Amphibian Monitoring on Mt. Mansfield, Underhill, Vermont

1993-2005

Vermont Reptile and Amphibian Atlas Update

2005

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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. Twelve 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.

Between April 1 and October 31, 2005, the Burlington International Airport, VT received a total of 27.6 inches of rain, 3.1 inches more than the average of 24.5 inches/year (weather data provided by the NOAA National Climatic Data Center local climatological data. The Vermont Monitoring Cooperative normally provides these data but unfortunately they were not available as of this writing).

Dowels

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. Starting 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 was to consider the addition of dowels to all traps after three years of dowels in 1/2 the traps. This would 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.

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. In 2005, the use of dowels reduced small mammal captures by 81%, but it also reduced amphibian captures by 64% (Table 1). This is a 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% (for the second year in a row), with a total of 24 caught in dowel-free buckets and zero in buckets with dowels. In 2003 they were reduced by 100% with 21 caught in dowel-free buckets. In 2002, they were reduced by 83% with a combined total of 7 being caught. The number of Eastern Newts (*Notophthalmus viridescens*) (N=19) was reduced by 73%. The number of Eastern Newts was reduced by 75% in 2003 (N=5), and was reduced by 80% in 2002 (N=12). The permanent use of dowels would 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, 2003, and 2005 data could not be compared to previous years' data. As dowels were only in half the traps, the dowel results were omitted and the non-dowel trap results were doubled. The snake trap data were added in for the calculation of the number per trapping event.

Changes in species composition

In 2005, as usual, the anurans (frogs and toads) continued to dominate at the fences and comprised 57% of the total catch. In 2003, the anurans comprised 73% of the total catch down from the 86% in 2002 (Table 2). In 2002, Green Frogs (*Rana clamitans*) 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, and 2005 resulted in a similar number of 3.5 per trapping and comprised 35% of the anuran catch (Table 2 and 3). In 2003, Wood Frogs (*Rana sylvatica*) comprised 39% of the anuran catch, but in 2005 Wood Frogs only comprised 23% of the anuran catch. The number of Wood Frogs caught per trapping continued to go down and was 1.9 per trapping after being 3.9 in 2003 and 6.7 in 2002. American Toads (*Bufo americanus*) generally fluctuate in their percentage of total anuran catch. They were as low as 4% in 2002, and increased to 31% in 2005. Their capture rate also increased from 1.9 in both 2002 and 2003 to 2.8 in 2005. Spring Peepers (*Pseudacris crucifer*) made up 9% of the anuran catch, up from 2003's 4%; and their number caught per trapping increased from 0.5 in 2003 to 1.1 in 2005. Only two young Pickerel Frogs (*Rana palustris*) were caught this year and no Gray Treefrogs (*Hyla versicolor*). This is not unusual as we rarely catch Pickerel Frogs and Gray Treefrogs can climb out of the buckets.

Overall, more salamanders were caught per trapping in 2005 than in previous years. Indices increased from 4.2 in 2003 to 7.8 in 2005. An index of 4.2 per trapping was the second lowest number of salamanders in eleven years, and 7.8 per trapping is the second highest. The percentage of Eastern Red-backed Salamanders showed an increase from 26% to 57% of the salamander population during 2002 and 2003. In 2005 they comprised 36% of the salamander catch. The numbers per trapping have also increased from 1.9 (2002) to 2.9 (2003) to 3.3 (2005). Spotted Salamanders (*Ambystoma maculatum*) went from 35% (2002) to 24% (2003) to 27% (2005) of the salamander catch. Spotted Salamanders per trapping continue to fluctuate showing a decrease in numbers per trapping from 1.9 to 0.4 in 2002 and 2003, and a subsequent increase in 2005 to 1.5. Eastern Newts decreased from 26% to 12% in 2002 to 2003 of the salamanders caught and their per trapping decreased from 1.6 to 0.5 per trapping. In 2005 they were again a considerable portion of the anuran catch comprising 21% of the catch and with a per trapping index of 1.7. In 2003, both Spotted Salamanders and Eastern Newts had their lowest per catch rate since the start of the study. Both rebounded to relatively high per catch rates. Only one Northern Dusky Salamander (*Desmognathus fuscus*) was caught in 2005. Their per trapping numbers dropped from 0.4 (2002) to 0.1. (2003) to 0.0 (2005). The Northern Two-lined Salamanders (*Eurycea bislineata*) increased from 2003 to 2005, from 1% to 11% of the salamander population; and, their numbers per trapping also increased from 0.3 to 1.1. This is the highest number of Northern Two-lined Salamanders caught per trapping since the inception of the study. The fences are not in appropriate habitat to capture enough of these two species to accurately monitor their populations, so it is probable that these slight changes do not reflect changes in their population size. Still the increase in the Two-lined Salamander numbers is interesting.

Young of the year and abnormalities

The percentage of young of the year for all amphibians was 33%, which was slightly lower than the 44% found in 2003. Both years had lower percentages that the amount of young of the year found in 2002, which was 74%, primarily due to the great number of Green Frogs found. This year 48% of all of the young of the year were anuran. In 2003, 55% were anuran young and in 2002, 81% were anuran young, again primarily due to the high number of Green Frogs found that year. In 2005, most Green Frogs (78%) were the young of the year. This was similar in 2003 when 70% of the Green Frogs were young, down from the 97% of Green Frogs found in 2002. In 2005, there were 36 young, in 2003 there were 31, and in 2002 there were 340. The percentage of young of the year in the salamander population was 12%, slightly down from 2003 when it was 14%. In 2003, no young Eastern Newts were caught, and all of the young

salamanders were either Spotted Salamanders or Northern Two-lined Salamanders. In 2005, young Spotted Salamanders, Eastern Newts, Northern Two-lined, and Red-backed Salamanders were found.

The number of abnormalities continues to be low. In 2002, only one abnormal amphibian was caught, out of 526 (<0.1%). In 2003 there were zero amphibians with abnormalities out of 167 caught (0%). In 2005, there were zero amphibians with abnormalities out of 189 caught (0%). The numbers of abnormalities at this site have always been well below a level of concern. From 1998 through 2005, the total number of amphibians showing abnormalities from all captures has been 11 individuals. The last reported abnormality was in 2002 when a young Northern Two-lined Salamander was found who was completely missing its right eye, including the socket. Previous to that, 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 1993-2005 (Figures 1-6). The data gathered suggest that two of the seven species abundant enough to monitor show an average increase over this eleven-year period: Green Frog and American Toad. 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. In 2003, there was a dramatic decrease from 2002 but still a relatively high number of Green Frogs (3.7) were caught, and a similar number (3.5) were caught in 2005; therefore the trend is still positive**.** As in 2003, all Green Frog records except for one are from the fences at 1200 feet elevation. The two fences at the 1200 feet elevation are the Proctor Maple Research Center fence (PMRC) and the Pleasant Valley Road fence (PVR). Although the number of Green Frogs has varied considerably over the years it is 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. This trend was reversed in 2002, 2003, and 2005 and only 15%, 30%, and 21% 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 2005 they were caught at a rate of 2.8 per trapping, which was the second highest trap rate since the study began. It will be interesting to continue to watch this species to see if these dramatic fluctuations are normal.

