

**Amphibian Monitoring on Mt. Mansfield,
Underhill, Vermont**

1993-2003

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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. Eleven 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 2003

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, as in 2002, 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, they also show that the dowels allowed a significant percentage of the amphibians to escape. Our plan is to consider the addition of dowels to all traps after three years of dowels in 1/2 the traps. This may allow us to first determine the rate of amphibian escape from traps with dowels and then come up with a conversion factor to compare old indices to new indices.

Between April and October 2003, Mount Mansfield, VT received 50 inches of rain, 6.3 inches more than the average since 1955, of 43.7 inches/year. (The Vermont Monitoring Cooperative provided these data 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 has been 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. The use of dowels reduced amphibian captures by 58% and small mammal captures by 86%, (Table 1). This is a fairly considerable reduction in the amphibian capture and is a concern for some species. The use of dowels reduced the Eastern Red-backed Salamander (*Plethodon cinereus*) by 100% with a total of 21 caught in dowel free buckets and zero in buckets with dowels. In 2002, they were reduced by 83% with a combined total of 7 being caught. The

number of Eastern Newts (N=5) was reduced by 75% in 2003, and was reduced by 80% in 2002 (N=12). The permanent use of dowels may not allow the monitoring of these species.

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 and 2003 data could not be compared to previous years' data. As dowels were in half the traps, the dowel results were omitted and the non-dowel trap results were doubled, finally the snake trap data was added in for the calculation of the number per trapping event.

Changes in species composition

In 2003, the anurans (frogs and toads) continued to dominate at the fences, and comprised 73% of the total catch (Table 2), down from the 86% in 2002. In 2002, Green Frogs had a dramatic year and 350 frogs were caught resulting in 22.1 caught per trapping. In 2003, the number of Green Frogs returned to a much lower number of 3.7 per trapping, but still the second highest since the beginning of the study (Table 3). Both Green Frogs and Wood Frogs comprised 39% of the anuran catch. Wood frogs decreased from 6.7 individuals in 2002 to 3.9 individuals caught per trapping in 2003. American Toads increased from 4% to 16% of the anuran catch, but their capture rate remained the same at 1.9 per trapping. In 2002 they had been a small percentage of the anuran catch, not due to their numbers, but due to the abnormally large numbers of Green Frogs. Spring Peepers made up 33% of the anuran catch, up from 2% in 2002, and 0% in 2001, up from last year's 0%, the highest percentage since the beginning of the study. No Pickerel Frogs were caught this year. Pickerel Frog numbers have always been low and these slight changes are not significant.

Overall, fewer salamanders were caught per trapping in 2003. Indices dropped from 6.1 to 4.2 per trapping, the second lowest number of salamanders in eleven years. The percentage of Eastern Red-backed Salamanders showed an increase from 26% to 57% of the salamander population. The numbers per trapping have also increased from 1.9 to 2.9. Spotted Salamanders went from 35% to 24% of the salamander catch showing a decrease in numbers per trapping from 1.9 to 0.4. This is the lowest number of Spotted Salamanders since the study started. Eastern Newts decreased from 26% to 12% of the salamanders caught and their captures decreased from 1.6 to 0.5 per trapping. This is also the lowest number since the start of the study. Dusky Salamanders showed a decrease in percentage of the salamander population from 10% to 2%, and their per trapping numbers dropped from 0.4 to 0.1. The Northern Two-lined Salamanders decreased 2002 to 2003 from 3% to 1 % of the salamander population; although, their numbers per trapping remained the same for both years at 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 percentage of young of the year for 2003, 74% of all amphibians, was lower than the record high of 2002 (95% were young of the year), and 68% of the total young were anuran. Similar to last year, most of them (70%) were Green Frogs but in 2003 there were 31 Green Frog young and in 2002 there were 340. The percentage of young of the year in the salamander population was the same as last year at 28% of the total salamander catch. In 2003, no young Eastern Newts were caught and all of the young salamanders were either Spotted Salamanders or Northern Two-lined Salamanders.

