

## **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, make them especially well suited as an indicator taxa of changes in environmental conditions in forest environments.

Highlights of our activities and results for 1995 include (1) no young redback salamanders were found in the drift fences at 1,200 and 2,200 feet, (2) few young spotted salamanders were found, (3) many young frogs and toads were found, and (4) patterns of abundance of all amphibians since 1993 appear to be stable or increasing, with the exceptions of redback salamanders and wood frogs, which appear to oscillate.

## 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 1995 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 from April to June 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. The number of egg masses provide an index of the abundance of adult females of each species. In 1995, 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.

## Results and Discussion

Inventory: We have so far identified 13 species of amphibians from this area, from a total possible of 24 species reported from Vermont, 21 of which show evidence of breeding in recent years. The list of species inventoried has not changed since 1992, and we are therefore confident that all species present have been identified from across the elevational range of the study area (Figure 3). Six of these 13 are generally common,

being observed or heard on almost all visits when suitable habitat is visited under appropriate conditions:

- 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.
- Northern spring peeper: heard calling regularly from ponds throughout the area, primarily below 2000 feet, but in small numbers as high as 3900 feet.
- Spotted salamander: adults found in drift fences at all elevations, on night-time road searches, and egg masses found in the spring in many of the ponds in the area.
- Northern two-lined salamander: drift fences and streams up to 3900 feet.
- Wood frog: located up to tree line where breeding ponds occur, including Lake of the Clouds at 3,900 feet.

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

- Gray treefrog: heard calling from ponds, primarily below 2000 feet.
- Eastern American toad: concentrated below 2200 feet, but also occasionally found at elevations near 4000 feet.
- Northern dusky salamander: found in streams and drift fences at all elevations up to 3,900 feet.
- Northern spring salamander: scattered in streams up to 2200 feet.
- Green frog: caught regularly at drift fences, mainly below 2000 feet.
- Pickerel frog: observed on roads and in drift fences up to about 2,200 feet.

The bullfrog is heard or seen only rarely at sites along Pleasant Valley Road near 1,200 feet.

Population trends: We have only five years of data on these species (1991-95). 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 five indicator species.

Spring peepers: commonly caught at drift fences (Tables 1 and 2) and seen or heard during night-time road searches (Tables 3 and 4). They are by far the most common species observed on the roads and had many times the number of choruses (107) of any other species. Data from drift fences and choruses suggest an increase from the previous year (after a decline in 1994), but many fewer young were observed in 1995 than of other anurans (Tables 1 and 7).

Gray treefrogs: not observed at all during night-time road searches in 1995 (Table 4). Twelve calling individuals were noted but no choruses (Table 3). Although the number of calling individuals represents an increase over 1994, it still represents a decline over the five years of study. Populations are probably too small to assess trends without many more years of data, but special attention should be given to this species.

Redback salamanders: commonly found in drift fences (Tables 1 and 2). There was a major decrease in 1995 from the previous year (Table 2), returning their numbers to 1993 levels. Of special note is the absence of any young in the drift fences (Table 1), foretelling possible declines in older age classes in the future.

Spotted salamanders: Twenty-five individuals were found in drift fences (Table 1). Egg masses were located in all of the pools and the Lake of the Clouds, with

possible successful hatching at the Proctor Maple Research Center and at the Lake of the Clouds (Table 5). The pH of the Lake of the Clouds (4.6-4.8; Table 6) continues to be close to the lethal pH for this species measured in other studies. The number of egg masses has shown a general increase from 1992 (Table 6).

Wood frogs: commonly observed on night-time road searches and in drift fences (Tables 1, 3, and 4). Wood frogs successfully bred in at least two of the four ponds studied, although the number of egg masses observed declined from the previous year (Tables 5 and 6). Their populations appear to have increased from their dramatic decline in 1994 (Table 2).