In 2000, we reported that the Wood Frog was showing a slight decline; in 2001 and 2002 the number of Wood Frogs increased, and by 2003 the population was showing a slight increase. Unfortunately, in 2005 their per trapping rate fell again to 3.9 and they are now showing a slight downward trend (Figure 6).

Although the numbers vary from year-to-year, the overall trend for Spring Peepers has been downward (Figure 6). 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. In the last few years the numbers have increased, so perhaps the population is rebounding.

The Eastern Newts fluctuate from year to year and are also showing a slight decrease in overall numbers (Figure 3).

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).

We catch so few Pickerel Frogs (>1.0 per trapping) that although it appears the population is relatively stable, since the number of captures is so low, it is not possible to draw any meaningful conclusions.

In the past we have also caught very few Northern Two-lined Salamanders. This year showed a great increase to 1.1 per trapping. The previous high had been 0.5. Currently, the population shows an upward trend and it will be interesting to watch this species over the next few years. Although the number caught are increasing, this salamander is generally caught in such low numbers that a significant increase or decrease in population can't be reliably shown at this time.

Future use of dowels

When checking the trap, each target-individual is removed, measured, checked for abnormalities, and released unharmed on site. In the years of this study we have captured 3268 amphibians. Non-target mammals are often captured. An average of 274 non-target small mammals have been caught per year over the last three field seasons. Non-target small mammals are not injured. They have either drowned in a wet trap or are alive and active in a trap that leaked, evaporated, or did not receive any rainfall. If alive, they are assisted out with an additional stick or dowel on which they climb out and escape. There has been no need for euthanasia. Non-target mortality is an issue that we have been attempting to reduce over the years. In 2002, we attached dowels to the side of half of the buckets and half of the stainless steel cylinders to allow an escape route for the non-target small mammals. We put the dowels in half of the traps and left the other half as our control. We had hoped that after a period of three years we would be able to generate a series of reliable conversion factors. We could then multiply the number of amphibians of different species and age classes caught in traps with dowels by the appropriate conversion factor to calculate what would have theoretically been caught in a trap without dowels. As it turned out this was not possible. For the past three seasons, when examining the trends in populations we disregarded the amphibians caught in traps with dowels and multiplied the numbers caught in traps without dowels by two. We did continue to use the measurements of all amphibians in all traps for natural history and age class information.

This method of dowels in half the traps continued for 2003 and 2005. The non-target small mortality decreased 81%, 86%, and 81% respectively. Although there is a benefit of the dowels; unfortunately there is an overall reduction of amphibians captured at the same time. The reduction of total amphibians captured in 2002, 2003 and 2005 were 26%, 58%, and 64% respectively. In addition, the dowels inordinately affect some of the species that we are monitoring for long-term trends. In 2002, 2003, and 2005 Eastern Red-backed Salamanders were reduced by 83%, 100% and 100%, American Toads by 55%, 63%, and 38%, Spring Peepers 100%, 50% and 100%, and Wood Frogs by 42%, 50%, and 50%. With almost 100% reductions in Eastern Red-backed Salamanders and Spring Peepers in buckets with dowels, it would be impossible to monitor them in a system of all dowels. Declines in the numbers of other species would reduce the statistical power of our analysis. After considerable literature review, thought, and discussion we have decided to remove the dowels for the 2006 field season and return to our original methods of no dowels. To calculate population trends with power analysis it is important that we are able to compare all the year's data. Anytime we adjust our methods it is very important that we know the effects of these changes. In an ideal situation, protocols for long-term monitoring are kept the same for the length of the study. If we were able to develop a consistent and reliable way to adjust the data, the addition of dowels would have been an excellent improvement in our protocol. Unfortunately it was not possible. In addition, during the three-year course of this experiment we have weakened our data by using only data from 1/2 of our buckets to compare with past years. We also do not know for sure if the buckets with dowels had any impact on captures in buckets without dowels. It seems a better use of resources and statistically safest to remove the dowels and be able to use data from all buckets at these sites. Consequently, the dowels were removed for the 2006 field season.

Summary

Although always rare at this site, the number of abnormalities continues to decrease from its high in 1998.

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 continue for the Green Frog and the American Toad, but have reversed for the Wood Frog. The downward trend for Spring Peepers also continues, and we will have to watch the Eastern Newt to see if it is also decreasing long-term or if this year's decline is part of a normal year-to-year fluctuation. In the next few years we will be able to re-evaluate power for all species.

These data and this project are extremely important. It has been necessary to close the drift fence arrays at Lye Brook and at Ward Marsh. The drift fence array at Mt. Mansfield is not only the longest running amphibian monitoring in the state, it is also the only long-term monitoring occurring at this time.

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 2005 were Irene Linde, Robert Robbins, and Warren Ellison.