The number of abnormalities continues to be low. In 2002, only one abnormal amphibian was caught, out of 526 (<0.1%), and in 2003 there were 0 amphibians with abnormalities out of 167 caught (0%). 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 2002, the total number of amphibians showing abnormalities from all captures was 5,3,2,0, and 1 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 1993-2003 (Figures 1-6). The data gathered suggest that three of the seven species abundant enough to monitor show an average increase over this eleven-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 year, there was a dramatic decrease from 2002 but still a relatively high number of Green Frogs (3.7) were caught and the trend is still positive. All except one of the Green Frog records are from the fences at 1200 feet elevation (Proctor Maple Research Center (PMRC) and Pleasant Valley Road (PVR). Although the number of Green Frogs has varied considerably over the years it is still interesting to examine where the majority of the frogs are coming from each year. In 1998, 1999, 2000 and 2001 the majority of Green Frogs captured were from the PMRC drift fence, 94%, 94%, 60% and 76% respectively. In 2002 and 2003, that was reversed and only 15% and 30% of the total Green Frogs captured were from the PMRC drift fence. 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. It seems likely that the increase at the Pleasant Valley Road fence must be due to a change in water permanence (more rain, new dam) and/or overwintering success near that fence, but we are unaware of any habitat changes, increased rain, or data supporting a milder winter. The beavers did rebuild an old beaver dam, but it is closer to the PMRC fences. At the seven fences at Ward Marsh in southern Vermont, Green Frogs were holding relatively steady for five years, but had a fairly dramatic jump in 2003 from 0.7 to 18.7 per trapping event, like the Green Frogs at Mt Mansfield in 2002, a high percentage of these were young of the year. The numbers of young that emerge in a given year may be the result of weather conditions during the previous two winters or summers. Two wet summers (or deeper ponds) combined with one or two mild (depth of freeze) winters could produce a large crop of young. If these spikes reoccur, they should be examined more fully.

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 and 2003, they were caught at a rate of 1.9 per trapping. In 2000, we reported that the Wood Frog was showing a slight decline; since that year, the number of Wood Frogs has generally increased. However, this year there was a drop from 6.7 to 3.9 caught per trapping event (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 since populations at Lye Brook Wilderness in southern Vermont have remained steady over the same time period. Local changes in breeding habitat could be one possible explanation for a localized long-term decline, but we have no data to support the change in habitat.

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 number of captures is so low, it is not possible to draw any meaningful conclusions.

Summary

Although always rare at this site, 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 lower 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 both last year and this year. The downward trend for Spring Peepers also continues.

Acknowledgments

Long-term monitoring at this site has been supported by the Lintilhac Foundation and the Vermont Department of Forests, Parks, and Recreation through the Vermont Monitoring Cooperative (VMC). Field personnel for 2003 were Irene Linde, Jean Archibald, Robert Robbins, and Gabriel Halberg, under the direction of Warren Ellison.

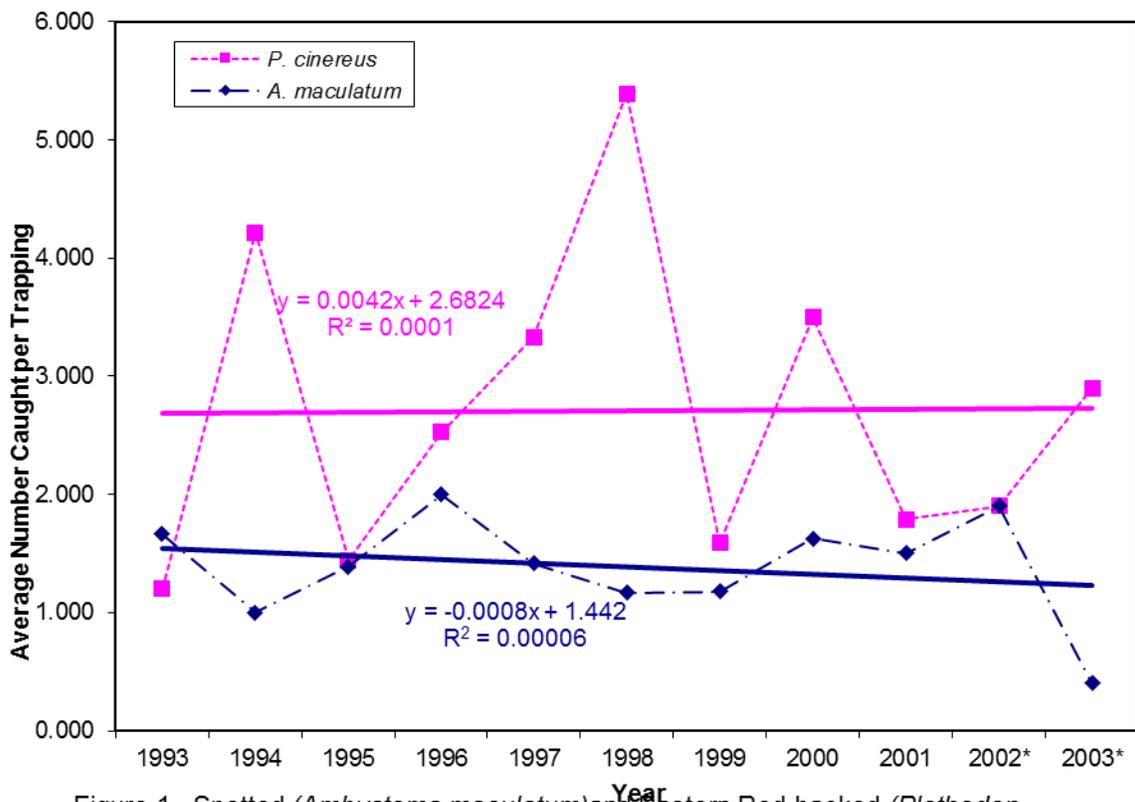


Figure 1. Spotted (*Ambystoma maculatum*) and Eastern Red-backed (*Plethodon cinereus*) Salamander population indices from Mt. Mansfield, Underhill, Vermont, 1993-2003.

