Mt. Mansfield Amphibian Monitoring

Update

2012

(Covering 1993-2012)

For the Vermont Monitoring Cooperative

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Amphibian Monitoring on Mt. Mansfield, Vermont
1993-2012

Background

After an initial amphibian survey and establishment of monitoring protocols, populations of amphibian species have been monitored annually on Mount Mansfield since 1993. 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. 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.

We have drift-fence data from Mt. Mansfield from 1993 to the present, with the exceptions of only 2004 and 2009. Although, we also collect data from fences near the Lye Brook Wilderness in southern Vermont periodically, the drift-fence array at Mt. Mansfield was the only active amphibian drift-fence monitoring location in Vermont from 2003 through 2007. During 2008 monitoring began again at Lye Brook Wilderness and continued at Mt. Mansfield as well. Periodic monitoring at Lye Brook allows us to compare data at the two locations to see if there are corresponding patterns that may signal statewide changes. In 2009 only the Lye Brook Wilderness fences were monitored, and in 2010 only Mt. Mansfield fences were monitored. In the fall of 2011, Hurricane Irene washed out the road leading to the Lye Brook drift fences, preventing data collection in the fall of 2011 and in 2012. Prior to monitoring at this site again a new road allowing access from Manchester needs to be completed. We also need to locate and train new staff. This process could be completed as early as 2014, but it is more likely everything will be in place by 2015. Intensive monitoring was completed in 2011 and 2012 at Mt. Mansfield, and the plans are to continue to annually monitor at that site.

As per a former contract with the State of Vermont, in 2009 it was agreed that amphibian and reptile monitoring and survey data would continue to be gathered, reviewed, entered into our database, and forwarded to the Vermont Monitoring Cooperative. However, in an effort to save money and time, we agreed at that point to begin an every-other-year schedule of generating indices, analyzing, and reporting on the data gathered. Consequently, the 2009 report included basic background information and a very brief review of the survey data. The 2010 report included new data gathered from Lye Brook in 2009 and Mt. Mansfield in 2010. Following the every-other-year schedule this report includes new data collected in 2011 and 2012 from Mt. Mansfield. Electronic copies of the data are included with this report.

Population Trends at Mt. Mansfield

In 2011 and 2012 all the usual salamander species were caught as adults, including two Spring Salamanders (*Gyrinophilus porphyriticus*) caught in 2011. Young of all of these salamander species except Northern Dusky (*Desmognathus fuscus*) and Spring Salamanders were also caught both years.

In 2008 and in 2010 (no data were collected from Mt. Mansfield in 2009) adults of all the local anurans (frogs) normally found were caught except there were no adult or young Spring Peepers (*Pseudacris crucifer*). Their absence after a long period of gradual decline concerned us. In 2011 and 2012 adult Spring Peepers were caught once again (15 and 3) and one young of the year was caught in 2012. In 2011 all anuran young of the year were found except Pickerel Frogs (*Lithobates palustris*) and Spring Peeper. In 2012 all anuran young of the year were found.

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 1993-2012 (Figures 1-6). The data gathered suggest that only the Eastern Red-backed Salamander (*Plethodon cinereus*) shows a significant increase, and the American Toad (*Anaxyrus americanus*) shows a slight decrease. Between 1993 and 2010 the Spring Peeper had disappeared from our fences, and although 15 animals were caught in 2011, the overall trend still shows a decline. The Wood Frog (*Lithobates sylvaticus*) is also showing a significant decline at these fences.

Young of the Year

For the 1995 report we began calculating the number of young of the year and percentage of young of the year, and recording date of first metamorph found in a drift fence. The cutoff lengths listed on Table 1 and Table 2 were calculated in 1995, based on data we had collected and information gathered from the literature. As mentioned in the footnotes, in addition to using the total length as one cutoff for determining young of the year, we also use dates, as some larvae or tadpoles may overwinter in their aquatic phase and metamorphose in the early spring. In 2012 and 2011, young of the year made up 23% and 17% of those caught (Table 4 and 5). As was the case in 2010, 2008, and 2007 (23%, 16%, 17%), these percentages are lower relative to all but one of the previous years of this study. Since the study's inception the young of the year have varied from 16% (1998 and 2008) to 74% (2002). Table 4 and Table 5 summarize the young of the year information for salamanders and frogs respectively.