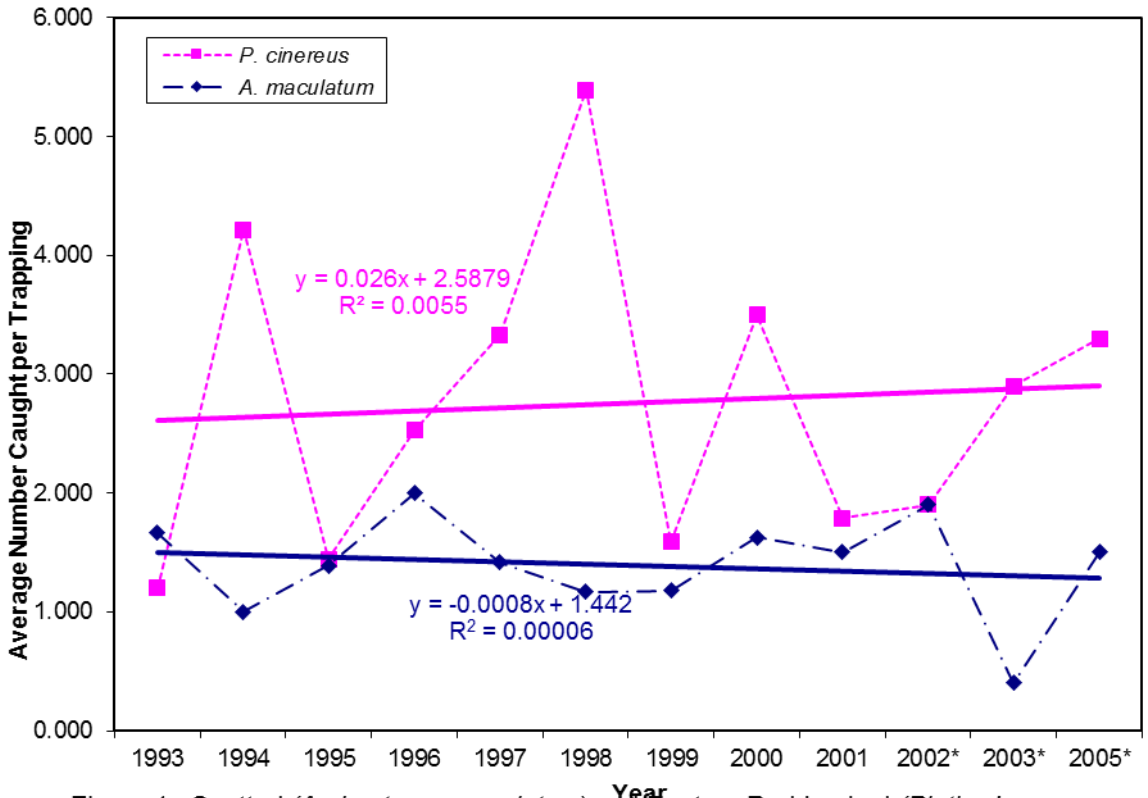

Figure 1. Spotted *(Ambystoma maculatum)* and Eastern Red-backed *(Plethodon cinereus)* Salamander population indices from Mt. Mansfield, Underhill, Vermont, 1993-2005.

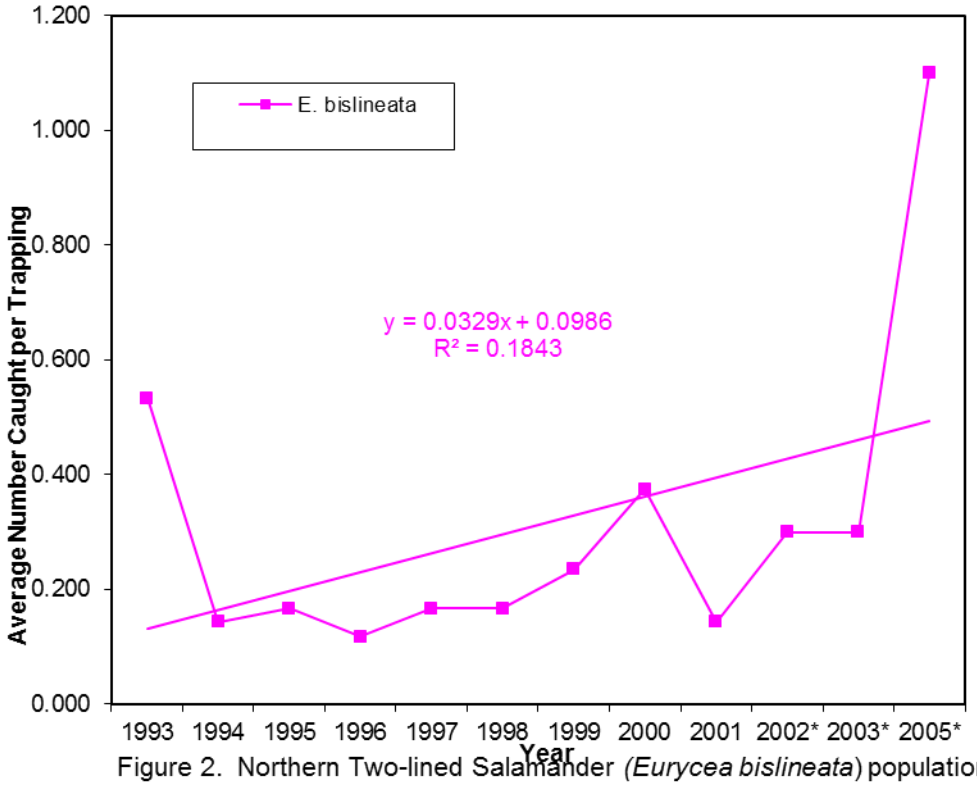

Figure 2. Northern Two-lined Salamander *(Eurycea bislineata)* population index from Mt. Mansfield, Underhill, Vermont, 1993-2005. For this species the numbers are too low to draw meaningful conclusions.