In general, results of our monitoring in 1995 indicated that:

- . Reproduction in redback salamanders was not successful that year;
2. With the exception of the spring peeper, reproduction in frogs and toads was general good, with 80% or more of the individuals caught in some species (e.g., American toad, pickerel frog, and green frog) being young of the year;
3. All species of salamanders except the redback salamander show population indices similar to previous years. The redback showed a decline from 1994, returning to its 1993 level.
4. All species of frogs and toads show population indices greater than in previous years. This increase is quite dramatic in the pickerel frog and spring peeper

### **Future plans**

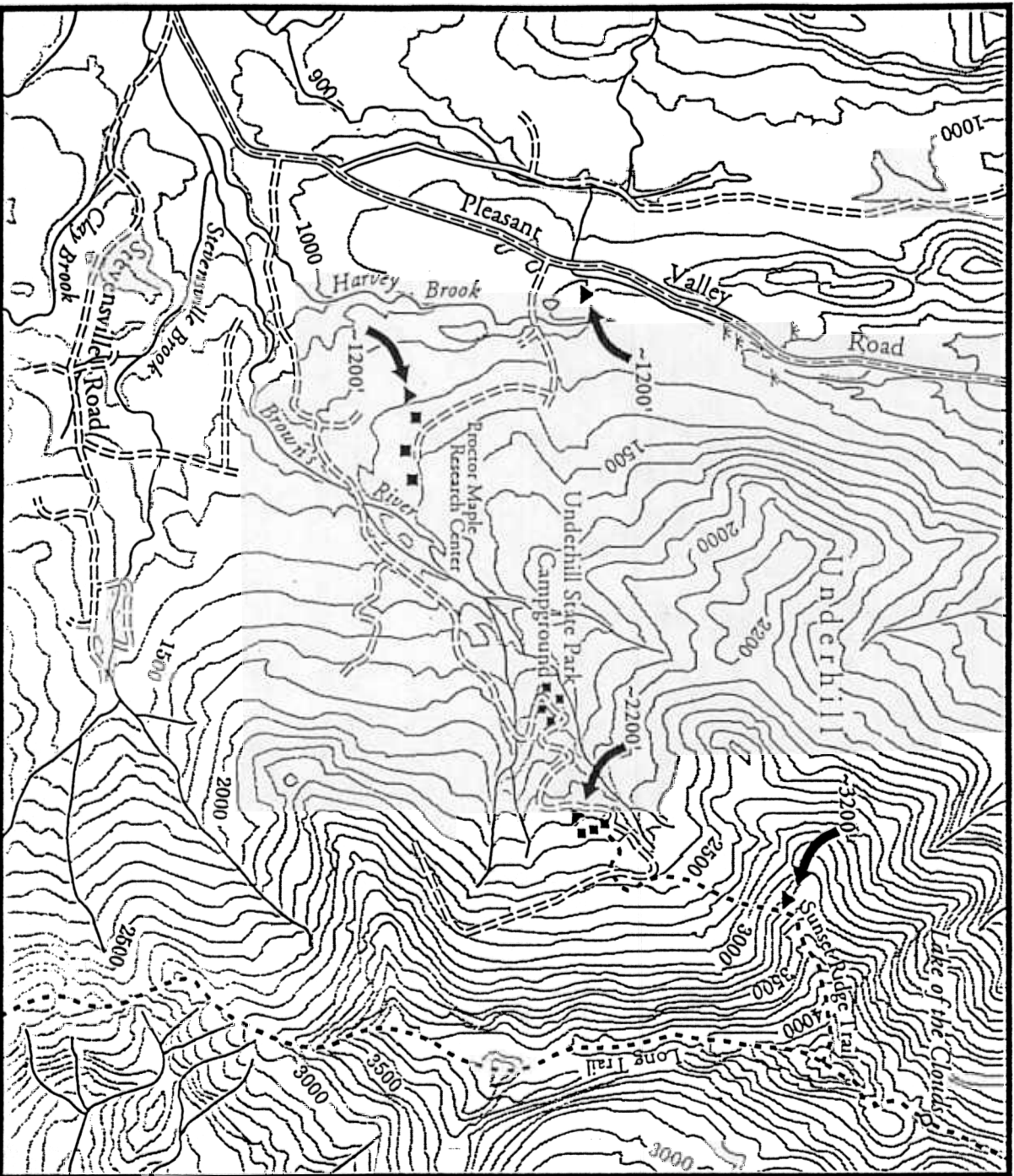
We plan to continue monitoring the amphibian populations throughout this area following the techniques we have employed so far. We feel confident that we have a complete survey of the species in the study area; therefore, our efforts continue to focus exclusively on monitoring the populations and breeding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