All frogs monitored except for Green Frogs (*Lithobates clamitans*) generally grow from egg to metamorph in one season. At this latitude and elevation, Green Frogs usually spend at least one winter as a tadpole and metamorphose a year or more after the eggs were laid. Other frogs can metamorphose at a very small size. American Toads (*Anaxyrus americanus*) can be as small as 8-13 mm after metamorphosis. Gray Treefrogs (*Hyla versicolor*) as small as 15 mm. Wood Frogs can transform as small as 10-20 mm and Spring Peepers as small as 13 mm. It is possible that a froglet may have transformed in a previous year but still be under the cut-off size to be considered young of the year when found the following spring. Therefore, when determining young of the year we did not include small frogs or toads found in spring or early summer if it was unlikely enough time had passed to allow for development through metamorphosis. Different species of salamanders show even more variability and for many the term *young of the year* is misleading. It would be more accurate for us to say *first year of terrestrial phase*. The Eastern Newt (*Notophthalmus viridescens*) and the Eastern Red-backed Salamander generally develop into a terrestrial form in the first year of their life; although like the frogs, they may still be very small and below our cutoff sizes the spring after they were deposited as eggs. Spotted Salamanders (*Ambystoma maculatum*) have a minimum larval phase of about 60 days but can remain in the water as larvae over their first winter. Small Spotted Salamanders found in the spring and early summer are not counted as young of the year in this report. Northern Dusky Salamanders can spend 7 to 11 months as larvae and transform the spring after emerging from eggs. Northern Two-lined Salamanders (*Eurycea bislineata*) may remain in their aquatic stage for 2 – 3 years, and Spring Salamanders can remain in their larval form for up to 3-4 years (Harding 2000). What we refer to as young of the year for these species are individuals that had hatched in previous years but were spending their first year in the terrestrial form.

Green Frog

The number of Green Frogs increased slightly through 2002 when there was a dramatic increase from 1.9 per trapping to 22.1 per trapping, for a total of 350 Green Frogs captured (Figure 1). After that one dramatic year, there was a large drop back down to the historic trend line in 2003 and only relatively small annual variations since then. In 2010 only 0.9 Green Frogs were found per trapping, increasing to 1.5 per trapping in 2011 and 4.1 per trapping in 2012. Currently, the population appears to be level with only a slight increase showing. So far, the take home message here is the ability of this species to show dramatic short-term population changes.

American Toad

In our last update we reported that the number of American Toads appeared to fluctuate in a cyclical way growing to peaks over the course of a few years and then gradually dropping back down over a few years. However, the data from 2003 through 2008 revealed an entirely new pattern of large annual variations (Figure 2) with the peak in 2007 (3.4 toads per trapping) very close to the all-time high in 1998 of 3.6 toads per trapping. In 2010, 2.2 toads were found per trapping. Only 1.7 per trapping were caught in 2011, and a large increase to 3.4 per trapping was seen in 2012. This annual variation is so large that although the population trend appears to be increasing, no significant long-term trend can be seen. It will be interesting to see if the numbers in 2013 continue to be as high as 2012, or if this was a one year fluctuation.

Wood Frog

Wood Frogs continue to have large year-to-year fluctuations (Figure 3 and Table 3) but a long-term decline is very clear with a high of 7 per trapping in 1997. In 2005 and in 2006 their per-trapping rate fell to 1.9 and 2.1 followed by an increase in 2007 to 4.7 and back down to 2.5 in 2008. In 2010 very few Wood Frogs were found (1.9 per trapping), yet there was a slight increase in 2011 with 4.5 followed by another decrease in 2012 when 3.1 per trapping were found. Perhaps of greater concern for the future is the dramatic decrease of young of the year found in 2012, from 31% in 2011 to 4% in 2012. This is the lowest number of young of the year detected since the inception of the study (Table 5).

