

Amphibian Monitoring on Mt. Mansfield, Vermont 1993-2002

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Update

Background

Populations of amphibian species are monitored annually on Mount Mansfield using drift-fences. The goals of the monitoring are to (1) establish a baseline data set of abundance indices for the amphibian species caught in the fences, (2) monitor year-to-year changes in their abundance indices, (3) monitor changes in the number and type of obvious external abnormalities, (4) gather inventory data for the Vermont Herp Atlas, and (5) gather basic natural history information on the species present. Amphibians are targeted for this kind of study because their multiple habitat usage and permeable skin make them especially sensitive to changes in environmental conditions. Ten years of data have now been gathered at this site. This is the longest-running set of amphibian monitoring data in the state. Three fences are opened and checked up to five times per month during rain events throughout the field season (April through October excluding August). The abundance indices are generated using the three most successful trap-nights per month. For more detailed information on methods, locations of fences, and survey results, see the 1995 VForEM annual report.

Changes for 2002

Every year, mice, shrews, and voles die in the pitfall traps. Although our data show no decline in small mammal numbers, we would like to minimize these non-target mortalities. This year, in order to decrease the mortality of small mammals, and to address the concerns of the Institutional Animal Care and Use Committee (IACUC) at Middlebury College, we added fixed rough-cut 1" x 1" dowels to one of each pair of traps. Placing dowels in the pitfall trap creates an escape route for trapped mammals. The data show that the dowels did reduce small mammal mortality. Unfortunately, it also appears that the dowels allowed a percentage of the amphibians to escape. Our plan is to add dowels to all traps after three years of dowels in 1/2 the traps. This will allow us to determine the rate of amphibian escape from traps with dowels and come up with a conversion factor to compare old indices to new indices.

In 2001; at our other two monitoring sites, Lye Brook and Ward Marsh, we experimented with small round dowels that were freestanding. Contrary to what was reported in the 2001 report for Mt. Mansfield, dowels were not used during that field season at this site. These dowels did not prove successful in lowering the number of small mammals captured. Consequently, we moved to the larger dowels at all three sites.

Between April and October 2002, Mount Mansfield, VT received 53 inches of rain, slightly more than the average since 1955, of 43.6 inches/year. (Weather Data were provided by the Vermont Monitoring Cooperative with permission from Wesley Alan Wright, primary investigator for the Mount Mansfield Summit Meteorology project.)

Results of adding dowels to traps

In order to test the effectiveness of the dowels, one dowel was placed in one of each pair of traps, on alternate sides of the fence. The dowels were permanently attached to the inside of the can, through the funnel, with non-toxic silicon aquarium sealant. To allow for drying of the silicon sealant it was necessary to have a few days of dry weather to completely dry out the traps. This did not occur until after the first two trap-efforts, April 10th, and April 14th. In addition to the dowel, from May 10th through June 27 (four trap-efforts) a sponge was placed in the water of the trap. This, theoretically, allows a small mammal to have something to climb onto to escape drowning, before climbing out of the trap via the dowel. The use of dowels and sponges combined reduced amphibian captures by 58% and small mammal captures by a 78%, (Table 1). It is possible that the sponges were used as a launching pad for

the frogs and enabled a significant number to escape. For the final 10 trap events of the season only the dowels were used, resulting in a 23% decrease in the number of amphibians, and an 80% reduction of small mammal mortality. Removing the sponges made little difference in the small mammal mortality, but a significant difference in the amount of escaped amphibians.

Calculations based on changes as a result of the Dowels

There was a decrease in the number of amphibians caught, as a result of placing the dowels in half of the traps; therefore, the absolute values of 2002 data could not be compared to previous years' data. As dowels were in half the traps, the non-dowel trap results were doubled for all the calculations and results discussed below.

Changes in species composition

In 2002, a higher percentage of anurans (frogs and toads) was caught at the fences than last year; they continued to dominate at the fences, and comprised 86% of the total catch (Table 2). This varied from 2001, when they were 65% of the total catch. Green Frogs continued to show an increase in number caught per trapping and in percentage of the anuran population. This year there was a dramatic increase as the number caught per trapping went from 1.9 in 2001 to 22.1 in 2002. This was the second year that Green Frogs (77% of the anuran catch) surpassed Wood Frogs (16% of anuran catch). The lower overall percentage of Wood Frogs (from 59% of anurans to 16%) is due to the increase in the number of Green Frogs caught. Wood Frogs increased from 5.4 to 6.7 individuals caught per trapping. American Toads decreased from 17% to 4% of the anuran catch, this is also due to the greater number of Green Frogs, as their individual numbers per trapping increased from 1.6 to 1.9. Spring Peepers made up 2% of the anuran catch, up from last year's 0%, but still down from their high of 30% of the frog population in 1994. Only 2 Pickerel Frogs were caught this year. Pickerel Frog numbers have been fluctuating slightly over the last few years, but their numbers have always been very low.

Overall, a greater number of salamanders were caught per trapping in 2002, from 5.0 to 6.1. The percentage of Eastern Red-backed Salamanders showed a decrease from 36% to 26% of the salamander population, continuing its downward trend from 2000 when it was 48%. Although the Eastern Red-backed percentage has decreased, the numbers per trapping have stayed about the same (1.8 to 1.9). Spotted Salamanders went from 30% to 35% of the salamander catch showing a slight increase in numbers per trapping from 1.5 to 1.9. Eastern Newts remained constant at 26% of the salamander population, consistent with last year's results; although their trapping numbers also increased from 1.3 to 1.6. Dusky Salamanders showed a slight increase in percentage of the salamander population from 5% to 10%, while Northern Two-lined Salamanders stayed the same from 2001 to 2002 as 3% of the salamander population; although, their numbers per trapping increased from 0.1 to 0.3. The fences are not in appropriate habitat to accurately monitor the populations of these latter two species, so it is probable that these slight changes do not reflect changes in their population size.