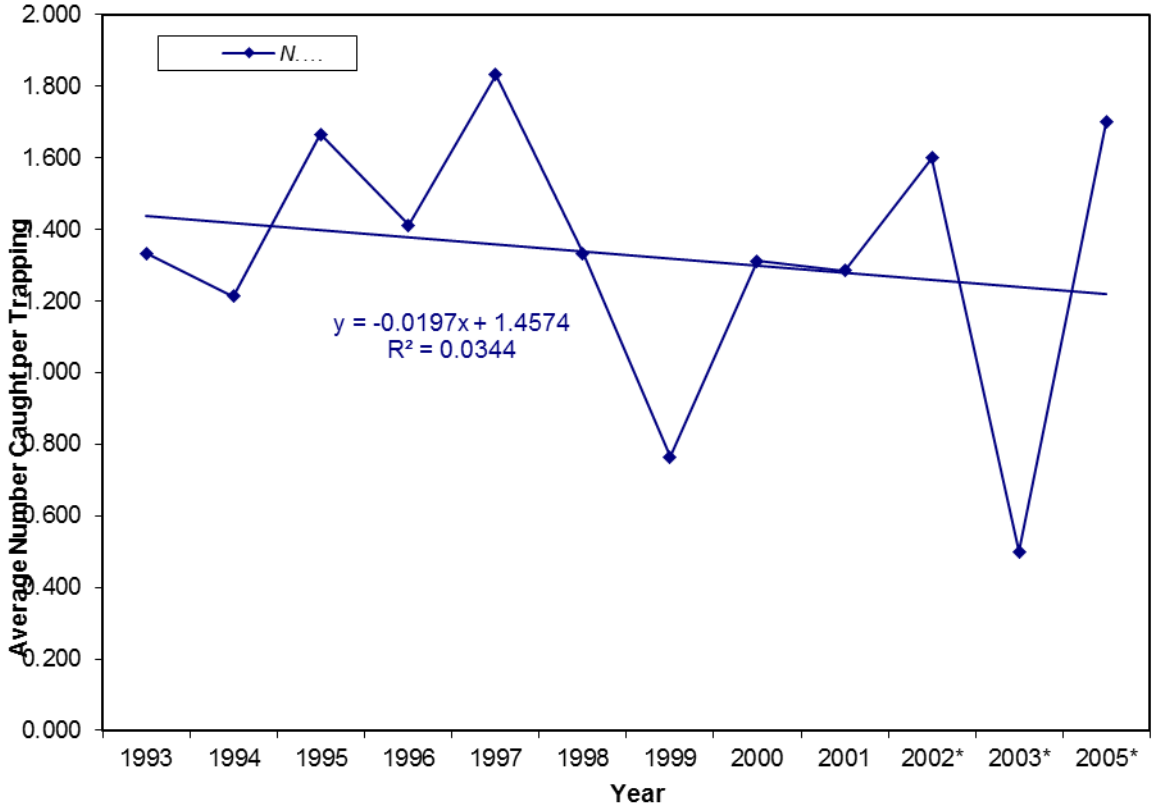

Figure 3. Eastern Newt *(Notophthalmus viridescens)* population indices from Mt. Mansfield, Underhill, Vermont, 1993-2005.

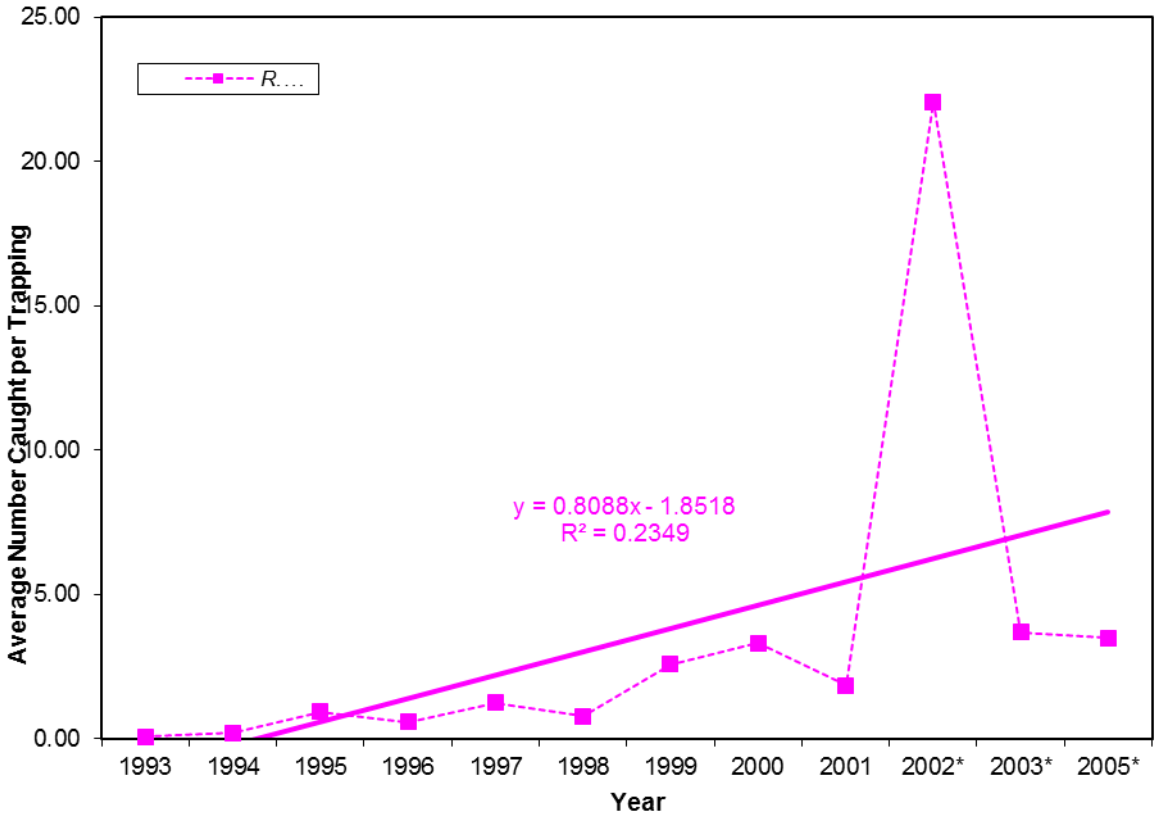

Figure 4. Green Frog *(Rana clamitans)* population indices from Mt. Mansfield, Underhill, Vermont, 1993-2005.