The species is showing a distinct, and dramatic, downward trend. The cause of this decline is unknown but is of concern. Appropriate breeding habitat still exists close to at least one of the fences and egg-masses have been observed in these pools. However, there may have been declines in foraging habitat, overwintering success, or successful development of the eggs or young. The fluctuation in spring weather has been dramatic in the past few years and this may be having an effect on those amphibians that breed in early spring. Future data from Lye Brook will help us understand if this is just a localized decline. We have not seen this decline at a privately funded site in Lincoln (Colby Hill Ecological Preserve) where we are monitoring egg-mass numbers.

Spring Peeper

Although the numbers vary from year-to-year, the overall trend for Spring Peepers has been steadily downward since 1993 (Figure 3 and Table 3). In 2007 we had only two Spring Peepers caught during the entire season and no young of the year. In 2008 and in 2010 we had no adults or young. In 2011, 1.0 per trapping were found, but no young of the year and in 2012, 0.2 per trapping were found and the first young of the year were detected since 2003. As mentioned in previous updates, local changes in breeding habitat are one possible explanation for a localized long-term decline, but we have no data to support a significant change in habitat. Spring Peepers breed primarily in open, shallow, and well-vegetated wetlands. If local breeding habitat were flooded by beaver and/or exposed to trout, populations might well be expected to decline. This is supported by the fact that we have never caught a Spring Peeper at the drift-fence at Underhill State Park. As far as we can tell, there is no breeding habitat in that area.

We mentioned in our last update that predation from an increased number of Green Frogs might be related to the decline of the Spring peeper; however, Green Frogs and Spring Peepers are both showing a slight increase over the last few years. Other possible causes could be the aging of forests, loss of edge habitat, and the resulting shading of wetlands in the area. However, the concurrent decline in Wood Frogs, a species that breeds successfully in pools surrounded by mature hardwood forests, suggests there may be some other factor impacting both species (foraging habitat, overwintering success, predation or other conditions in the breeding ponds, developmental issues). We have not seen this decline at Lye Brook Wilderness, so the peeper decline may be a local phenomenon, or over time we may find that the population naturally cycles.

Eastern Newt

The Eastern Newt has also shown large annual fluctuations in recent years. From 1993 to 2002 the largest annual change in our abundance index was 0.5 per trapping. Then in one year (2003) the index dropped 1.1, to 0.5 per trapping and then jumped back up 1.2 to 1.7 in 2005 (two years later), dropping again by 0.9 to 0.8 in 2006 and then climbed by 0.5 per year for two years reaching 1.8 per trapping in 2008. Since that peak, the numbers have dropped steadily to 1.6 per trapping in 2010, 1.0 in 2011, and 0.7 per trapping in 2012. The 2012 rate was the second lowest found since the inception of the study. The long-term trend line shows a slight decrease in the population between 1993 and 2012 (Figure 4).

Eastern Red-backed Salamander

Like the other amphibian species found at this site, the Eastern Red-backed Salamander population occasionally shows large annual fluctuations; however, since 2001 this species has shown a steady, and now dramatic, increase from 1.8 to 6.7 captures per trapping in 2008 and a record 8.9 salamanders per trapping in 2010 (Figure 5 and Table 3). The numbers decreased slightly in 2011 and 2012 to 7.5 and 7.2 per trapping, but still they are relatively high. This species is reported to do well in mature hardwood forests with abundant coarse woody debris. Unlike the Wood Frog and Spring Peeper it overwinters deep in the soil below the frost line, so it should not be subject to overwintering mortality. Also, unlike Wood Frogs and Spring Peepers, it does not require wetlands in any stage of its development, so hydroperiod or other conditions in breeding ponds would not have any direct impact on their numbers.