Young of the year and abnormalities

The number of young of the year for 2002 was higher than in all the previous years. This was due to the large number of anuran young (95% of all young) specifically young Green Frogs (Table 3). Three hundred and forty young Green Frogs were caught accounting for 97% of all Green Frogs caught in 2002.

The percentage of young of the year in the salamander population was similarly high (28% of total salamander catch). The number of abnormalities continues to be low, with only one abnormal amphibian caught out of 526 (<0.1%). The numbers of abnormalities at this site, as well as our other two monitoring sites, have always been well below a level of concern. From 1998 through 2000 the total number of amphibians showing abnormalities from all captures were 5,3,2, and 0 individuals respectively. In 2002, the one abnormality was in a young Northern Two-lined Salamander. The salamander was completely missing its right eye, including the socket. This was most likely due to a developmental abnormality. A traumatic event would show scarring or perhaps an empty socket. The last reported abnormalities in 2000 were in a Dusky Salamander and a Spring Peeper.

Trends

Linear regressions most closely fit most of the data plots, so they were used to show potential trends in the abundance indices for all species caught from 1993-2002 (Figures 1-6). The data gathered suggest that three of the seven species abundant enough to monitor show an average increase over this ten year period: Green Frog, American Toad, and Wood Frog. The number of Green Frogs has increased since 1993 with a slight dip in 2001 (Figure 4). In 2002 there was a dramatic increase from 1.9 per trapping to 22.1, for a total of 350 Green Frogs captured. This species is showing the most dramatic and consistent trend of any species monitored in this study. All except one of the Green Frog records are from the fences at 1200 feet elevation (Research Center and Pleasant Valley Road). In 2000 the majority of Green Frog records came from the fence near the Research Center (60%), and the rest from the fence near Pleasant Valley Road. In 2001, although there were slightly fewer Green Frogs, 77% of them were found near the fence near the Research Station. In 2002 there were more Green Frogs found at that drift fence, increasing from 20 in 2001 to 55 in 2002. But, there was an even greater increase in Green Frogs near Pleasant Valley Road where they increased from 6 in 2001 to 294 in 2002. It is very possible that this increase is due to renewed beaver activity near these fences. The beavers rebuilt an old beaver dam, thereby reflooding the area. The Green Frog is a permanent-water breeder and needs to overwinter for one or two winters under the ice as a tadpole before metamorphosis. Increased water levels in the beaver ponds would allow them to overwinter successfully. At the three fences in the Lye Brook Wilderness Region in southern Vermont, Green Frogs appear to be holding relatively steady, with no obvious increase over the ten years of monitoring there.

The number of American Toads increased steadily until 1998 when they peaked at 3.6 caught per trapping (Figure 5). In 1999, 2000 and in 2001 they decreased with the lowest numbers found in 2001, 1.6 per trapping. In 2002 they again increased to 1.9 caught per trapping. Overall, even with the slight recent decline, using linear regression it appears their population is increasing slightly. In 2000 we reported that the Wood Frog was showing a slight decline; since that year, the number of Wood Frogs has increased and in 2002 the number per trapping was 6.7, almost at its peak of 7.0 in 1997 (Figure 6).

Although the numbers vary from year-to-year, the overall trend for Spring Peepers has been downward (Figure 6). This appears to be a local phenomenon. The numbers of Spring Peepers may be decreasing for much the same reason the Green Frogs are increasing. Beaver activity has changed the local breeding habitat and may have made it less suitable for the Spring Peepers. Warren Ellison, drift fence supervisor, reports that choruses of Spring Peepers are still very common in the area. This could indicate that either the downward trend of the Spring Peepers we show here is localized to the immediate area of the study site, or that a larger more widespread decline is not yet large enough to affect the perceived abundance of the species in the area. The steady decline of Spring Peepers has not been seen at the other two study sites.

Eastern Newts, Eastern Red-backed Salamanders, and Spotted Salamanders appear to be relatively stable, with some variation from year-to-year, but with no visible upward or downward trend (Figures 1 and 3). We catch so few Pickerel Frogs and Northern Two-lined Salamanders that it is difficult to observe any long-term trends for these species. Fewer than 1.0 Pickerel Frogs and Northern Two-lined Salamanders were caught per trapping (Figure 2 and 5). It appears that both populations are relatively stable, but the numbers of captures are so low, it is not possible to draw any meaningful conclusions.

Summary

Although always rare, the number of abnormalities continues to decrease from its high in 1998. This year at the fences, all of the seven amphibian species that can be reliably monitored were caught in higher numbers per trapping than last year. In 2001, power was re-evaluated for all species (see 2001 VforEM annual report). At that time, three species (American Toad, Green Frog, and Wood Frog) were increasing overall, and we had the statistical power to confidently report those trends. Those trends appear to be continuing this year. The downward trend for Spring Peepers continues, despite this year's slight increase in number caught per trapping.