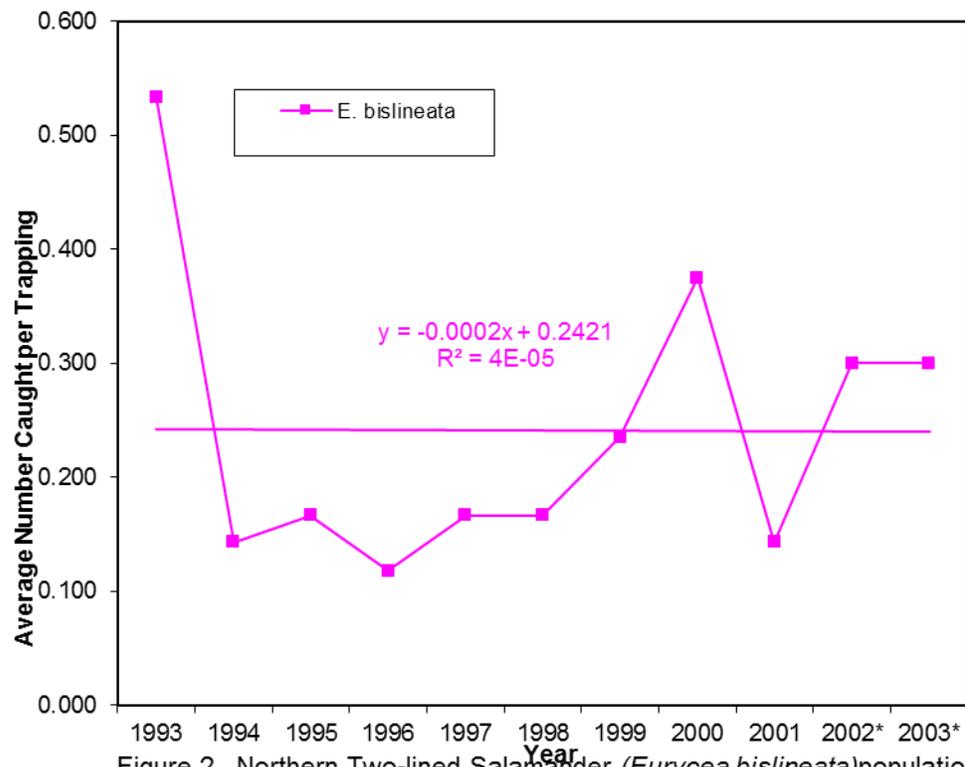


Figure 2. Northern Two-lined Salamander (*Eurycea bislineata*) population index from Mt. Mansfield, Underhill, Vermont, 1993-2003. For this species the numbers are too low to draw meaningful conclusions.