Spotted Salamander

The Spotted Salamander has a virtually flat trend line, with increased annual variation since 2002 (Figure 5). In 2010, 2.0 animals were captured per trapping. The second time this many animals have been found since the study began. The numbers continued to show an annual variation with 0.9 per trapping found in 2011 and 1.5 per trapping found in 2012. This is a long-lived species with a life span of over 20 years. As a result, adult numbers are not expected to vary as much as a shorter-lived species such as a Spring Peeper or Wood Frog. At this site it breeds in the same pools as the Wood Frog. Table 4 shows that breeding in these pools was successful in 2011 and 2012 as 38% and 40% were young of the year. One might assume that Wood Frog recruitment should also have been high in these pools, but Table 4 shows that recruitment of Wood Frogs has been low since 2003 when 59% of those caught were young of the year, with the lowest number found in 2012 (4%). One difference is that Spotted Salamanders are more resistant than Wood Frogs to a variety of potentially threatening conditions such as predation, short-term draught, and late season freezes in their breeding ponds. The spring temperatures have varied a great deal in the past few years with some Wood Frogs moving at record early dates elsewhere in Vermont. This could result in fatal freezing temperatures after eggs were laid. Spotted Salamanders also over-winter well below the frost line. In contrast, Wood Frogs freeze and thaw in the leaf litter and are very susceptible to winter kill if soil temperatures drop below approximately -6 C (20-21 F). Another interesting correlation is that the increased annual variation of Spotted Salamanders began in 2002, the same year that Green Frog populations soared, Wood Frog populations peaked, and E. Red-backed Salamanders began their impressive increase. The different life histories of these species may provide some clues as to what is driving declines in Wood Frogs and Spring Peepers at the same time that we see increases in other species such as Eastern Red-backed Salamanders.

Pickerel Frog

We catch so few Pickerel Frogs (fewer than 1.0 per trapping) that although it appears the population continues to decrease slightly; it is not possible to draw any meaningful conclusions (Figure 2 and Table 3).

Northern Two-lined Salamander

In the past, we have also caught very few Northern Two-lined Salamanders. In 2005 we saw an increase to 1.1 per trapping, followed in 2006 by a drop back to 0.2, then a slow increase until the population peaked again in 2010 with 1.1 per trapping found. Since then, the population has decreased to 0.9 and 0.5 in 2011 and 2012 respectively (Figure 6 and Table 3). The fences are not located in appropriate locations to monitor for this species. They prefer saturated soils and increased saturation of soils as a result of heavy rains would be expected to increase numbers of this species at the fences. However, the increasing trend line shown in Figure 6 represents a very small sample size and could change quickly.

Abnormalities

The number of abnormalities continues to be low. In 2007 and 2008 there were no amphibians found with abnormalities out of 300 caught in 2007 and 208 caught in 2008. Again in 2010, no abnormalities were found in the 274 animals captured. In 2011, one abnormality was detected in the 314 animals captured. A Wood Frog had a left leg that bent back over the top of the frog. In 2012, two of the 384 animals were found with abnormalities. One Spring Salamander was missing toes and its lower leg, and a Green Frog was found with an atrophied right rear leg. The numbers of abnormalities at this site have always been well below the level of concern. From 1998 through 2012, the total number of amphibians showing abnormalities from all captures has been 14 individuals.

Summary

The drift-fence array at Mt. Mansfield has facilitated the longest-running amphibian-monitoring program in the state. It is the only amphibian drift-fence location in Vermont that has been monitored almost continuously from 1993 through 2012. During 2009 monitoring took place only at Lye Brook and we plan to continue there following road repair and the hiring and training of new staff. Data from these efforts has been exported in Excel format and sent via E-mail to VMC. Monitoring will continue at Mt. Mansfield in 2013 and hopefully return for one more year at Lye Brook in 2014 or 2015.

Although we have not used power analysis to evaluate apparent trends in species populations since 2001 (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. Despite the lack of the more statistically rigorous power analysis recently, the linear regressions alone show that these trends have not continued. The Green Frog and the American Toad show no significant trends, although they have shown some large annual variation. The Wood Frog is now showing a dramatic decline as a result of particularly low abundance in 2005, 2006, 2008, and 2010. Finding only 4% were young of the year in 2012 could mean next year's numbers will be even lower. The downward trend for Spring Peepers continues, even though some animals were found in 2011 and 2012. Although the Eastern Red-backed Salamanders did not continue to increase in 2011, after increasing in abundance for the last nine years, they were still found in relatively high numbers. There was some precipitating event in 2002 when Green Frogs showed a very brief one-year peak in abundance. At the same time Spotted Salamanders began larger annual oscillations in annual populations and within a year Eastern Red-backed Salamanders began their dramatic population increase. Life history differences and similarities between species will help us rule out some potential causes of these changes and suggest others, but at this point, little is known about what is driving these changes.

