolor*  
*P. crucifer*  
*R. catesbeiana*  
*R. clamitans*

*Notophthalmus viridescens*  
*Plethodon cinereus*  
*Rana sylvatica*

{  
*A. maculatum*  
*B. americanus*  
*D. fuscus*  
*E. bislineata*  
*G. porphyriticus*  
*H. versicolor*  
*P. crucifer*  
*R. catesbeiana*  
*R. clamitans*  
*R. sylvatica*  
*R. palustris*

*Eurycea bislineata*  
*Notophthalmus viridescens*  
*Ambystoma maculatum*  
*Rana sylvatica*  
*Bufo americanus*

{  
*D. fuscus*  
*G. porphyriticus*  
*H. versicolor*  
*P. cinereus*  
*P. crucifer*  
*R. catesbeiana*  
*R. clamitans*  
*R. sylvatica*  
*R. palustris*

13 species located and confirmed

Table 2

**A Comparison of Drift Fence Data for Mt. Mansfield, Vermont, Based on Surveys  
During the 1991-1993 Field Seasons, Using Balanced\* Data.**

Species name	Common name	# of ind.		# per trapping*		% of total catch	
		91-2	93	91-2	93	91-2	93
<u>Ambystoma maculatum</u>	Spotted salamander	2	16	.4	1.6	4	12
<u>Desmognathus fuscus</u>	Northern dusky salamander	4	3	.8	.3	9	2
<u>Eurycea bislineata</u>	Northern two-lined salamander	4	4	.8	.4	9	3
<u>Gyrinophilus porphyriticus</u>	Spring Salamander	0	1	0	.1	0	1
<u>Notophthalmus viridescens</u>	Red-spotted newt	11	8	2.2	.8	24	6
<u>Plethodon cinereus</u>	Redback salamander	11	9	2.2	.9	24	7
<u>Bufo americanus</u>	Eastern American toad	2	9	.4	.9	4	7
<u>Pseudacris crucifer</u>	Northern spring peeper	1	24	.2	2.4	2	18
<u>Rana clamitans</u>	Green frog	1	0	.2	0	2	0
<u>Rana palustris</u>	Pickerel frog	1	0	.2	0	2	0
<u>Rana sylvatica</u>	Wood frog	9	60	1.8	6.0	20	4.5
<b>Totals</b>		<b>46</b>	<b>134</b>	<b>9.2</b>	<b>13.4</b>	<b>100</b>	<b>101</b>

\*1993 data included trappings during times of the year that were not sampled during 1991-91. These data were not used in this comparison. In addition some data sets from 1993 were not used in order to balance the distribution of data sets at different times of the year. Trappings not included in this comparison are; 5/16, 5/29, 8/11, 8/21, 9/1, 9/28, 10/13 and 10/21.

\*\*Number per trapping are rounded to the nearest .1. All other figures are rounded to the nearest whole number.

Total trappings used for this comparison from 1991-1992 = 5 out of 5.  
Total trappings used for this comparison from 1993 = 10 out of 15.

Trappings counted are those nights or adjacent nights combined where at least 2 of the three lower traps were opened under appropriate weather conditions for amphibian movement.



Table 3

**Total Choruses Surveyed During Night-time Road Searches in the 1993 Field Season**

Species name	Common name	# of total choruses		size of choruses		# per NTRS **		% of total choruses	
		91-2	93	91-2	93	91-2	93	91-2	93
<u>Hyla versicolor</u>	Gray tree frog	4	4	*	O L-3 M-1 H	.7	.4	6	5
<u>Pseudacris crucifer</u>	Northern spring peeper	50	78	*	O-5 L-17 M-53 H-3	8.3	7	81	90
<u>Rana sylvatica</u>	Wood frog	8	5	*	O L M-5 H	1.3	.5	13	6
<b>Totals</b>		<b>62</b>	<b>87</b>	<b>*</b>	O-5 L-20 M-59 H-3	<b>10.3</b>	<b>7.9</b>	<b>100</b>	<b>101</b>

Total night-time road searches during 1991-1992 field seasons = 6

Total night-time road searches during 1993 field season = 11

\*not differentiated in 1991-92

\*Number per NTRS are rounded to the nearest .1. All other figures are rounded to the nearest whole number.

Table 4

**A Comparison of Night-time Road Search Data for Mt. Mansfield, Vermont,  
Based on Balanced Surveys**

**During the 1991-1993 Field Seasons.**

During the 1993 field season a greater number of NTR searches were performed than during the two previous seasons combined. Of more importance is the fact that some of the searches were performed during times of the year which were not sampled during the first two years. This would have the effect of altering the species percentages toward the later breeding and mid-summer species. To fairly compare these two data sets we only include data from April and May of each year.