### **Context**

This work on Mount Mansfield is part of a large survey and monitoring effort we are conducting throughout the Green Mountains of Vermont. We have similar sites 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 locally coordinated by Elizabeth Chapek, with the help of Kathleen Ferguson, Theresa Hunt, Josh May, Suzanne Spear, and Kyle Walker. We are extremely grateful for their interest in amphibians at Mt. Mansfield and all their hard work.



Underhill State Park

Map of Underhill State Park

Underhill Valley



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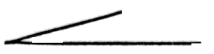


Figure 2. Night-time road search route; Part 1.

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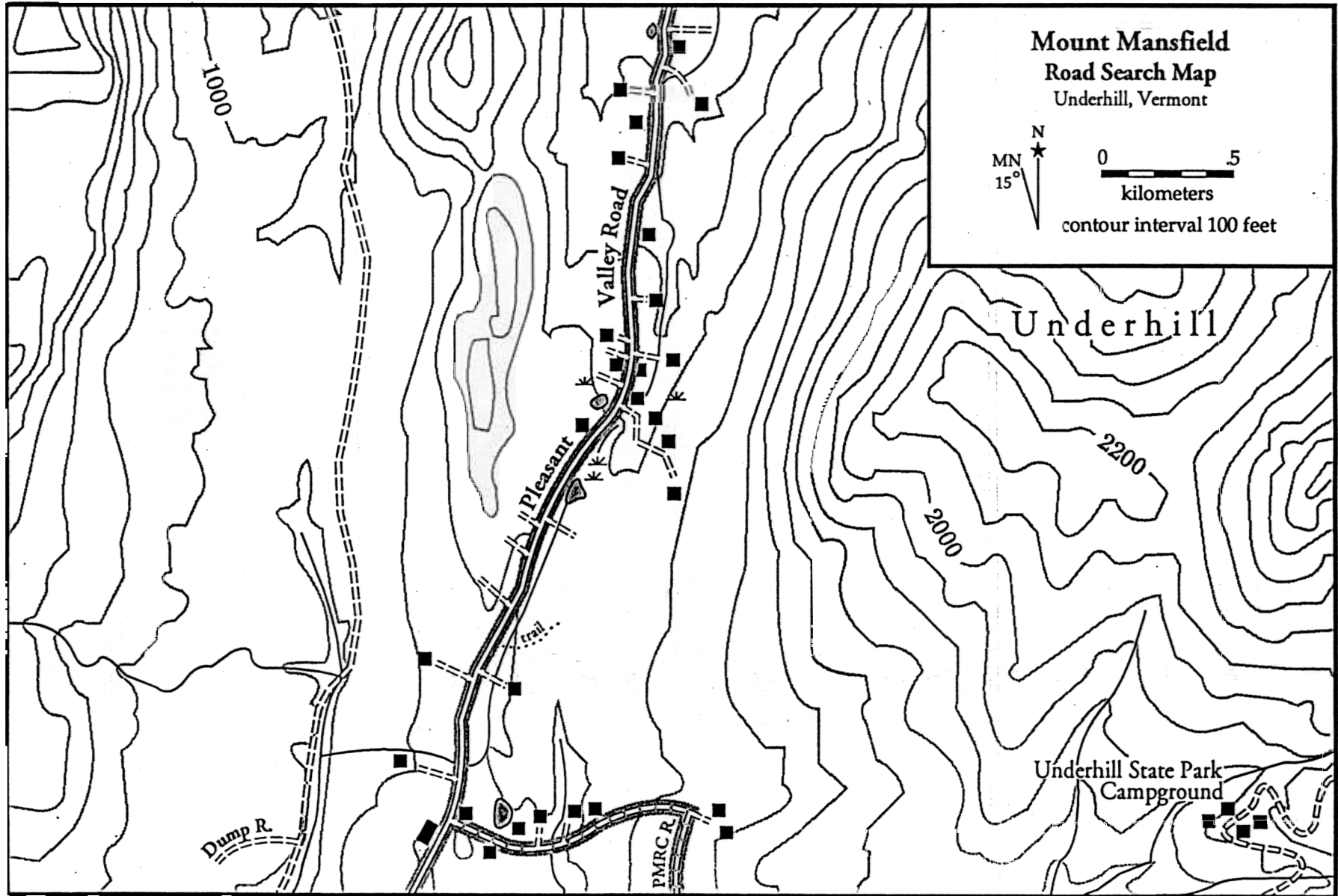
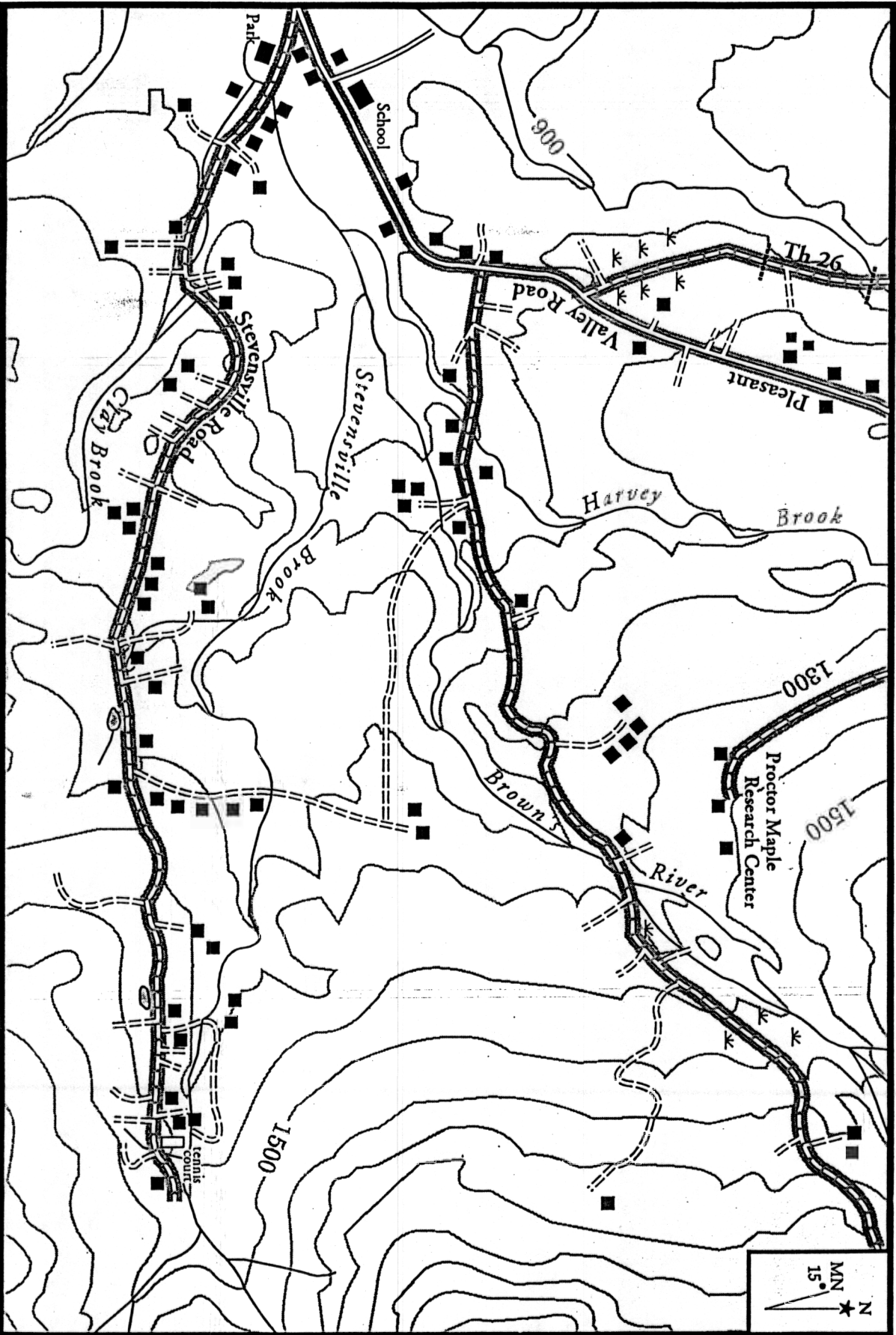