Although always rare at this site, the number of abnormalities remains very low.

Acknowledgments

The Vermont Department of Forests, Parks, and Recreation through the Vermont Monitoring Cooperative (VMC) and Vermont Family Forests supported long-term monitoring at Mt. Mansfield during 2011 and 2012. Field personnel were Karl Riemer, Robert Robbins, and Warren Ellison.

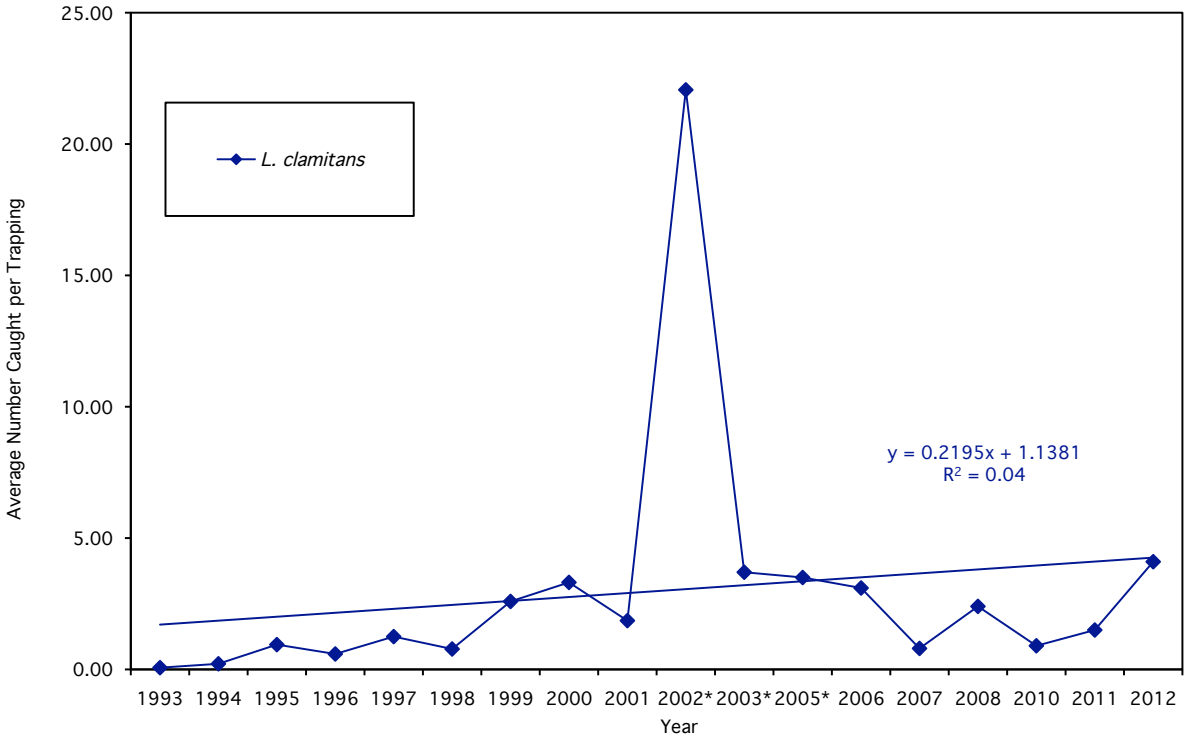

Figure 1. Green Frog *(Lithobates clamitans*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2012.