**Individuals**

Species name	Common name	# of ind.		# per NTRS **		% of total count	
		91-2	93	91-2	93	91-2	93
<u>Ambystoma maculatum</u>	Spotted salamander	0	6	0	1.5	0	4
<u>Gyrinophilus porphyriticus</u>	Spring salamander	1	0	.2	0	1	0
<u>Notophthalmus viridescens</u>	Red-spotted newt	2	23	.4	4.6	2	15
<u>Bufo americanus</u>	Eastern American toad	14	16	2.8	3.2	11.0	11
<u>Hyla versicolor</u>	Gray treefrog	0	2	0	.5	0	1
<u>Pseudacris crucifer</u>	Northern spring peeper	93	43	18.6	8.6	73	29
<u>Rana catesbeiana</u>	Bullfrog	1	0	.2	0	1	0
<u>Rana clamitans</u>	Green frog	2	5	.4	1	2	3
<u>Rana palustris</u>	Pickerel frog	0	3	0	.6	0	2
<u>Rana sylvatica</u>	Wood frog	14	53	2.8	10.6	11	35
<b>Totals</b>		<b>127</b>	<b>151</b>	<b>25.4</b>	<b>30.2</b>	<b>101</b>	<b>100</b>

Number of night-time road searches used for this comparison from the 1991-1992 field seasons = 5 out of 6.

Number of night-time road searches used for this comparison from the 1993 field season = 4 out of 11.

\*\*Number per NTRS are rounded to the nearest .1 All other figures are rounded to the nearest whole number.

Table 5

## 1993 Egg mass Data from Mt. Mansfield

Site No.	Location/Date	# of A. mac. egg masses	mean # of eggs	# of R. syl. egg masses	mean # of eggs	mean pH
1	Bear Pond					
	5/18	26	140	20		6.9±.2
2	West bank of Harvey Brook					
	4/26	8		0		
	5/6	9		0		6.2±.3 (6.1 in mass)
	5/25	4	28±3.3	0		
	6/9	1	50	0		
	7/7	0		0		
3	Vernal pool below PMRC					
	4/26	7	77±2.4	36	403±14.0	
	5/6	6		30		4.3±.5 (3.6 in mass)
	5/25	12	75±5.6	tadpoles		
	6/9	6	67±4.8	tadpoles		5.1±.7
	7/7	dried egg masses				dry
4	Pond behind sugar shack					
	4/26	0		82	400 (n=1)	
	5/6	6		tadpoles		4.8±.4
	5/25	3	42.3±5.9	tadpoles		
	6/9	0		tadpoles		6.2±.9
	7/7	0				almost dry
5	Lake of the Clouds					
	5/8	12	52.5±4.5	46	400 (n=1)	4.9±.6
	6/2	1	80	2	285±15	5.0±.2
	6/24	0		2	130±3.8	5.0±.5

Table 6

**A Comparison of 1992 & 1993 Egg mass Data from Mt. Mansfield**

Site	A. maculatum				R. sylvatica				pH	
	High # of egg masses		Mean # of eggs at peak		High # of egg masses		Mean # of eggs at peak		Range of mean pH	
	1992	1993	1992	1993	1992	1993	1992	1993	1992	1993
West Bank of Harvey Brook	7	9	51.3	28	0	0			?	6.9
Vernal pool Below the PMRC	18	12	?	75	36	36	?	403	?	4.3-5.1
Pond Behind the Sugar Shack at PMRC	3	6	69.3	42.3	hatched	82	?	400	4.4	4.8-6.2
Lake of the Clouds	2	12	55	52.5	22	46	415	400	4.58	4.9-5.0