Acknowledgments

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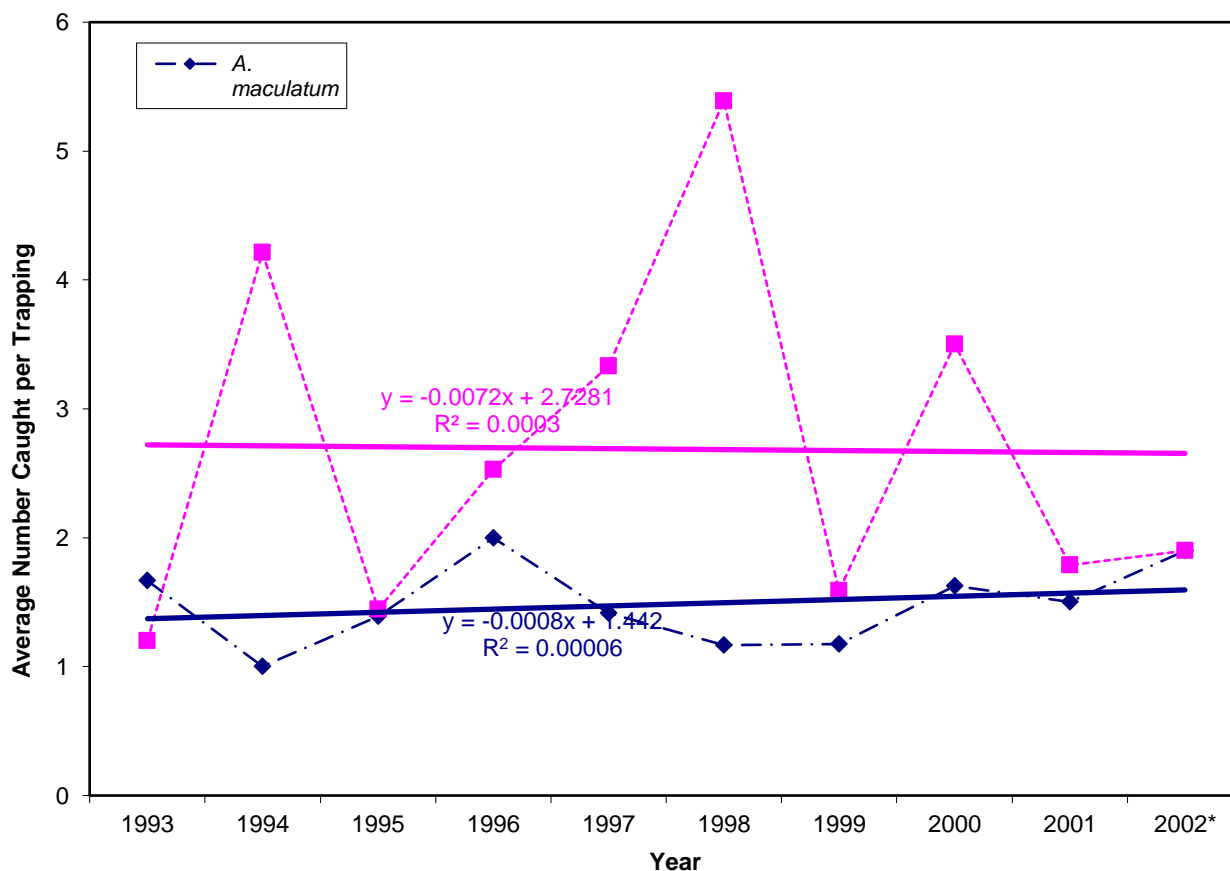


Figure 1. Spotted (*Ambystoma maculatum*) and Eastern Red-backed (*Plethodon cinereus*) Salamander population indices from Mt. Mansfield, Underhill, Vermont, 1993-2002.

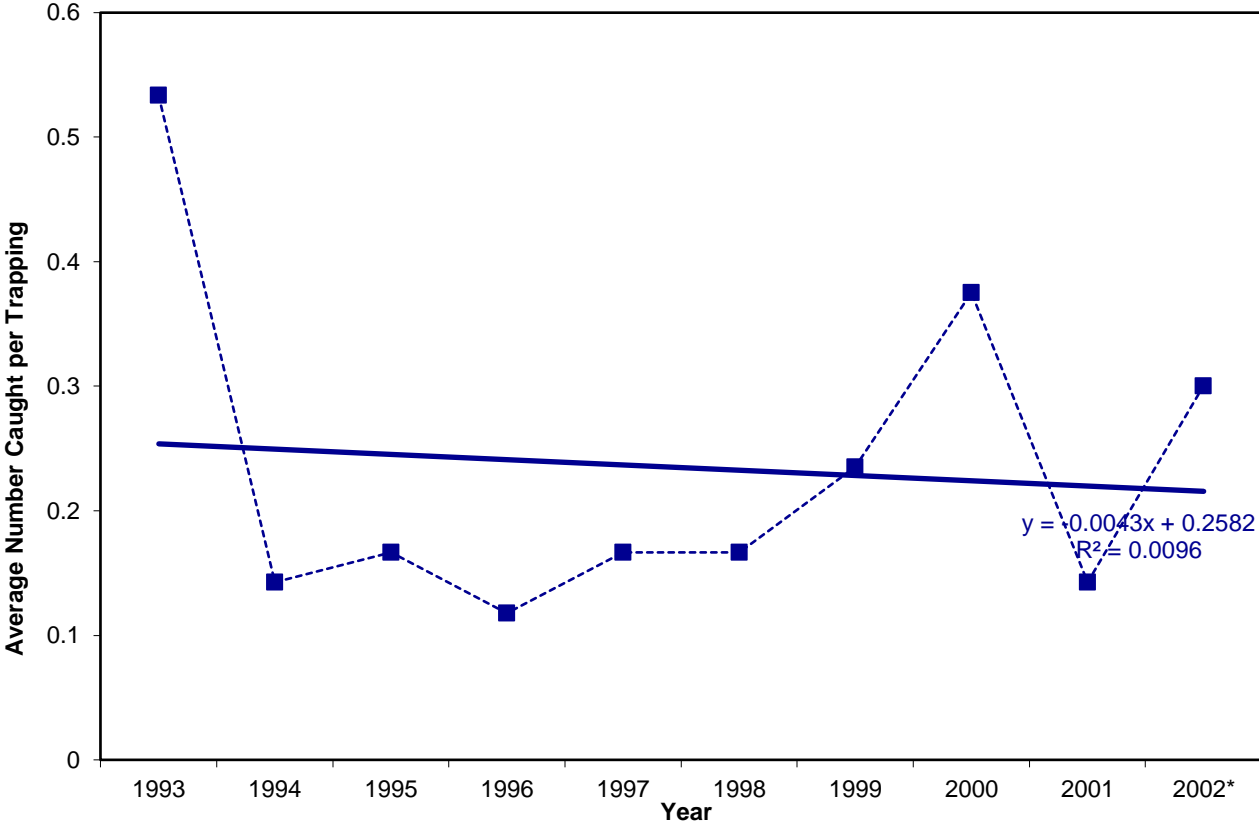


Figure 2. Northern Two-lined Salamander (*Eurycea bislineata*) population index from Mt. Mansfield, Underhill, Vermont, 1993-2002. For this species the numbers are too low to draw meaningful conclusions.