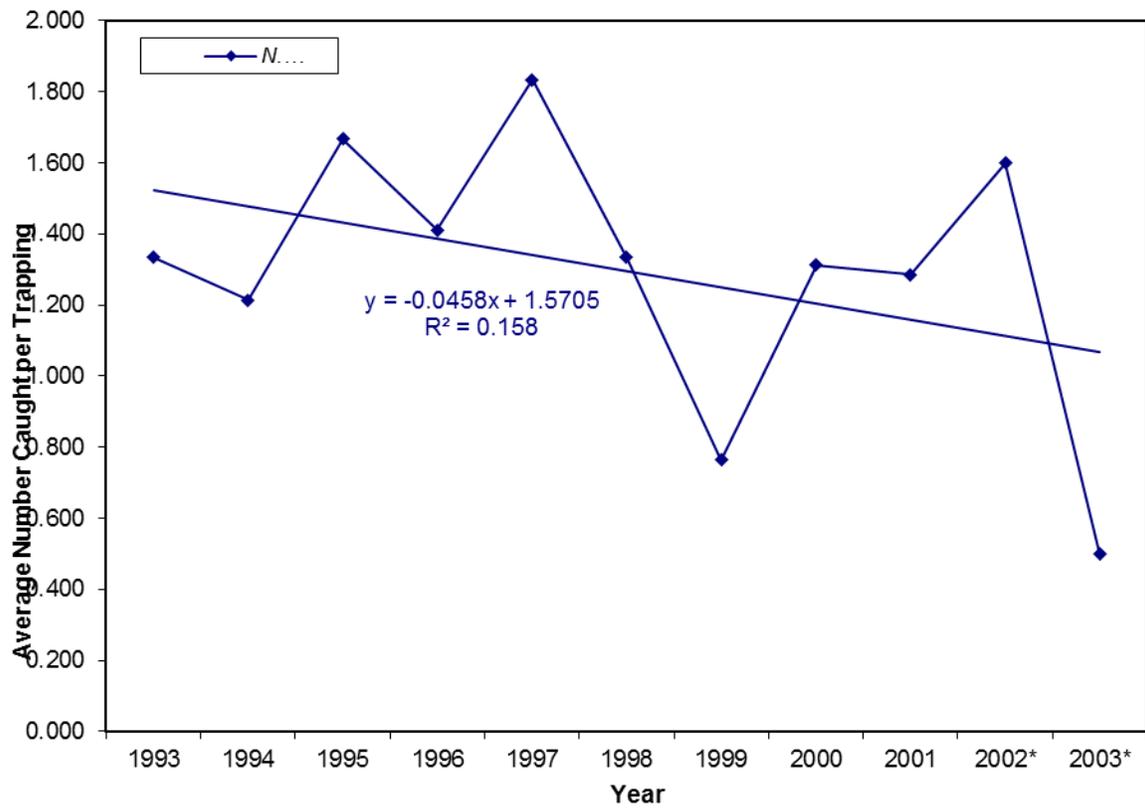


Figure 3. Eastern Newt (*Notophthalmus viridescens*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2003.

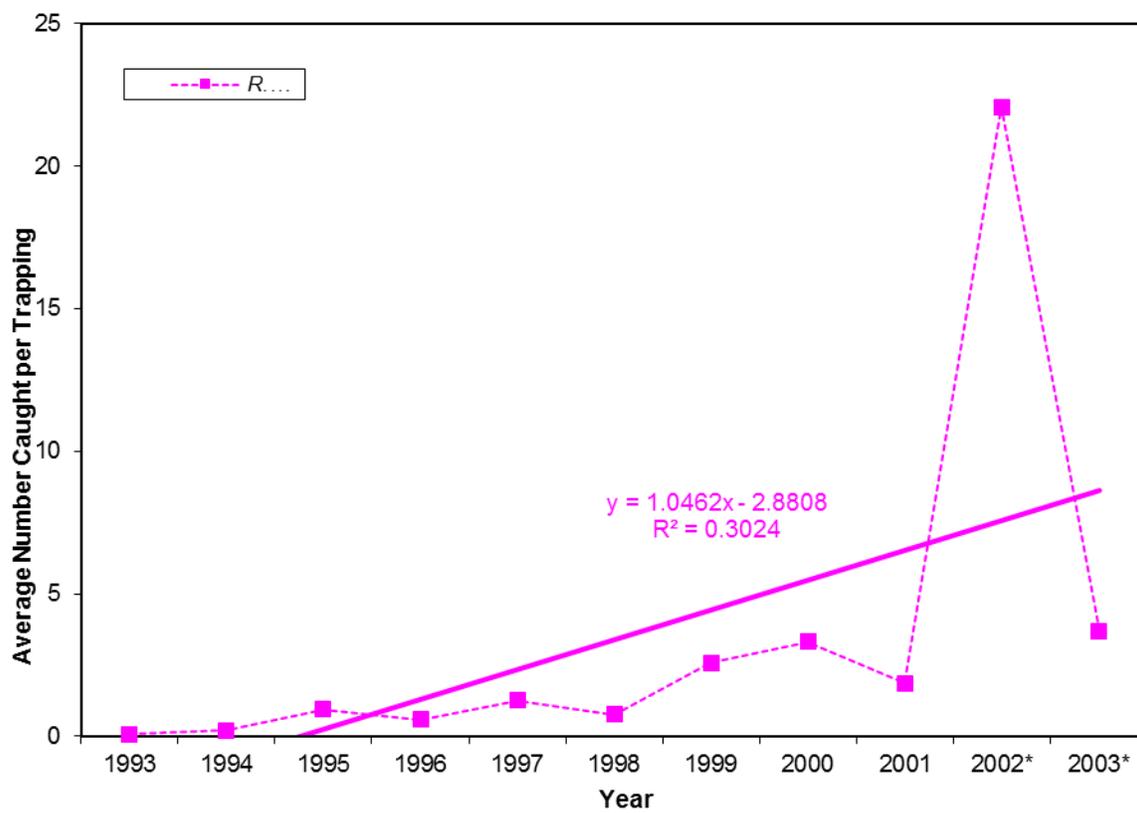


Figure 4. Green Frog (*Rana clamitans*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2003.