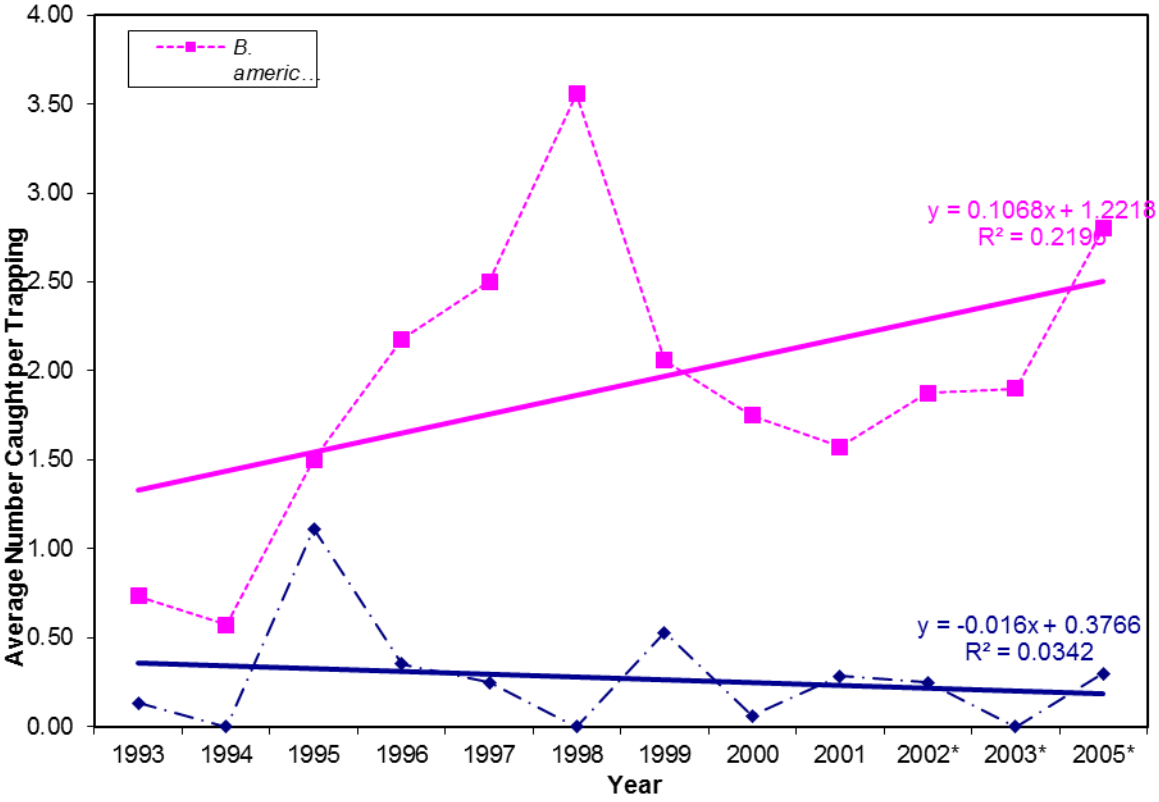

Figure 5. American Toad *(Bufo americanus)* and Pickerel Frog *(Rana palustris)* population indices from Mt. Mansfield, Underhill, Vermont, 1993-2005. The numbers for the Pickerel Frog are too low to draw any meaningful conclusions.

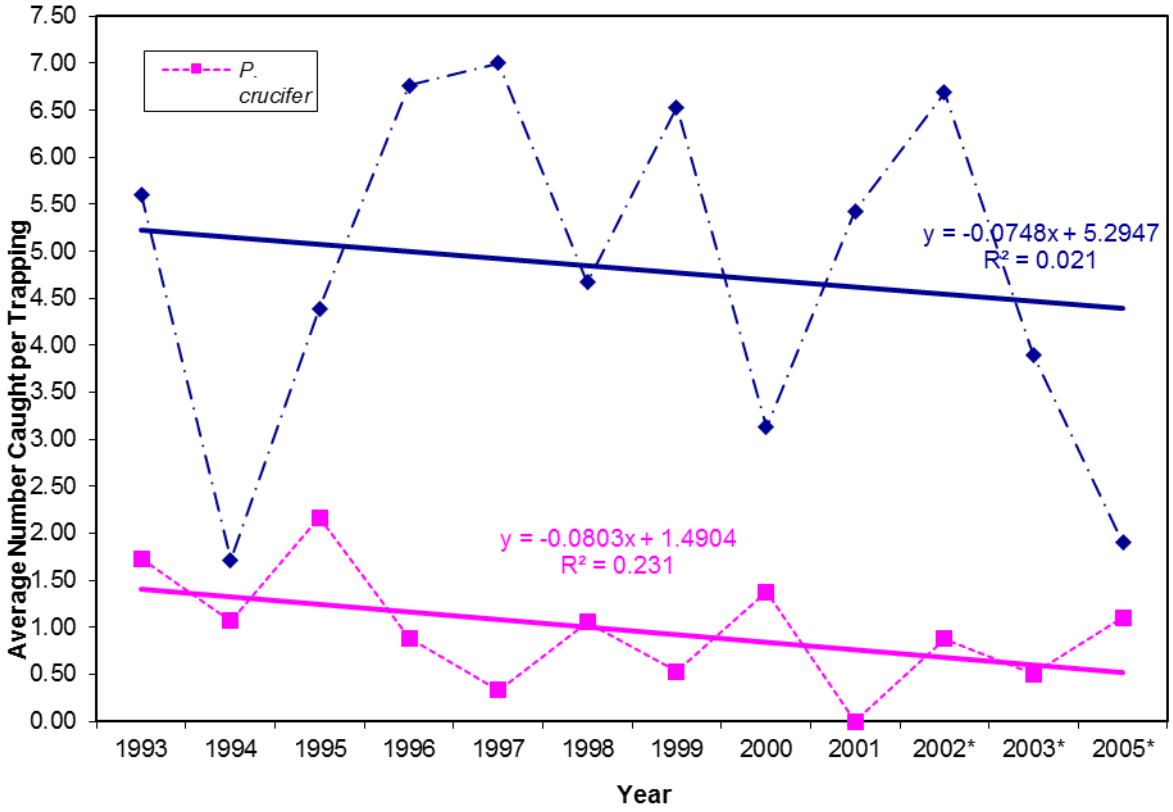

Figure 6. Wood Frog *(Rana sylvatica)* and Spring Peeper *(Pseudacris crucifer)* indices from Mt. Mansfield, Underhill, Vermont, 1993-2005.