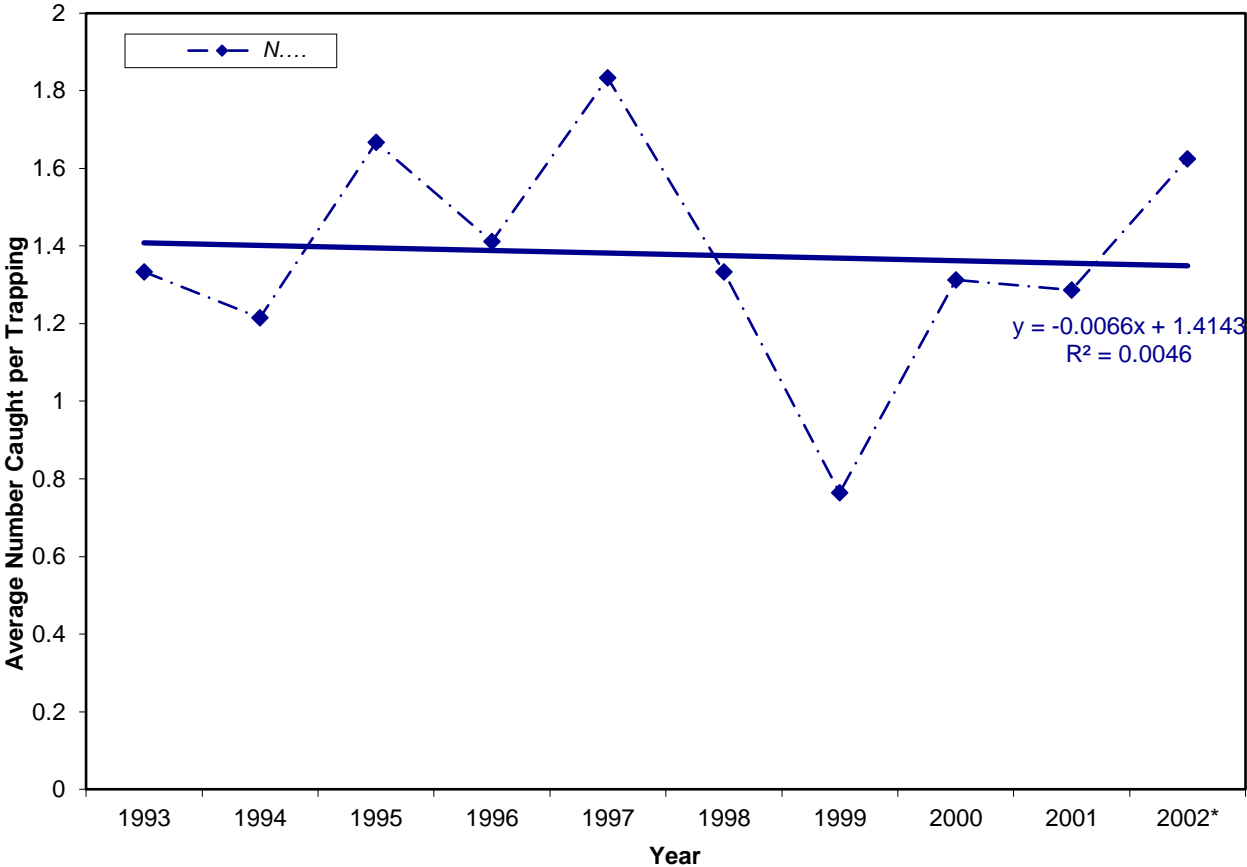


Figure 3. Eastern Newt (*Notophthalmus viridescens*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2002.