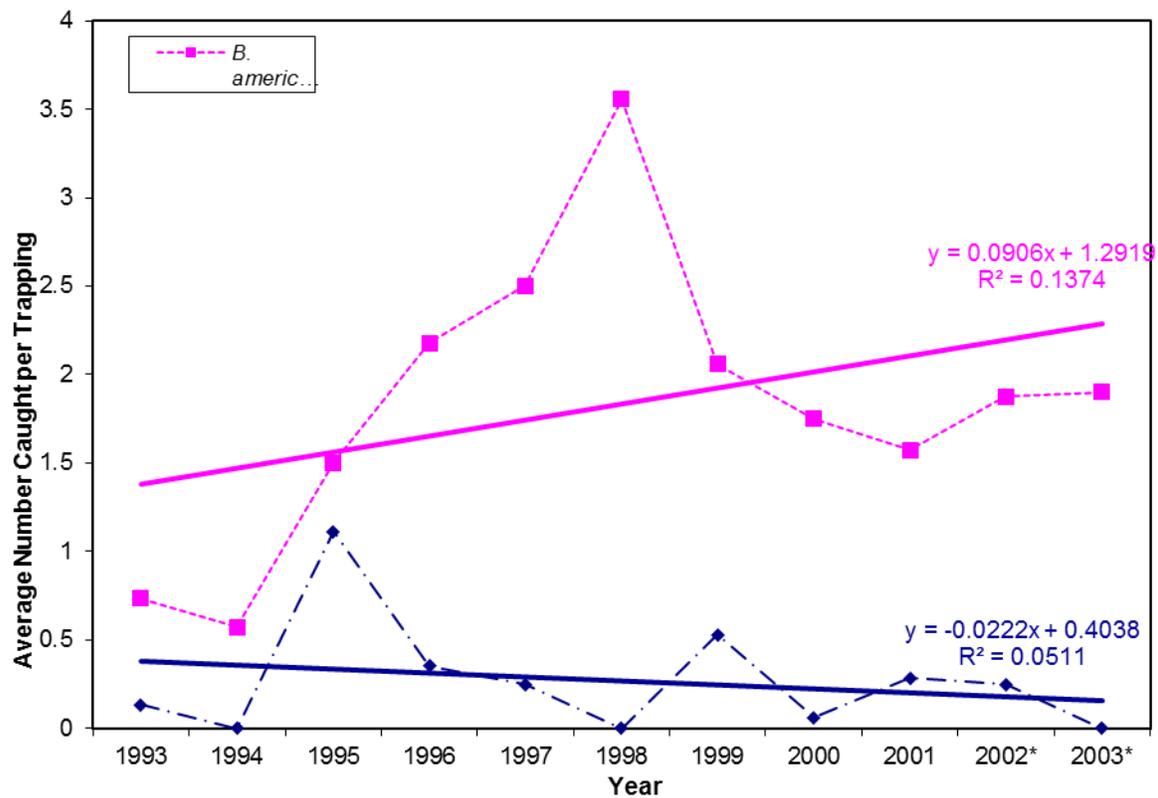


Figure 5. American Toad (*Bufo americanus*) and Pickerel Frog (*Rana palustris*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2003. The numbers for the Pickerel Frog are too low to draw any meaningful conclusions.