Figure 1. Night-time road section: Part



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Figure 3. Updated results based on new data gathered since the original 1991 and 1992 amphibian inventory of the western slope of Mt. Mansfield in Underhill and Cambridge Vermont. Thirteen species were located.

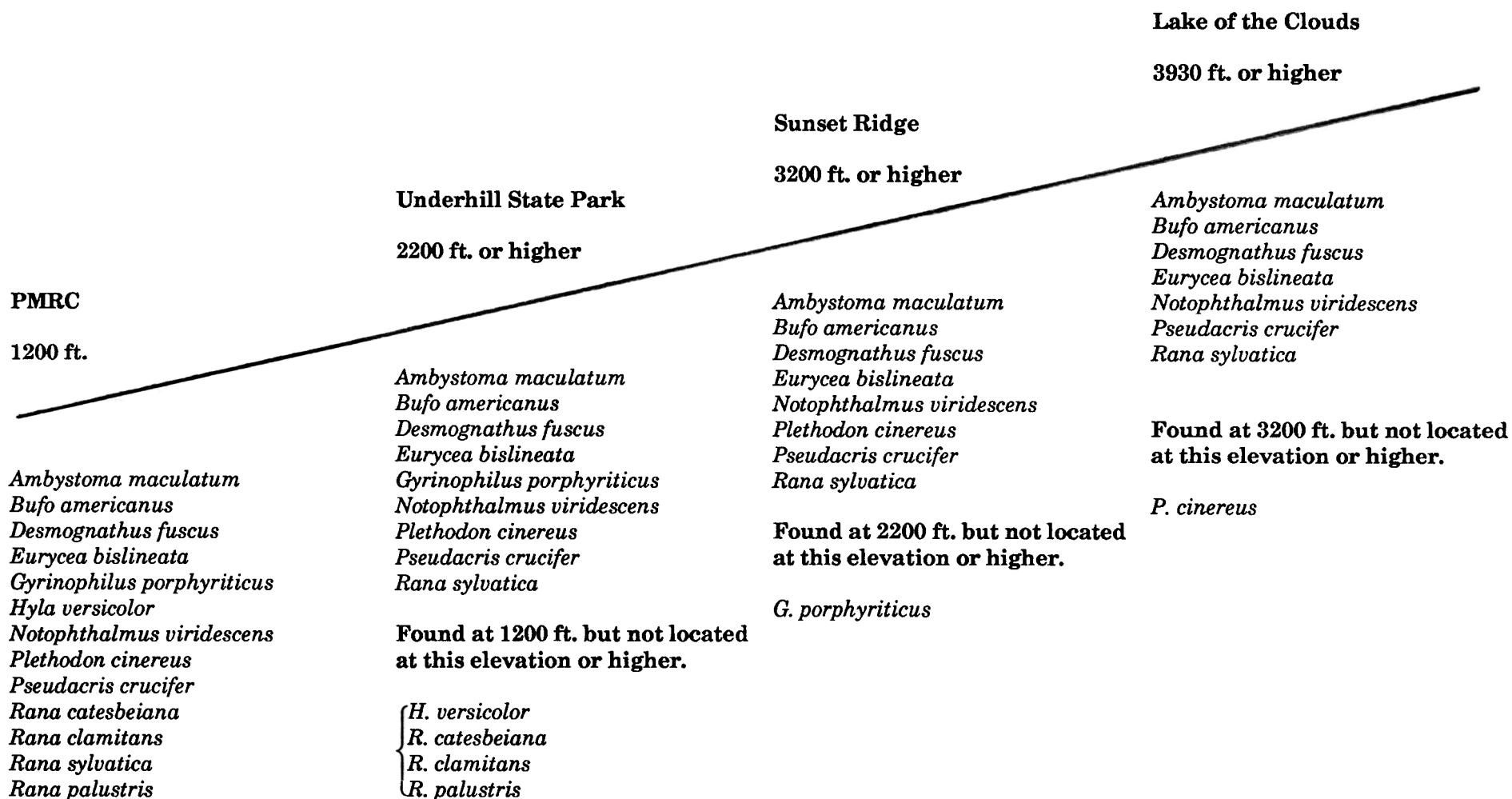




Table 1. Monitoring results from the drift-fences at 1,200 ft. and 2,200 ft. on Mt. Mansfield, Underhill, Vermont during 1995. Three trappings per month in April, May, June, July, September, and October are included (18 trappings).

Species name	# of all ages	# of young of the year	% young of the year <sup>1</sup>	date of first meta-morph <sup>2</sup>	largest adult (total length) in mm	# per trapping <sup>3</sup>	% of group	% of total catch
<b>Salamanders</b>								
Eastern newt	30	13	43	May 25	80	1.7	34	11
Spotted salamander	25	3	12	Sept. 14	204	1.4	28	9
Redback salamander	24	0	0	-----	92	1.3	27	9
Dusky salamander	6	0	0	-----	92	0.3	7	2
Northern two-lined	3	0	0	-----	88	0.2	3	1
Group totals	88	16	18	n/a	n/a	4.9	~100	32
<b>Frogs and Toads</b>								
Wood frog	79	31	39	Sept.6	62	4.4	43	29
Spring peeper	39	3	8	April 29	35	2.2	21	14
American toad	27	25	93	May 13	68	1.5	15	10
Pickerel frog	20	19	95	Sept. 6	50	1.1	11	7
Green frog	17	14	82	July 7	54	0.9	9	6
Group totals	182	92	51	n/a	n/a	10.1	~100	66
Amphibian totals	270	108	40	n/a	n/a	15.0	n/a	

<sup>1</sup>For each species individuals under a given total length were considered young of the year. The chosen length was based on the timing of their appearance, gaps in their size continuum and records in the literature. The cutoff sizes used were *A. maculatum* (70 mm), *E. bislineata* (60 mm), *N. viridescens* (45 mm), *P. cinereus* (32 mm), *B. americanus* (32 mm), *P. crucifer* (20 mm), *R. clamitans* (41 mm), *R. palustris* (30 mm), and *R. sylvatica* (33 mm). The maximum size of any year's young is not fixed. However, I have chosen to use these sizes for comparisons.