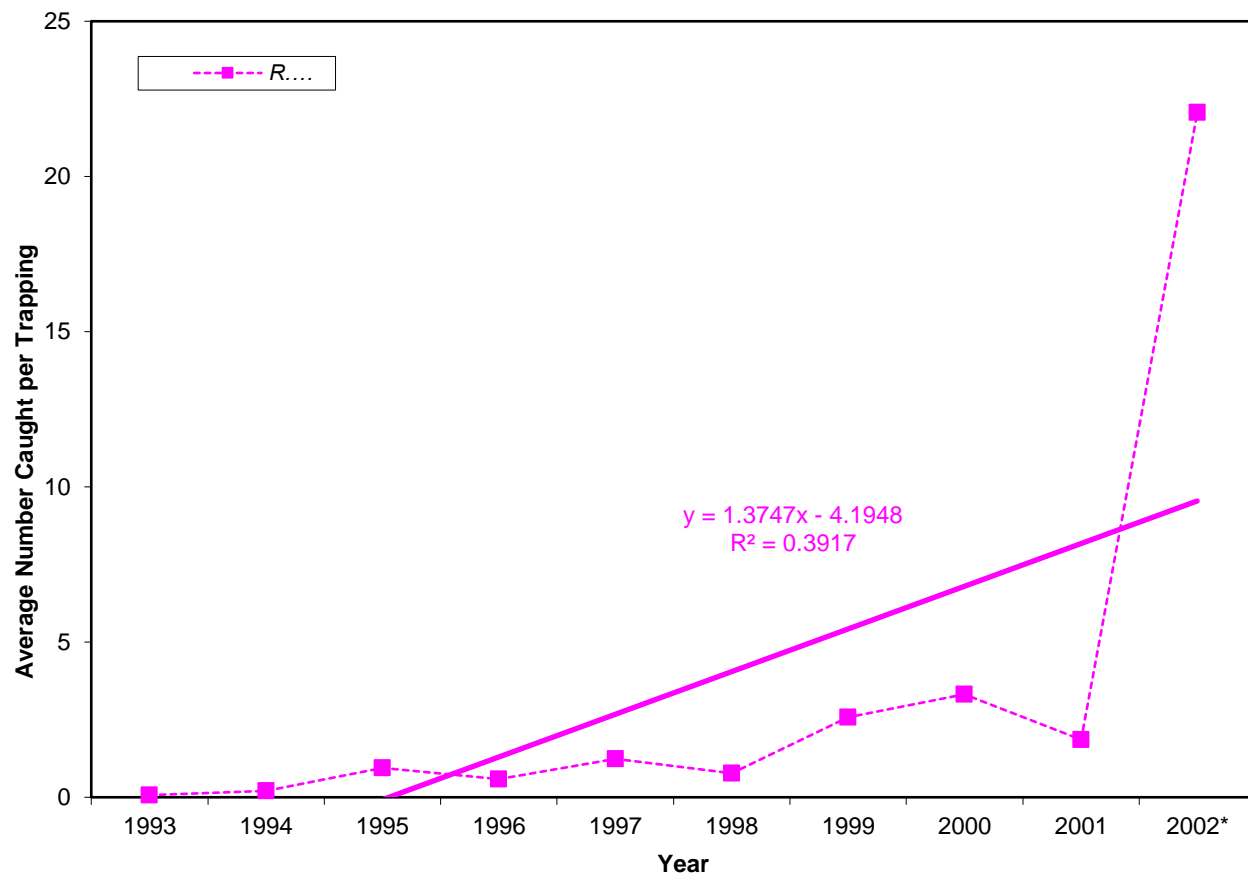


Figure 4. Green Frog (*Rana clamitans*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2002.

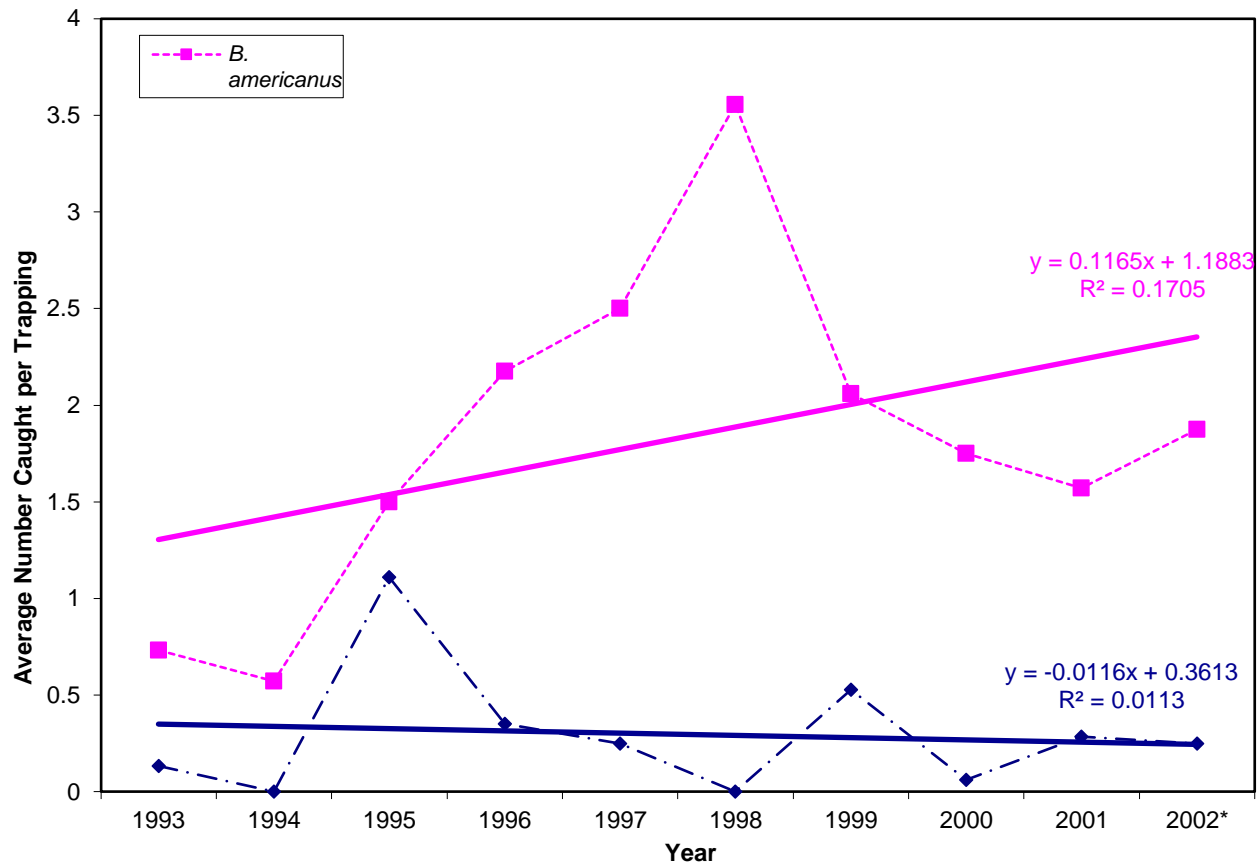


Figure 5. American Toad (*Bufo americanus*) and Pickerel Frog (*Rana palustris*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2002. The numbers for the Pickerel Frog are too low to draw any meaningful conclusions.