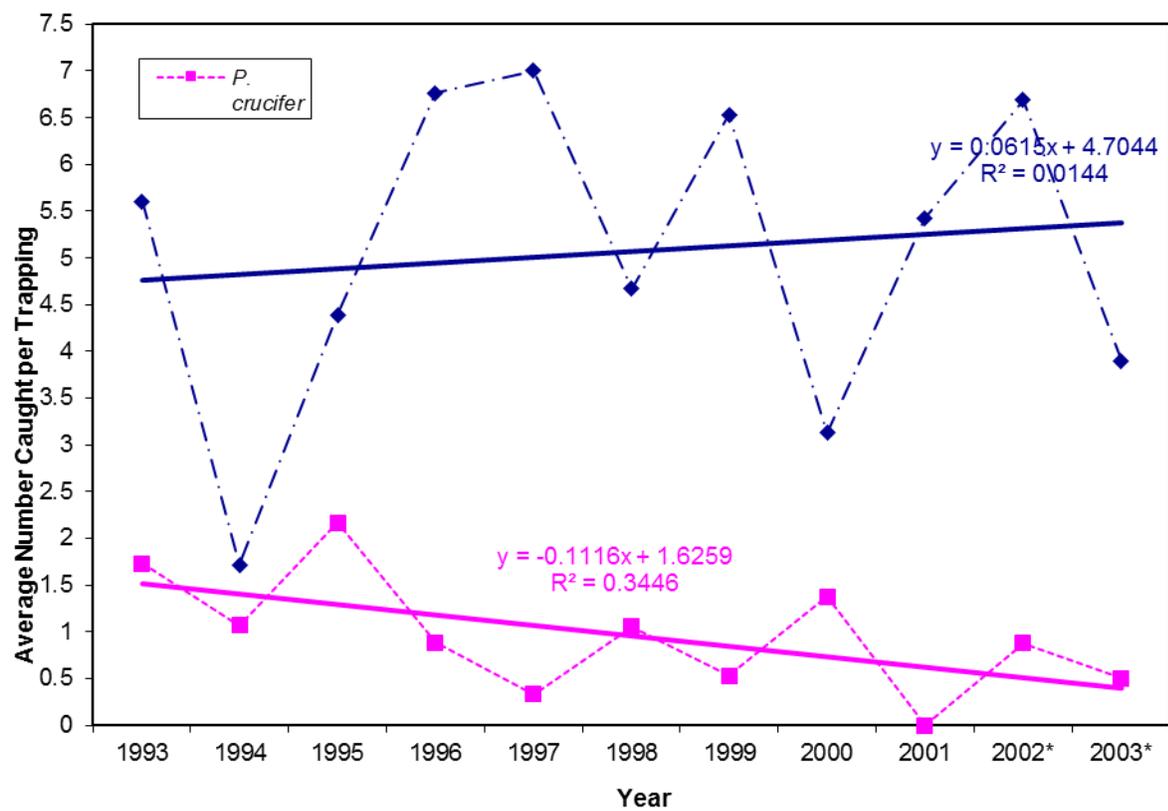


Figure 6. Wood Frog (*Rana sylvatica*) and Spring Peeper (*Pseudacris crucifer*) indices from Mt. Mansfield, Underhill, Vermont, 1993-2003.

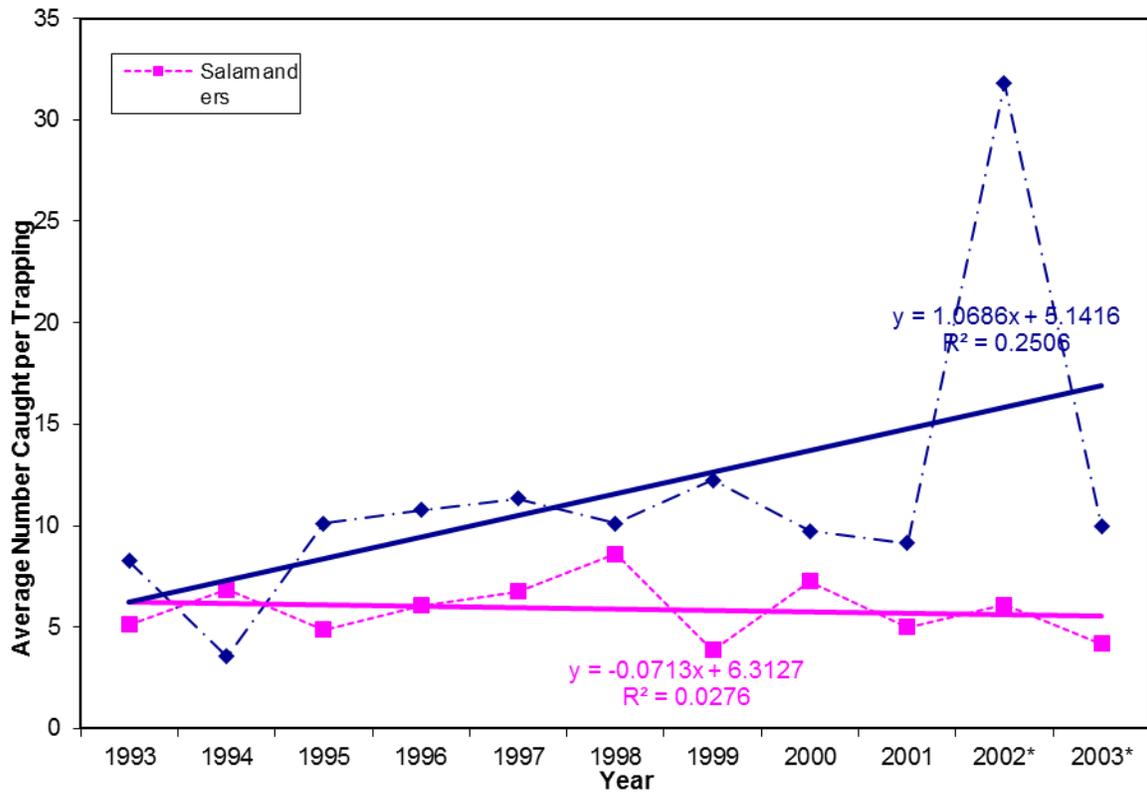


Figure 7. Salamander and frog population indices from Mt. Mansfield, Underhill, Vermont, 1993-2003. The increase in frogs in 2002 is due to the dramatic increase in Green Frogs caught per trapping, from 1.9 in 2001 to 22.1 in 2002.