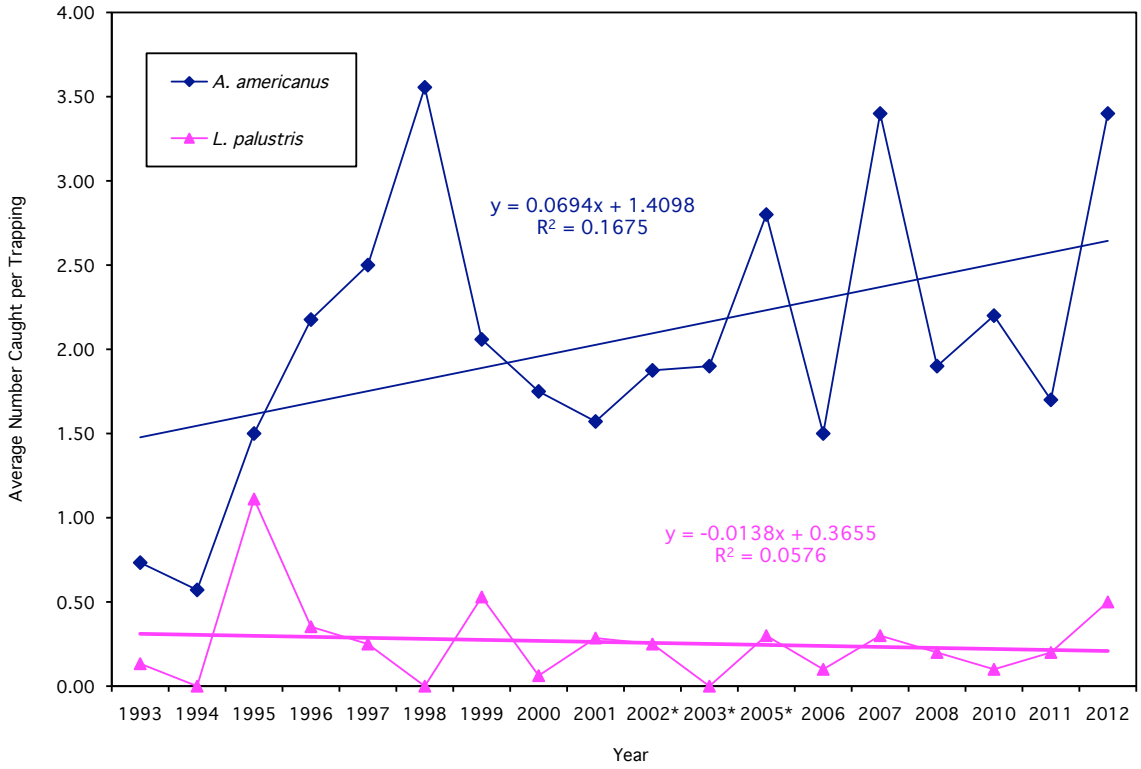

Figure 2. American Toad *(Anaxyrus americanus*) and Pickerel Frog *(Lithobates palustris*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2012. The numbers for the Pickerel Frog are too low to draw any meaningful conclusions.