<sup>2</sup>No trapping took place in August.

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

Table 2. A comparison of drift-fence data from the 1993, 1994, and 1995 field seasons at Mt. Mansfield, Underhill, Vermont using all data from the 1,200 ft. and 2,200 ft. drift fences.

Species name	Common name	# per trapping <sup>1</sup>			% of group catch		
		93	94	95	93	94	95
<b>Caudates (Salamanders)</b>							
<i>Ambystoma maculatum</i>	Spotted salamander	1.7	1.0	1.4	12	10	9
<i>Desmognathus fuscus</i>	Dusky salamander	0.3	0.3	0.3	2	3	2
<i>Eurycea bislineata</i>	Northern two-lined salamander	0.5	0.1	0.2	4	1	1
<i>Gyrinophilus porphyriticus</i>	Spring salamander	< 0.1	0.0	0.0	< 1	0	0
<i>Notophthalmus viridescens</i>	Eastern newt	1.3	1.2	1.7	10	12	11
<i>Plethodon cinereus</i>	Redback salamander	<u>1.2</u>	<u>4.2</u>	<u>1.3</u>	<u>9</u>	<u>40</u>	<u>9</u>
Group totals		5.1	6.8	4.9	38	66	32
<b>Anurans (Frogs and Toads)</b>							
<i>Bufo americanus</i>	American toad	0.7	0.6	1.5	5	5	10
<i>Pseudacris crucifer</i>	Spring peeper	1.7	1.1	2.2	13	10	14
<i>Rana clamitans</i>	Green frog	< 0.1	0.2	0.9	< 1	2	6
<i>Rana palustris</i>	Pickerel frog	0.1	0.0	1.1	1	0	7
<i>Rana sylvatica</i>	Wood frog	<u>5.6</u>	<u>1.7</u>	<u>4.4</u>	<u>42</u>	<u>16</u>	<u>29</u>
Group totals		8.2	3.6	10.1	62	33	66
<b>Totals</b>		<b>13.4</b>	<b>10.4</b>	<b>15.0</b>	<b>~100</b>	<b>~100</b>	<b>~100</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, 14 in 1994, and 18 in 1995. Trappings counted are those nights where at least two of the three lower traps were opened under appropriate weather conditions for amphibian movement.