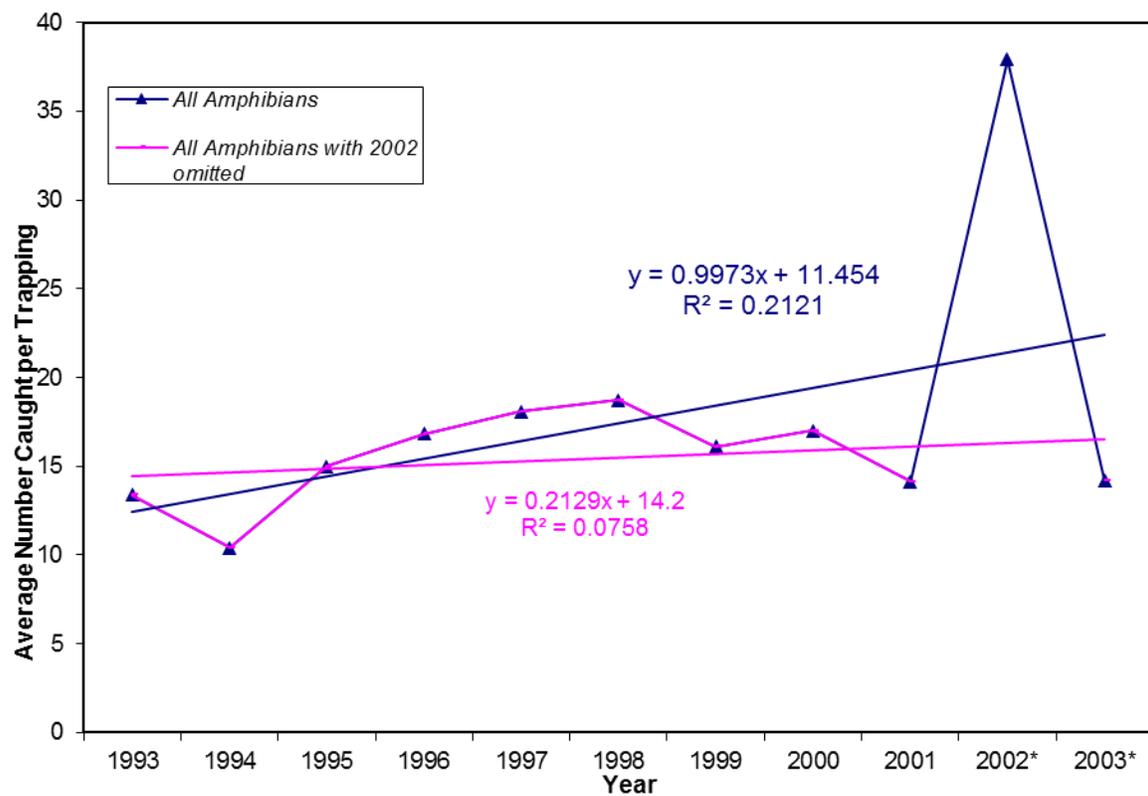


Figure 8. Amphibian indices from Mt. Mansfield, Underhill, Vermont, 1993-2003. The increase in amphibians in 2002 is due to the dramatic increase in Green Frogs caught per trapping, from 1.9 in 2001 to 22.1 in 2002.

Table 1. Effects of dowels on drift-fence captures, Mt. Mansfield, 2003. Dowels were placed in 1/2 of the traps throughout the entire field season.

Herptile Capture					
Species	Total Caught¹	# Dead	With Dowels	Without dowels	% Reduction
<i>Ambystoma maculatum</i>	12	0	7	5	-40%
<i>Bufo americanus</i>	22	0	6	16	63%
<i>Desmognathus fuscus</i>	1	0	0	1	ISD
<i>Eurycea bislineata</i>	2	0	0	2	ISD
<i>Notophthalmus viridescens</i>	5	0	1	4	75%
<i>Pseudacris crucifer</i>	6	0	2	4	50%
<i>Plethodon cinereus</i>	21	0	0	21	100%
<i>Rana clamitans</i>	46	1	16	30	47%
<i>Rana palustris</i>	1	0	1	0	ISD
<i>Rana sylvatica</i>	45	4	15	30	50%
Total Amphibians	161	5	48	113	58%
Non-target Vertebrate Capture					
Small Mammal Species	Total Caught¹	# Alive	With Dowels	Without dowels	% Reduction
Woodland Jumping Mouse	27	1	1	26	96%
Meadow Jumping Mouse	8	1	0	8	100%
<i>Peromyscus</i> species	24	0	0	24	100%
Meadow Vole	1	1	0	1	ISD
Other Vole	8	0	4	4	0%
Short-tailed Shrew	84	0	18	66	73%
Other shrews	91	0	5	86	94%
Moles	7	1	2	5	60%
Total Small Mammals	250	4	30	220	86%