Table 7

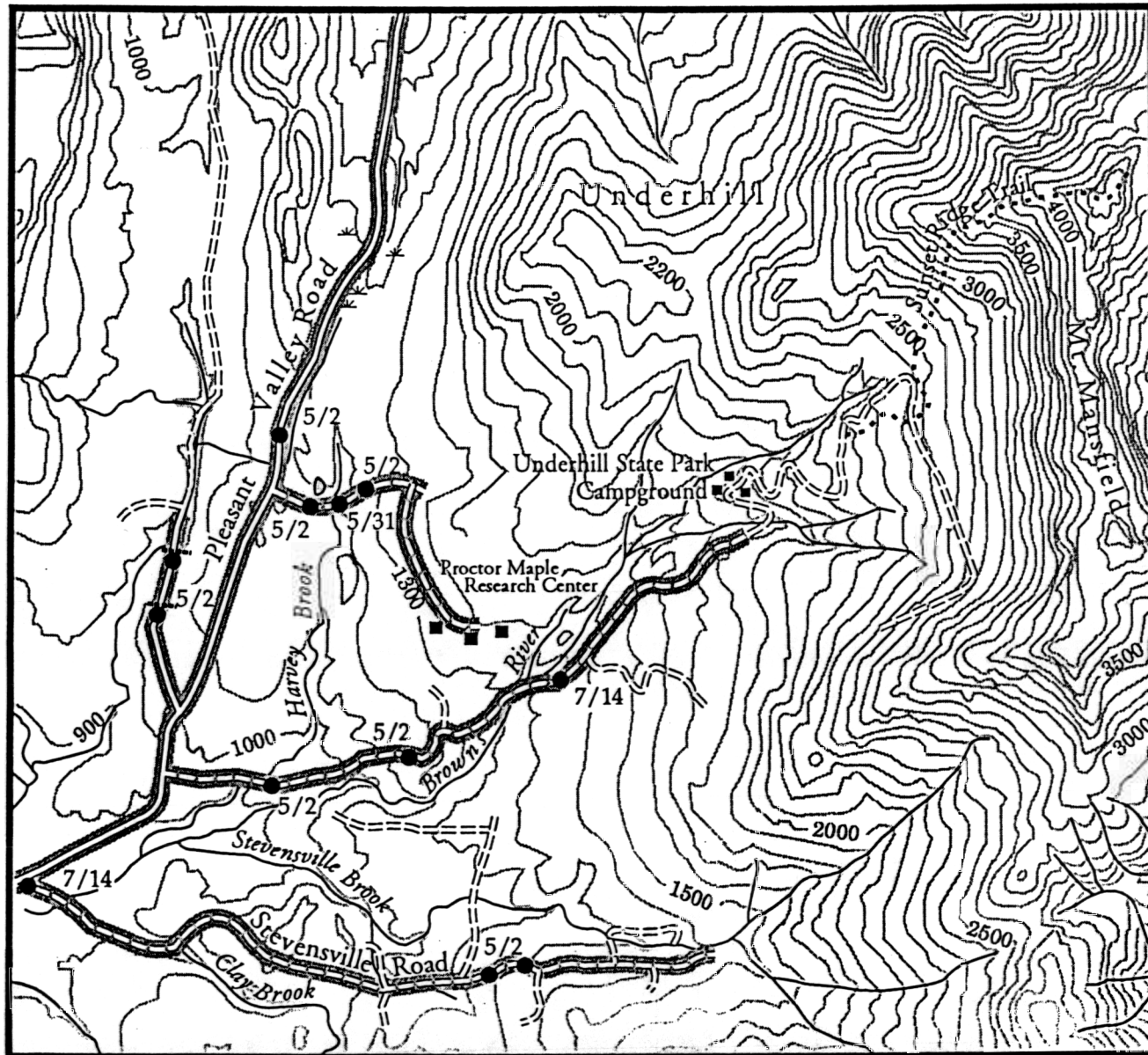
**Summary of Population Changes of Selected Species, Between the 1991-2 and 1993 Field Seasons as Suggested by Three Indicators at Mt. Mansfield Vermont**

Species shown are only those species whose index changed by 1.0 or greater by any one method. Only one species shows nonconflicting evidence of population growth by more than one index, and none show a decline. However, these results are too short term to suggest or discount any meaningful trends caused by anthropogenic causes. We suspect that the effects of natural environmental changes such as breeding conditions are likely to have a larger short term impact on populations. Natural population changes of these magnitudes have been shown to occur annually in some amphibian species. These results only suggest species to watch.

There were no significant, site wide population changes indicated through egg mass counts.

<b>Species</b>	<b>Drift Fence Indices Using Balanced Data in Individuals per trap-night</b>	<b>Night-time Road Search Indices Using Balanced Data in Individuals per NTRS</b>	<b>Night-time Road Search Indices Using Balanced Data in Choruses per NTRS</b>	<b>Thoughts</b>
<i>A. maculatum</i>	up 1.2	up 1.5	n/a	appears real
<i>N. viridescens</i>	down 1.4	up 4.2	n/a	go figure, artifact of search image?
<i>P. cinereus</i>	down 1.3	insufficient data	n/a	unfortunately very difficult to see on roads
<i>P. crucifer</i>	up 2.2	down 10.0	up 4.3	go figure
<i>R. sylvatica</i>	up 4.2	up 7.8	down .3	age class difference?, very sensitive to sampling times
<b>Totals for all species</b>	<b>up 4.2</b>	<b>up 5.8</b>	<b>up 3.1</b>	<b>appears real</b>

Figure 5



Bufo americanus

(American toad)

Results of Night-time Road Searches

conducted from

May 31, 1991 to July 14, 1992

Mount Mansfield Road Search

Underhill, Vermont