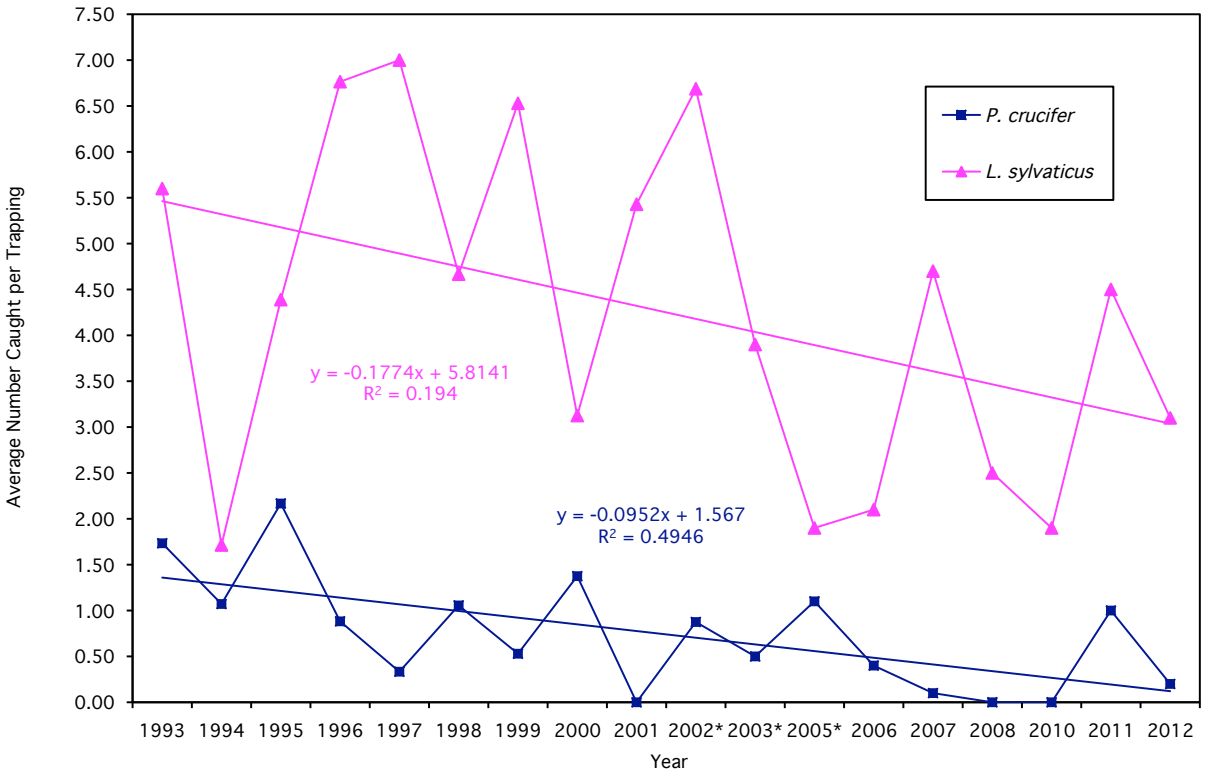

Figure 3. Wood Frog *(Lithobates sylvaticus)* and Spring Peeper *(Pseudacris crucifer)* indices from Mt. Mansfield, Underhill, Vermont, 1993-2012.