Table 2. A comparison of drift-fence data from the 1993 through 2003 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	03 ²	93	94	95	96	97	98	99	00	01	02 ²	03 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	0.4	12%	10%	9%	12%	8%	6%	7%	10%	11%	5%	6%	
Dusky Salamander	0.3	0.3	0.3	0.0	0.0	0.6	0.1	0.4	0.3	0.4	0.1	2%	3%	2%	0%	0%	3%	1%	3%	2%	1%	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	0.3	4%	1%	1%	1%	1%	1%	1%	2%	1%	0%	1%	
Spring Salamander	< 0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	< 1%	0%	0%	< 1%	0%	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	0.5	10%	12%	11%	8%	10%	7%	5%	8%	9%	4%	3%	
E. Red-backed Salamand	e1.2	4.2	1.3	2.5	3.3	5.4	1.6	3.5	1.8	1.9	2.9	9%	40%	9%	14%	18%	29%	10%	21%	13%	4%	15%	
Group totals	5.1	6.8	4.9	6.1	6.8	8.6	3.9	7.3	5.0	6.1	4.2	38%	66%	32%	36%	37%	46%	24%	43%	35%	14%	27%	
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	1.9	5%	5%	10%	13%	14%	19%	13%	10%	11%	4%	12%	
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%	0%	0%	< 1%	0%	1%	0%	0%	0%	
Spring Peeper	1.7	1.1	2.2	0.9	0.3	1.1	0.5	1.4	0.0	0.9	0.5	13%	10%	14%	5%	2%	6%	3%	8%	0%	2%	4%	
Green Frog	< 0.1	0.2	0.9	0.6	1.3	0.8	2.6	3.3	1.9	22.1	3.7	< 1%	2%	6%	3%	7%	4%	16%	19%	13%	67%	28%	
Pickerel Frog	0.1	0.0	1.1	0.3	0.3	0.0	0.5	0.1	0.3	0.3	0.0	1%	0%	7%	2%	1%	0%	3%	<1%	2%	0%	0%	
Wood Frog	5.6	1.7	4.4	6.8	7.0	4.7	6.5	3.1	5.4	6.7	3.9	42%	16%	29%	40%	39%	25%	41%	18%	38%	13%	28%	
Group totals	8.2	3.6	10.1	10.8	11.3	10.1	12.2	9.8	9.1	31.9	10.0	62%	33%	66%	64%	63%	54%	76%	57%	65%	86%	73%	
Amphibian totals	13.4	10.4	15.0	16.8	18.1	18.7	16.1	17.0	14.1	38.0	14.2	100%	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, 16 in 2002, and 15 in 2003. 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 second 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 snake trap 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 2003. 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. Data from 15 of 22 trap-efforts were used: April 27 and May 2; May 25 and 29; June 14, 20, and 30; July 18, 22, and 27; September 4, 16, and 24; September 29 and October 27. Abnormality, maximum size, and first metamorphic data were taken from all 22 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>	10	5	50%	Sept. 4	187	0.4	24%	6%	0/12
E. Red-backed Salamander	<i>Plethodon cinereus</i>	24	0	0%	NA	80	2.9	57%	15%	0/26
Eastern Newt	<i>Notophthalmus viridescens</i>	5	0	0%	NA	86	0.5	12%	3%	0/5
Dusky Salamander	<i>Desmognathus fuscus</i>	1	0	0%	NA	112	0.1	2%	1%	0/1
N. Two-lined Salamander	<i>Eurycea bislineata</i>	2	1	50%	Sept. 16	66	0.3	5%	1%	0/2
Group totals	Group totals	42	6	28%	NA	NA	4.2	####	27%	0/46
Frogs and Toads										
Green Frog	<i>Rana clamitans</i>	44	31	70%	June 14	58	3.7	39%	28%	0/46
Wood Frog	<i>Rana sylvatica</i>	44	26	59%	July 18	57	3.9	39%	28%	0/45
American Toad	<i>Bufo americanus</i>	19	3	16%	July 22	87	1.9	17%	12%	0/23
Spring Peeper	<i>Pseudacris crucifer</i>	6	2	33%	Sept. 16	31	0.5	5%	4%	0/6
Pickerel Frog	<i>Rana palustris</i>	0	0	0%	NA	NA	0.0	0%	0%	0/1
Group totals	Group totals	113	62	68%	NA	NA	10.0	####	73%	0/121
Amphibian totals	Amphibian totals	155	68	74%	NA	NA	14.2	NA	100%	0/167

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 second 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 snake trap 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.