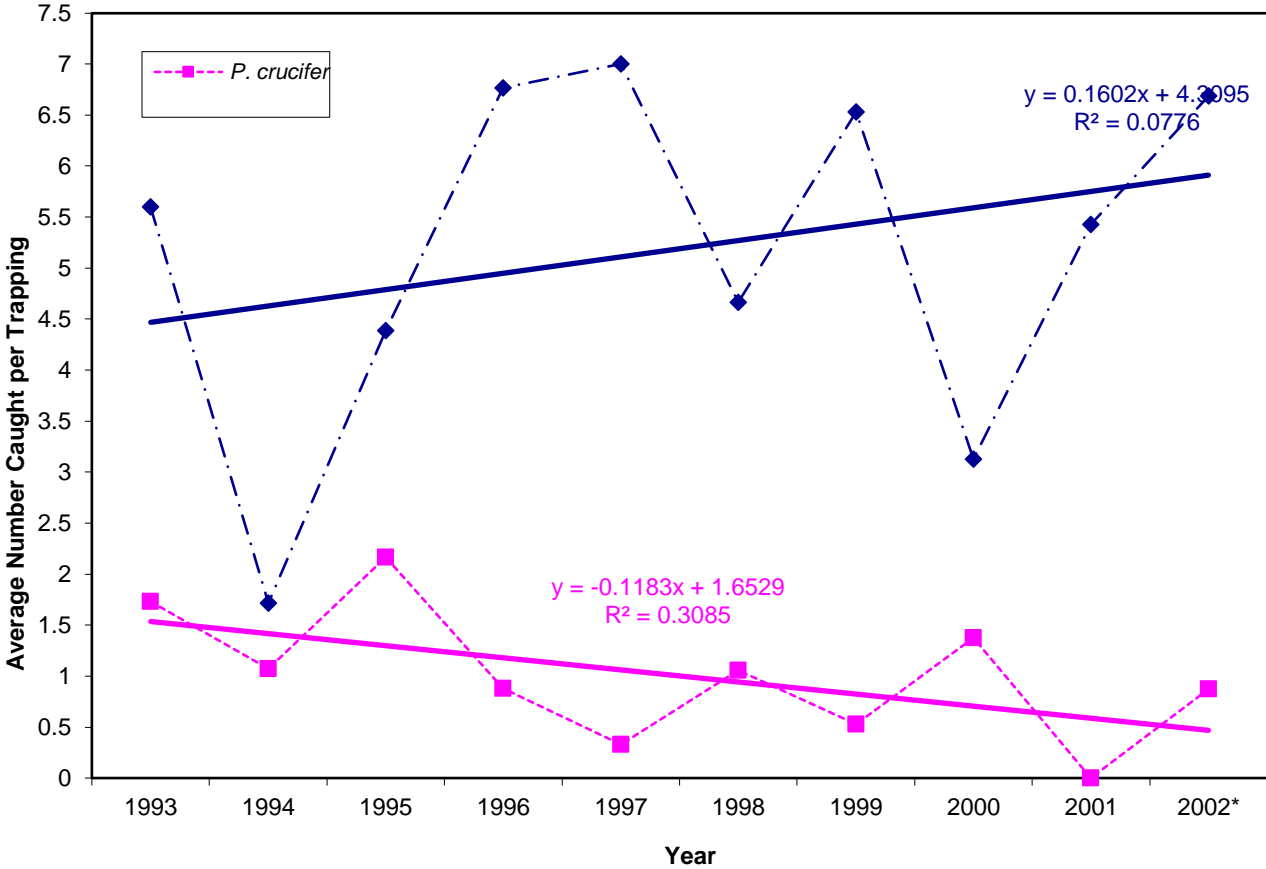


Figure 6. Wood Frog (*Rana sylvatica*) and Spring Peeper (*Pseudacris crucifer*) indices from Mt. Mansfield, Underhill, Vermont, 1993-2002.