Table 3. A comparison of the number of choruses and calling anurans surveyed during night-time road searches from April through July in 1993, 1994, and 1995. Data from six searches in 1993, five searches in 1994, and seven searches in 1995 are included.

Species	# of total choruses <sup>1</sup>			size of choruses <sup>2</sup>			# per NTRS <sup>3</sup>			% of total choruses		
	1993	1994	1995	1993	1994	1995	1993	1994	1995	1993	1994	1995
<i>Bufo americanus</i> American toad	0	1	2	C-4 O-0 L-0 M-0 H-0	C-2 O-0 L-1 M-0 H-0	C-15 O-0 L-0 M-0 H-2	0.0	0.2	0.3	0	1	2
<i>Hyla versicolor</i> Gray tree frog	4	0	0	C-7 O-0 L-3 M-1 H-0	C-6 O-0 L-0 M-0 H-0	C-12 O-0 L-0 M-0 H-0	0.7	0.0	0.0	5	0	0
<i>Pseudacris crucifer</i> Spring peeper	73	56	107	C-38 O-5 L-27 M-37 H-4	C-15 O-6 L-12 M-33 H-5	C-12 O-2 L-17 M-49 H-39	12.0	11.2	15.3	89	80	86
<i>Rana catesbeiana</i> Bullfrog	0	0	0	C-0 O-0 L-0 M-0 H-0	C-0 O-0 L-0 M-0 H-0	C-7 O-0 L-0 M-0 H-0	0.0	0.0	0.0	0	0	0
<i>Rana clamitans</i> Green frog	0	0	0	C-3 O-0 L-0 M-0 H-0	C-2 O-0 L-0 M-0 H-0	C-12 O-0 L-0 M-0 H-0	0.0	0.0	0.0	0	0	0
<i>Rana sylvatica</i> Wood frog	5	13	16	C-0 O-0 L-5 M-0 H-0	C-6 O-2 L-7 M-4 H-0	C-12 O-4 L-1 M-6 H-5	0.8	2.6	2.3	5	19	13
Totals	82	70	125	C-52 O-5 L-35 M-38 H-4	C-31 O-8 L-20 M-37 H-5	C-70 O-6 L-18 M-55 H-46	13.6	14.0	17.9	100	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, Underhill, Vermont, based on surveys from April through June in 1993, 1994, and 1995. All calling anurans are excluded from this table. Six searches took place during this time period in 1993, five during 1994, and seven during 1995.