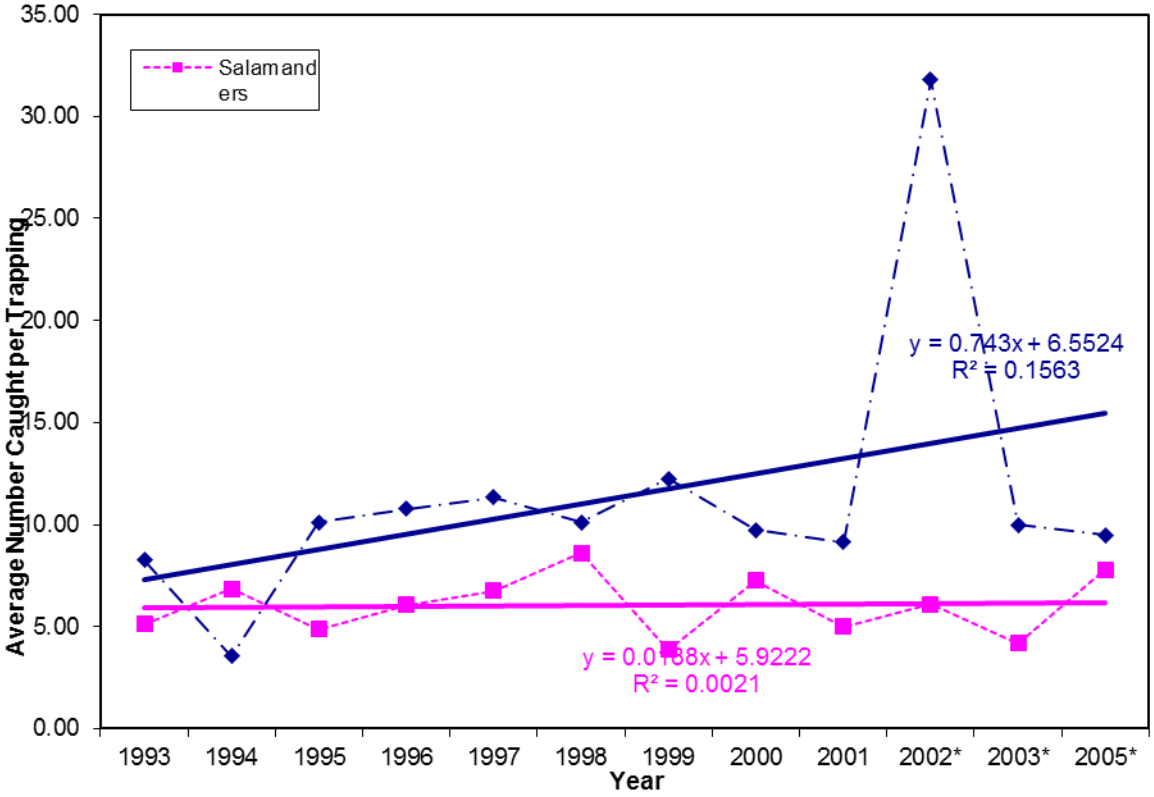

Figure 7. Salamander and frog population indices from Mt. Mansfield, Underhill, Vermont, 1993-2005. The increase in frogs in 2002 is due to the dramatic increase in Green Frogs caught per trapping, from 1.9 in 2001 to 22.1 in 2002.

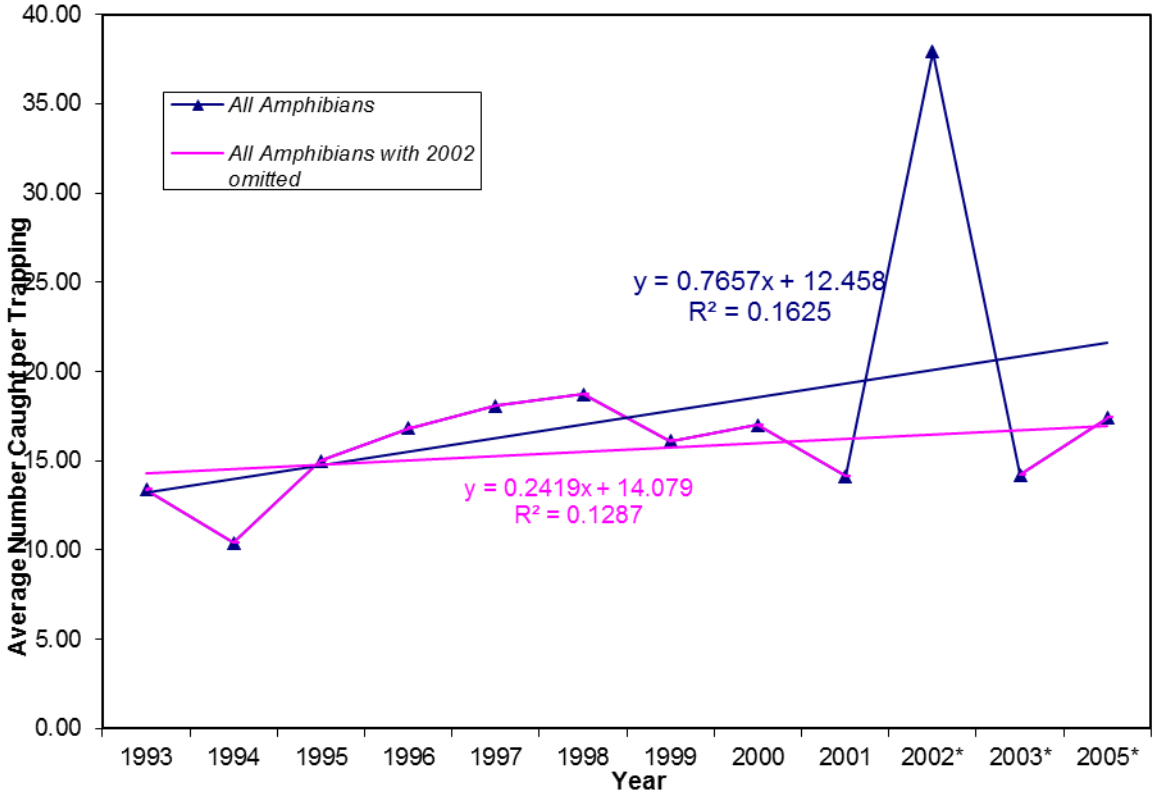

Figure 8. Amphibian indices from Mt. Mansfield, Underhill, Vermont, 1993-2005. The increase in amphibians in 2002 is due to the dramatic increase in Green Frogs caught per trapping, from 1.9 in 2001 to 22.1 in 2002.

Tables

Table 1. Effects of dowels on all drift-fence captures during the 2005 field season at Mt. Mansfield, Underhill, Vermont. Dowels were placed in 1/2 of the traps throughout the entire field season.

Herptile Capture					
Species	**Total Caught[1]**	**# Dead**	**With Dowels**	**Without dowels**	**% Reduction**
Ambystoma maculatum	20		9	11	18%
Bufo americanus	34		13	21	38%
Desmognathus fuscus	1		1	0	ISD
Eurycea bislineata	8		0	8	100%
G. porphyriticus	3		1	2	ISD
Notophthalmus viridescens	19		4	15	73%
Pseudacris crucifer	8		0	8	100%
Plethodon cinereus	24		0	24	100%
Rana clamitans	38		12	26	54%
Rana palustris	2		0	2	ISD
Rana sylvatica	24		8	16	50%
Total Amphibians	181	0	48	133	64%
Non-target Vertebrate Capture					
Small Mammal Species	**Total Caught[1]**	**# Alive**	**With Dowels**	**Without dowels**	**% Reduction**
Woodland Jumping Mouse	39	1	0	39	100%
Meadow Jumping Mouse	11		0	11	100%
Peromyscus species	77	1	10	67	85%
Meadow Vole	2		1	1	0%
Other Voles	32		11	21	48%
Short-tailed Shrew	37		10	27	63%
Other shrews	151		23	128	82%
Moles	1		0	1	100%
Total Small Mammals	350	2	55	295	81%