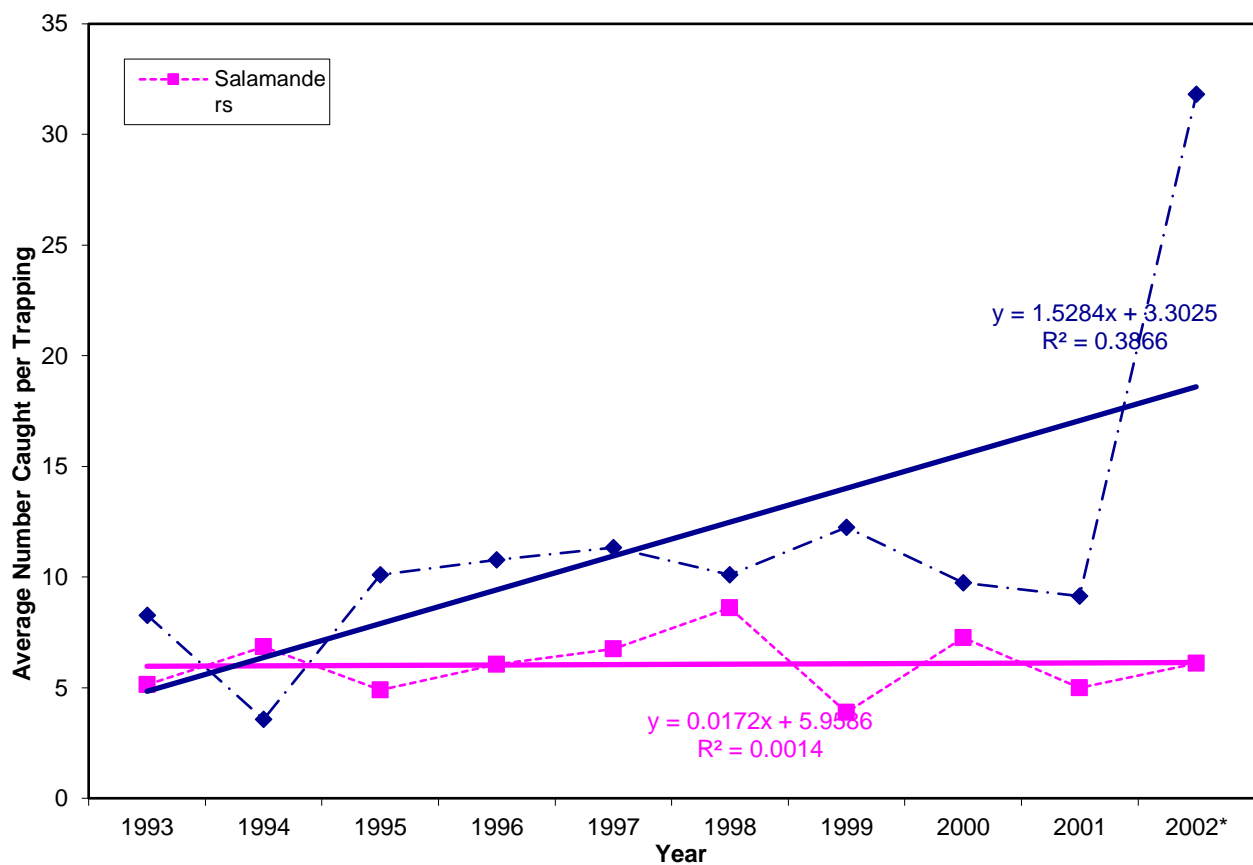


Figure 7. Salamander and frog population indices from Mt. Mansfield, Underhill, Vermont, 1993-2002. The increase in frogs in 2002 is due to the dramatic increase in Green Frogs caught per trapping, from 1.9 in 2001 to 22.1 in 2002.

Tables

Table 1. Effects of dowels and sponges on drift-fence captures, Mt. Mansfield, 2002. Traps were first opened April 10, 2002. Dowels and sponges were in place as of April 26, 2002. Sponges were removed by July 1, 2002. Unimproved traps are original traps without dowels or sponges.

Herptile Capture

Species	Total Caught ¹	# Dead	Pre-dowels (4/10-4/14)	Unimproved (4/26-6/27)	Dowels with Sponges ¹ (4/26-6/27)	% Reduction	Unimproved (7/9-11/11)	Dowels without Sponges ¹ (7/9-11/11)	% Reduction
Amphibians									
<i>Ambystoma maculatum</i>	26	0	10	2	0	100%	8	6	25%
<i>Bufo americanus</i>	21	0	0	4	1	75%	11	5	55%
<i>Desmognathus fuscus</i>	7	4	1	2	1	50%	1	2	-100%
<i>Eurycea bislineata</i>	3	0	0	1	0	100%	1	1	0%
<i>Notophthalmus viridescens</i>	19	0	2	2	3	-50%	10	2	80%
<i>Plethodon cinereus</i>	15	1	1	7	0	100%	6	1	83%
<i>Pseudacris crucifer</i>	10	0	6	1	0	100%	3	0	100%
<i>Rana clamitans</i>	348	2	0	9	8	11%	180	151	16%
<i>Rana palustris</i>	2	0	0	0	0		2	0	100%
<i>Rana sylvatica</i>	76	1	12	11	4	64%	31	18	42%
Total	527	8	32	39	17	56%	253	186	26%

Nontargeted Vertebrate Capture

Species	Total Caught ¹	# Alive	Pre-dowels (4/10-4/14)	Unimproved (4/26-6/27)	Dowels with Sponges ¹ (4/26-6/27)	% Reduction	Unimproved (7/9-11/11)	Dowels without Sponges ¹ (7/9-11/11)	% Reduction
Small Mammals									
Jumping mice	60	3	0	7	1	86%	47	5	89%
<i>Peromyscus</i> species	9	0	0	2	1	50%	5	1	80%
Voles	9	1	0	1	0	100%	6	2	66%
Short-tailed shrews	75	0	19	13	5	62%	26	12	54%
Other shrews	67	1	5	19	3	84%	38	2	95%
Moles	2	0	0	0	0		1	1	100%
Total	222	5	24	42	10	76%	123	23	81%

¹ Includes both dead and alive captures

Table 2. A comparison of drift-fence data from the 1993 through 2002 field seasons at Mt. Mansfield, Underhill, Vermont. Data used are from two fences at 1,200 ft. and one fence at 2,200 ft. in elevation.

Common name	# per trapping ¹											% of total catch									
	93	94	95	96	97	98	99	00	01	02 ²	93	94	95	96	97	98	99	00	01	02 ²	
Caudates (Salamanders)																					
Spotted Salamander	1.7	1.0	1.4	2.0	1.4	1.2	1.2	1.6	1.5	1.9	12%	10%	9%	12%	8%	6%	7%	10%	11%	5%	
Dusky Salamander	0.3	0.3	0.3	0.0	0.0	0.6	0.1	0.4	0.3	0.4	2%	3%	2%	0%	0%	3%	1%	3%	2%	1%	
N. Two-lined Salamander	0.5	0.1	0.2	0.1	0.2	0.2	0.2	0.4	0.1	0.3	4%	1%	1%	1%	1%	1%	2%	1%	0%	0%	
Spring Salamander	< 0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	< 1%	0%	0%	< 1%	0%	0%	0%	0%	0%	0%	
Eastern Newt	1.3	1.2	1.7	1.4	1.8	1.3	0.8	1.3	1.3	1.6	10%	12%	11%	8%	10%	7%	5%	8%	9%	4%	
E. Red-backed Salamander	1.2	4.2	1.3	2.5	3.3	5.4	1.6	3.5	1.8	1.9	9%	40%	9%	14%	18%	29%	10%	21%	13%	4%	
Group totals	5.1	6.8	4.9	6.1	6.8	8.6	3.9	7.3	5.0	6.1	38%	66%	32%	36%	37%	46%	24%	43%	35%	14%	
Anurans (Frogs and Toads)																					
American Toad	0.7	0.6	1.5	2.2	2.5	3.6	2.1	1.8	1.6	1.9	5%	5%	10%	13%	14%	19%	13%	10%	11%	4%	
Gray Treefrog	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0%	0%	0%	0%	0%	< 1%	0%	1%	0%	0%	
Spring Peeper	1.7	1.1	2.2	0.9	0.3	1.1	0.5	1.4	0.0	0.9	13%	10%	14%	5%	2%	6%	3%	8%	0%	2%	
Green Frog	< 0.1	0.2	0.9	0.6	1.3	0.8	2.6	3.3	1.9	22.1	< 1%	2%	6%	3%	7%	4%	16%	19%	13%	67%	
Pickerel Frog	0.1	0.0	1.1	0.3	0.3	0.0	0.5	0.1	0.3	0.3	1%	0%	7%	2%	1%	0%	3%	< 1%	2%	0%	
Wood Frog	5.6	1.7	4.4	6.8	7.0	4.7	6.5	3.1	5.4	6.7	42%	16%	29%	40%	39%	25%	41%	18%	38%	13%	
Group totals	8.2	3.6	10.1	10.8	11.3	10.1	12.2	9.8	9.1	31.8	62%	33%	66%	64%	63%	54%	76%	57%	65%	86%	
Amphibian totals	13.4	10.4	15.0	16.8	18.1	18.7	16.1	17.0	14.1	37.9	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	