Species name	# of ind.			# per NTRS <sup>1</sup>			% of total		
	1993	1994	1995	1993	1994	1995	1993	1994	1995
<b>Caudates (salamanders)</b>									
<i>Ambystoma maculatum</i> Spotted salamander	6	3	19	1.0	0.6	2.7	4	2	8
<i>Desmognathus fuscus</i> Dusky salamander	0	0	1	0.0	0.0	0.1	0	0	<1
<i>Eurycea bislineata</i> N. two-lined salamander	0	0	1	0.0	0.0	0.1	0	0	<1
<i>Gyrinophilus porphyriticus</i> Spring salamander	0	1	1	0.0	0.2	0.1	0	1	<1
<i>Notophthalmus viridescens</i> Eastern newt	24	9	29	4.0	1.8	4.1	14	7	12
<i>Plethodon cinereus</i> Redback salamander	0	0	1	0.0	0.0	0.1	0	0	<1
Group total	30	13	52	5.0	2.6	7.4	18	9	21
<b>Anurans (frogs and toads)</b>									
<i>Bufo americanus</i> American toad	25	38	45	4.2	7.6	6.4	15	28	18
<i>Hyla versicolor</i> Gray treefrog	3	4	0	0.5	0.8	0.0	2	3	0
<i>Pseudacris crucifer</i> Spring peeper	44	52	96	7.3	10.4	13.7	26	38	39
<i>Rana catesbeiana</i> Bullfrog	1	0	2	0.2	0.0	0.3	1	0	1
<i>Rana clamitans</i> Green frog	5	3	11	0.8	0.6	1.6	3	2	4
<i>Rana palustris</i> Pickerel frog	3	2	5	0.5	0.4	0.7	2	1	2
<i>Rana sylvatica</i> Wood frog	60	26	34	10.0	5.2	4.9	35	19	14
Group total	141	125	193	23.5	25.0	27.6	82	91	79
Grand total	171	138	245	28.5	27.6	35.0	100	100	100

<sup>1</sup>Number per NTRS are rounded to the nearest 0.1. All other figures are rounded to the nearest whole number.

Table 5. Spring 1995 egg mass data from Mt. Mansfield, Underhill, 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
<b>West bank of Harvey Brook</b>				
April 13	0	0	-----	beaver dam
May 8	0	0	-----	broken and
June 7	not	checked	-----	deserted
<b>Vernal pool below PMRC</b>				
April 13	0	4	-----	<i>A. mac.</i> spermatophores, water level low
May 8	16	36 (some hatched)	5.2	
June 7	13 (on pool bottom)	0	-----	dry, some embryos still alive
June 25	0	0	-----	dry
<b>Pond behind sugar shack at PMRC</b>				
April 13	0	81	-----	some appeared to have been frozen, many nonviable
May 8	4	100 (1000's of tadpoles)	5.5 <sup>1</sup>	very shallow
June 7	2	6	5.0	
June 25	0	0	-----	almost entirely dry
<b>Lake of the Clouds<sup>2</sup></b>				
May 16	0	7	4.8	fresh beaver activity
June 7	32 (hatched)	20 (fresh)	4.7	
June 21	12 (many tadpoles)	2 (some hatched)	4.6	

<sup>1</sup>N=4

<sup>2</sup>Including the adjacent pool along the trail

Table 6. A comparison of egg mass and pH data from 1992-1995 on Mt. Mansfield.

Site	<i>Ambystoma maculatum</i>				<i>Rana sylvatica</i>				Range of mean pH			
	'92	'93	'94	'95	'92	'93	'94	'95	'92	'93	'94	'95
West Bank, Harvey Brook	7	9	1	0	0	0	0	0	----	6.9	----	----
Vernal Pool below PMRC	18	12	38	16	36	36	72	36	----	4.3-5.1	4.6-5.1	5.2
Sugar Shack Pond at PMRC	3	6	6	4	----	82	150	100	4.4	4.8-6.2	5.2-5.6	5.0-5.5
Lake of the Clouds	2	12	14	32	22	46	6	20	4.6	4.9-5.0	4.7-4.9	4.6-4.8
Combined totals <sup>1</sup>	30	39	59	52	58	164	228	156	4.4-4.6	4.3-6.2	4.6-5.6	4.6-5.5

<sup>1</sup>Not including pH data from Harvey Brook

Table 7. Species for which all indices indicated nonconflicting population trends between 1994 and 1995. Only those species whose populations were measured by more than one index are shown.

Species	Drift fences	NTRS choruses	NTRS individuals
<b>Caudates (salamanders)</b>			
<i>Notophthalmus viridescens</i> Eastern newt	up 0.5	n/a	up 2.3
<b>Anurans (Frogs and Toads)</b>			
<i>Pseudacris crucifer</i> Spring peeper	up 1.1	up 4.1	up 3.3
<i>Rana palustris</i> Pickerel frog	up 1.1	no change	up 0.3