1 Includes both dead and live captures
ISD -- Insufficient Data

Table 2. A comparison of drift-fence data from the 1993 through 2005 (no data were collected in 2004) 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]	05[2]	93	94	95	96	97	98	99	00	01	02[2]	03[2]	05[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	1.5	12%	10%	9%	12%	8%	6%	7%	10%	11%	5%	6%	11%
Dusky Salamander	0.3	0.3	0.3	0.0	0.0	0.6	0.1	0.4	0.3	0.4	0.1	0.0	2%	3%	2%	0%	0%	3%	1%	3%	2%	1%	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	1.1	4%	1%	1%	1%	1%	1%	1%	2%	1%	0%	1%	5%
Spring Salamander	< 0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	< 1%	0%	0%	< 1%	0%	0%	0%	0%	0%	0%	0%	2%
Eastern Newt	1.3	1.2	1.7	1.4	1.8	1.3	0.8	1.3	1.3	1.6	0.5	1.7	10%	12%	11%	8%	10%	7%	5%	8%	9%	4%	3%	9%
E. Red-backed Salamander	1.2	4.2	1.3	2.5	3.3	5.4	1.6	3.5	1.8	1.9	2.9	3.3	9%	40%	9%	14%	18%	29%	10%	21%	13%	4%	15%	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	7.8	38%	66%	32%	36%	37%	46%	24%	43%	35%	14%	27%	43%
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	2.8	5%	5%	10%	13%	14%	19%	13%	10%	11%	4%	12%	18%
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%	0%	0%	< 1%	0%	1%	0%	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	1.1	13%	10%	14%	5%	2%	6%	3%	8%	0%	2%	4%	5%
Green Frog	< 0.1	0.2	0.9	0.6	1.3	0.8	2.6	3.3	1.9	22.1	3.7	3.5	< 1%	2%	6%	3%	7%	4%	16%	19%	13%	67%	28%	20%
Pickerel Frog	0.1	0.0	1.1	0.3	0.3	0.0	0.5	0.1	0.3	0.3	0.0	0.3	1%	0%	7%	2%	1%	0%	3%	<1%	2%	0%	0%	1%
Wood Frog	5.6	1.7	4.4	6.8	7.0	4.7	6.5	3.1	5.4	6.7	3.9	1.9	42%	16%	29%	40%	39%	25%	41%	18%	38%	13%	28%	13%
Group totals	8.2	3.6	10.1	10.8	11.3	10.1	12.2	9.8	9.1	31.9	10.0	9.5	62%	33%	66%	64%	63%	54%	76%	57%	65%	86%	73%	57%
Amphibian totals	13.4	10.4	15.0	16.8	18.1	18.7	16.1	17.0	14.1	38.0	14.2	17.4	100%	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, 15 in 2003, and 16 in 2005. 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 third 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 2005. 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 21 trap-efforts were used: April 23 and 28; May 1 and May 15; June 10, and 22; July 6, 23, and 27; September 9, 17, and 23; October 8, 14, and November 7.** Abnormality, maximum size, and first metamorphic data were taken from all 21 trappings.

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]
Ambystoma maculatum	20	3	15%	Oct 8	207	1.5	27%	11%	0/20
Desmognathus fuscus	1	0	0%	N/A	83	0.0	1%	1%	0/1
Eurycea bislineata	8	1	13%	14-Oct	86	1.1	11%	5%	0/8
Gyrinophilus porphyriticus	3	0	0%	N/A	152	0.3	4%	2%	0/3
Notophthalmus viridescens	16	4	25%	Sept 9	85	1.7	21%	9%	0/20
Plethodon cinereus	27	1	4%	Sept 17	87	3.3	36%	15%	0/29
Group totals	75	9	12%	NA	NA	7.8	100%	42%	0/81
Bufo americanus	32	11	34%	May 15	86	2.8	31%	18%	0/34
Pseudacris crucifer	9	0	0%	N/A	35	1.1	9%	5%	0/9
Rana clamitans	36	28	78%	June 10	57	3.5	35%	20%	0/38
Rana palustris	2	2	0%	Sept 9	33	0.3	2%	1%	0/2
Rana sylvatica	23	8	35%	July 23	25	1.9	23%	13%	0/25
Group totals	102	49	48%	NA	NA	9.5	100%	58%	0/108
Amphibian totals	177	58	33%	NA	NA	17.4	NA	100%	0/189

[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). Young of the year for *G. porphyriticus* have external gills and are aquatic for up to 4 years. 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 third 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.

Vermont Reptile and Amphibian Atlas Project
2005

Introduction

Amphibian monitoring at Mt. Mansfield provides locally intensive data on a subset of amphibian species. While this data is particularly valuable and allows us to see year to year population changes of the monitored species at this site, it will not allow us or future researchers to see more widespread changes in the distribution and/or natural history (calling times, migration dates etc.) of the full range of reptiles and amphibians statewide. While monitoring amphibian populations at Mt. Mansfield should reflect changes in forest health at that site, it will not allow us to see the impacts of forest fragmentation and consumption statewide. One of the goals of the Vermont Reptile and Amphibian Atlas is to help us gather baseline distribution and natural history data throughout the state. This state-wide project has been funded periodically by the Vermont Monitoring Cooperative. As a result of a transition to a new funding year, this aspect of our monitoring was added back into our agreement for 2004/2005 and maintained for this subsequent agreement. Leaving it in the goals of agreement allows us the flexibility to use these funds for the statewide projects as funds allow.

The goals for the 2005/6 agreement were: (1) to gather data for the Vermont Reptile and Amphibian Atlas; (2) to update links to and from the Atlas website; (3) to update selected documents on the site; (4) review and enter current and previous year's herpetological reports; (5) forward hard and soft copies of the most recent calendar year's data to the VT Non-game and Natural Heritage Program; and (6) to respond to daily requests for information on the identification, conservation, natural history, and management of Vermont's reptiles and amphibians.

Background

The Vermont Reptile and Amphibian Atlas is an effort begun in 1994 by the Reptile and Amphibian Scientific Advisory Group for the Vermont Endangered Species Committee. The atlas project initially began as an effort to gather data for use by this committee. Data were needed in order to make informed recommendations regarding the appropriate status and conservation of these species. Since then, the goals have widened to incorporate education, citizen involvement, and dissemination of information. **The ultimate goal of the Atlas is to gather and disseminate data on the reptiles and amphibians of Vermont in a way that involves and informs Vermont individuals and organizations so that they will become more informed and effective stewards of wildlife habitat**. The Atlas Project has grown since its inception in 1994 to involve over 3,000 volunteers, fifteen private organizations and government agencies, and over 60,000 records. With the help of organizations, agencies, volunteers, and staff members, we are continuing to collect information and broaden our knowledge base regarding the natural history, distribution, and effective conservation of Vermont's reptiles and amphibians.

Progress for 2005

Although the current funding agreement began during the fall of 2005 and continues into the spring and summer of 2006, for consistency and convenience we agreed to report here on the activities of the entire 2005 season (not including the spring and summer of 2006).

All the goals listed in the introduction above were completed in 2005. Much of this funding was used to support two specific projects: the generation of new distribution maps for all known Vermont herptiles and the upgrade of our website. Both projects have been completed and the results can best be seen on our updated website at http://community.middlebury.edu/~herpatlas/index.html. The previous set of maps was produced in 2001 and it is very exciting to see the progress that has been made. The updated maps were included with the 2005.5 report.