¹ Numbers per trapping are rounded to the nearest 0.1. All other figures are rounded to the nearest whole number. As a result of this, group totals may not be equivalent to the sum of the individual species' values. There were a total of 15 trappings in 1993, 14 in 1994, 18 in 1995, 17 in 1996, 12 in 1997, 18 in 1998, 17 in 1999, 16 in 2000, 14 in 2001, and 16 in 2002. Trappings counted were on those nights when at least 2 of the three traps were opened under appropriate weather conditions for amphibian movement.

² This was the first year we used dowels to reduce small mammal mortality. In order to compare this year's and past year's data, we converted all numbers to approximate non-dowel values. Using the preselected data sets, this was done by excluding all dowel captures, doubling captures in unimproved traps and adding predowel data.

Table 3. Monitoring results from the two drift-fences at 1,200 ft. and one at 2,200 ft. on Mt. Mansfield, Underhill, Vermont during 2002. Traps were opened whenever conditions were appropriate for amphibian movement from April through November excluding August. Three successful trappings per month (± 10 days) were the goal, however due to periods of low rainfall, two trappings per month were sometimes used. There was a single late trapping for November. Data from 16 of 23 trap-efforts were used: April 10 and 14; May 10 and 31; June 23, 27, and July 9; July 18, 23, and 29; September 11, 15, and 23; September 28 and October 3; November 11. Abnormality, maximum size, and first metamorphic data were taken from all 23 trappings

Common name	Scientific name	# of all ages	# of young of the year ¹	% young of the year	date of first metamorph ²	largest adult (total length in mm)	# per trapping (adjusted) ^{3, 4}	% of group	% of total catch	# abnormal/total ⁵
Salamanders										
Spotted Salamander	<i>Ambystoma maculatum</i>	25	5	20%	July 9	206	1.9	35%	5%	0/25
E. Red-backed Salamander	<i>Plethodon cinereus</i>	19	0	0%	NA	81	1.9	26%	4%	0/19
Eastern Newt	<i>Notophthalmus viridescens</i>	19	14	74%	June 23	81	1.6	26%	4%	0/19
Dusky Salamander	<i>Desmognathus fuscus</i>	7	0	0%	NA	92	0.4	10%	1%	0/7
N. Two-lined Salamander	<i>Eurycea bislineata</i>	2	1	50%	July 23	71	0.3	3%	0%	1/2
Group totals	Group totals	72	20	28%	NA	NA	6.1	####	14%	1/72
Frogs and Toads										
Green Frog	<i>Rana clamitans</i>	350	340	97%	June 23	69	22.1	77%	67%	0/350
Wood Frog	<i>Rana sylvatica</i>	71	19	27%	July 18	56	6.7	16%	13%	0/71
American Toad	<i>Bufo americanus</i>	20	4	20%	May 31	80	1.9	4%	4%	0/20
Spring Peeper	<i>Pseudacris crucifer</i>	11	4	36%	May 31	32	0.9	2%	2%	0/11
Pickerel Frog	<i>Rana palustris</i>	2	2	100%	Sept. 15	NA	0.3	0%	0%	0/2
Group totals	Group totals	454	369	68%	NA	NA	31.8	####	86%	0/454
Amphibian totals	Amphibian totals	526	389	74%	NA	NA	37.9	NA	####	1/526

¹ For each species, individuals under a given total length were considered potential 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), *D. fuscus* (30 mm), *E. bislineata* (60 mm), *N. viridescens* (45 mm), *P. cinereus* (32 mm), *B. americanus* (23 mm), *H. versicolor* (26 mm), *P. crucifer* (20 mm), *R. clamitans* (44 mm), *R. palustris* (34 mm), and *R. sylvatica* (27 mm). In addition, it was necessary to examine the minimum possible development time for each species. Individuals shorter than the cutoff lengths clearly overwinter (possibly as larvae for *N. viridescens* and *A. maculatum*) and show up in very early spring. These are not counted as young of the year.

² No trapping took place in August.

³ This was the first year we used dowels to reduce small mammal mortality. In order to compare this year's and past years' data we converted all numbers to approximate non-dowel values. Using the preselected data sets, this was done by excluding all dowel captures, doubling captures in unimproved traps, and adding predowel data.

⁴ These figures are rounded to the nearest 0.1. All other figures are rounded to the nearest whole number. As a result of this, group totals may not be equivalent to the sum of the individual species' values.

⁵ These may contain old deformities (traumatic) as well as malformities (developmental). Salamanders missing all or portions of their tails are not included. The total number checked may contain specimens that were caught more than once.