During 2005, we entered just over 4800 new records of Vermont's reptiles and amphibians into our database. These records represent every county in Vermont and over 140 Vermont towns, gores, and

cities. Over 380 volunteers contributed reports, and those reports included all known species of Vermont herptiles except for one (Western Chorus Frog). Almost all of the contributors were individually contacted, thanked, and urged to continue contributing records. During this contact, conservation suggestions were regularly made. These reports included important new records of some of our rarest species. Heritage S1 species (rarest state category) included the Five-lined Skink, Fowler's Toad, Eastern Racer, Timber Rattlesnake, and Spiny Softshell (turtle). S2 species (rare) included Jefferson Salamander, Four-toed Salamander, Mudpuppy, Eastern Ratsnake, Eastern Ribbonsnake, and Stinkpot (turtle). S3 species (unusual) included Blue-spotted Salamander, Northern Watersnake, Wood Turtle, and Northern Map Turtle.

We discovered the only known denning site of the Eastern Racer, Vermont's rarest snake in the fall of 2004. In the spring of 2005, we located and PIT-tagged seven racers leaving this den. This site lies under a power line and the power company, the VT Department of Transportation, and the VT Department of Fish and Wildlife are all working with us to create and preserve habitat for this species. This is an unprecedented example of voluntary cooperation not forced by the regulatory process and we have highlighted the benefit of this cooperation when we presented at a recent regional conference on ecology and transportation and at 2005 Canadian Amphibian Reptile and Conservation Conference in Ottawa. This work continued throughout the fall of 2005, where we were able to follow the snakes back to the same den site. Unfortunately, one of the snakes was killed by a motor vehicle in the area. Although the accident was extremely unfortunate, it did result in a fair amount of positive press for snakes in Vermont and conservation in general. The project will continue through 2006.

The above cooperation is largely the result of an ongoing training program that we are providing to the employees of the VT Department of Transportation on transportation and wildlife issues. This is a field-training program run jointly by our organization, Keeping Track, and the VT Department of Fish and Wildlife. By the end of 2005, we had completed two years of training and we are seeing a much greater willingness to participate in conservation actions on the part of VTRANS. In 2006, the training will continue in Vermont and will expand into New Hampshire.

During the summer of 2005, we confirmed a road-killed Eastern Racer at a previously unknown location. This may lead us to the second known population of Eastern Racers.

One of the many organizations we cooperated with again this year was Audubon Vermont. As in the past, we worked with a group of teenagers from around the country for an eight-day period of herptile surveys in Vermont. With this group we managed to survey Rutland, Pittsford, Mendon, Wilmington, and potential Eastern Racer habitat in Guilford and Dummerston. As a result, we added many new species to our database that had not been previously documented from these towns. In all, they gathered 744 new records from 21 priority towns in eight counties.

Some of the atlas survey work completed in 2005 was through collaborations with graduate interns from Antioch New England and St. Mary of the Woods College who targeted rare species or towns that had been poorly surveyed.

In 2005, we worked with a Vermont Commons High School intern who produced an educational poster of the snakes and lizards of Vermont. This poster was recently printed and we will send you a copy under separate cover. She also drafted another educational poster focused on Vermont turtles. We plan on printing both of these in volumes that will allow us to distribute them at low cost to interested individuals and organizations. All proceeds from the sales will be used to fund additional Atlas activities.

We have kept our contacts going with the media. Outdoor Journal (Vermont Public Television) aired two short pieces on our work during the winter of 2004/5. One focused on the Five-lined Skink and the other on the Eastern Racer. We took advantage of both of these opportunities to promote awareness and conservation of herptiles as well as participation in the Vermont Reptile and Amphibian Atlas Project. The piece on the snakes of Vermont focused on the Milksnake and was not only carried by all the major Vermont newspapers but was picked up and distributed widely outside of the state through the Associated Press. A *New York Times* reporter spent a day with us gathering information for an article on calling

amphibians in Vermont. As usual, this type of media coverage generated many reports and requests for information. There was a variety of articles relating to the unfortunate demise of the radio-tracked Eastern Racer. Articles and/or pictures about the Racers were seen in the *Burlington Free Press*, *Addison Eagle*, *Rutland Herald*, *Brattleboro Reformer*, and assorted websites.

We finished the initial draft of the recovery plan for Timber Rattlesnakes in Vermont during the summer off 2005. We have set up a recovery team, including national and regional experts that we are very pleased with.

Interest in our spring amphibian crossing educational and research events is continuing to grow and spread to other organizations and locations.

In 2005, a senior at Middlebury College, and former Atlas employee, studied the genetic make up Vermont's Eastern Ratsnake. In addition to collecting some very important natural history information he also worked to determine the relatedness of our snakes to Eastern Ratsnakes in Canada. These results suggest that at one point the two populations were linked. For more information in Kyle's work please see: http://www.middlebury.edu/about/pubaff/sstory/fellowstudents/RatsnakeVonHasseln.htm

We continue to provide conservation information to a wide variety of private individuals, companies, and organizations, as well as governmental units. For example, we recently provided historic sighting information on Spiny Softshells (turtles) to help a team of Quebec researchers locate a missing radio-tagged turtle. Many foresters now consider the needs of herptiles and their movements in their management plans. Citizens have taken action to increase the permeability of roads. The Vermont Department of Transportation works with us regularly to help them meet the needs of herptiles. Critical habitat for Timber Rattlesnakes has been purchased. The Eastern Racer is now listed as a threatened species in Vermont. Lampricide concentration levels have been lowered to help prevent Mudpuppy mortality. We have played a pivotal role in all of these and many more conservation actions that benefit not only herptiles but also many other species. We expect them to continue as a result of our efforts.

2006 and Beyond

With the help of VMC funding and other funding sources our work continues. In addition to presence and absence data we are continually collecting data on lengths, masses, calling times, birthing and/or egg laying times, habitats, road crossings, and other natural history information for all of Vermont herptiles. We also plan to continue educational efforts. We envision an up-to-date website, the creation of additional educational posters, a reptile and amphibian book, and continued collaborations with local and regional organizations to continue to gather and disseminate data on the reptiles and amphibians of Vermont in a way that involves and informs Vermont individuals and organizations so that they will become more informed and effective stewards of wildlife habitat.

At the same time, our knowledge of the current distribution and natural history of Vermont's reptiles and amphibians needs to be steadily improved. These data are essential as a reliable baseline for any changes that may occur in the future. It is impossible to show range changes and/or extirpations if you don't have the baseline data as a reference.

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