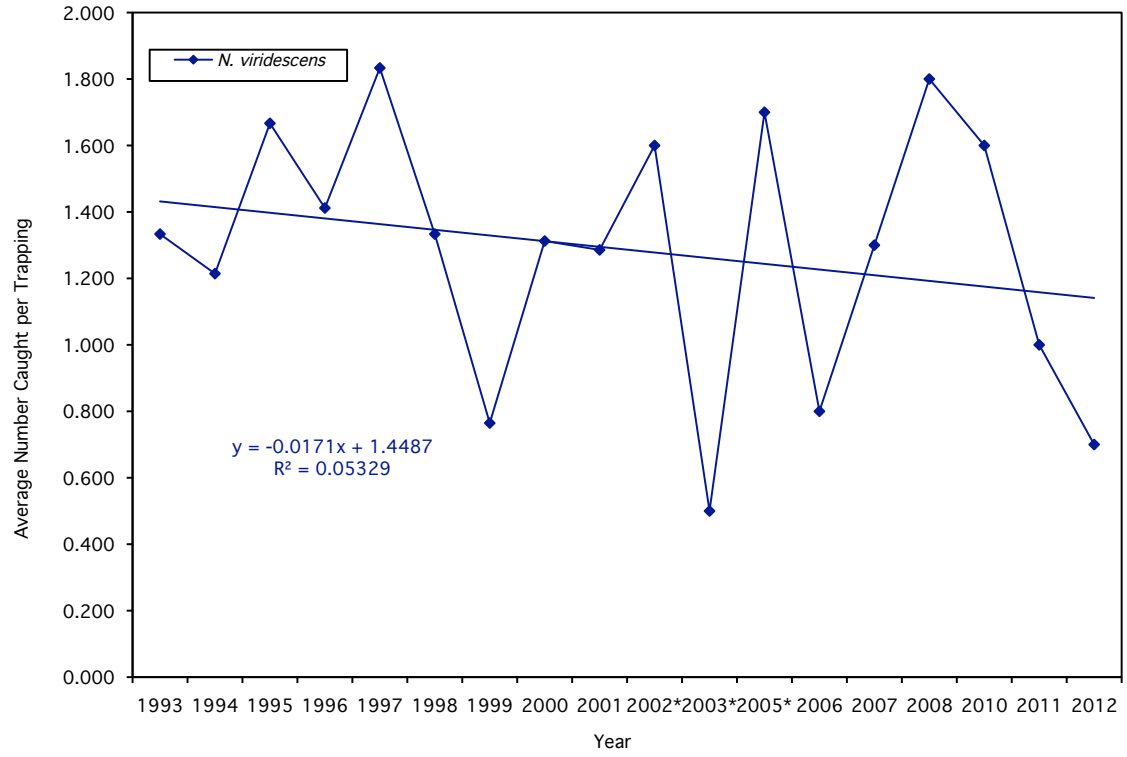

Figure 4. Eastern Newt *(Notophthalmus viridescens)* population indices from Mt. Mansfield, Underhill, Vermont, 1993-2012.

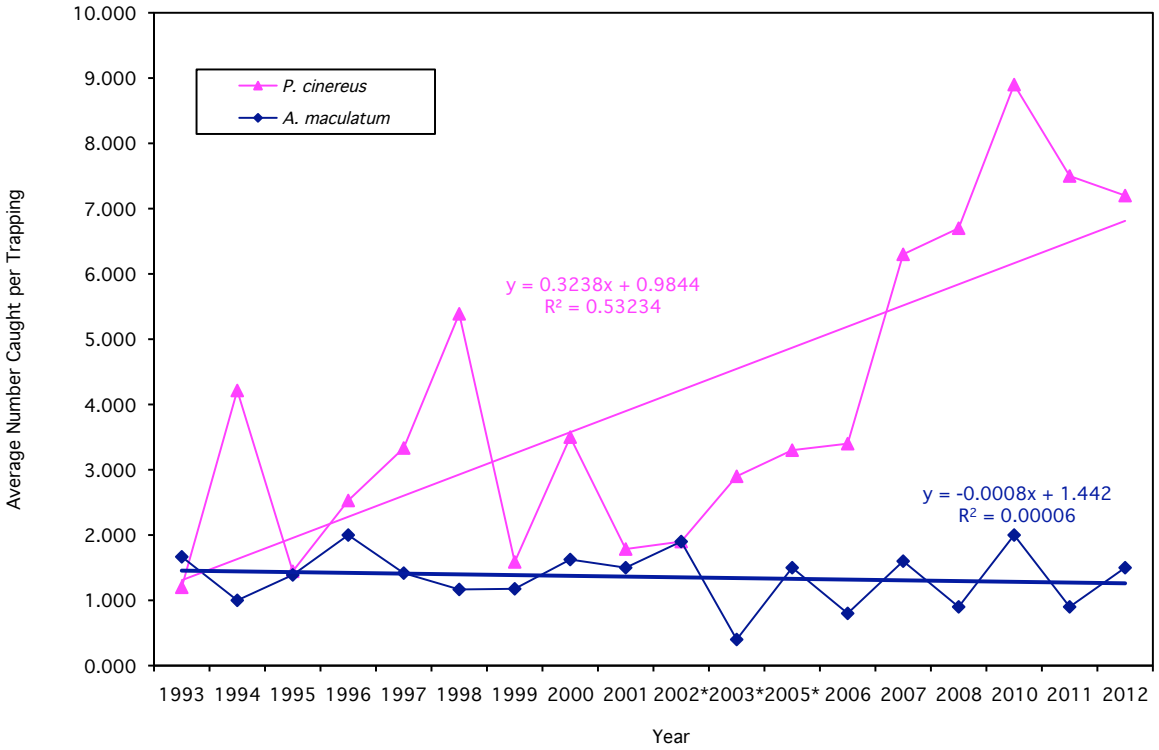

Figure 5. Spotted *(Ambystoma maculatum*) and Eastern Red-backed *(Plethodon cinereus*) Salamander population indices from Mt. Mansfield, Underhill, Vermont, 1993-2012.

Figure 6. Northern Two-lined Salamander *(Eurycea bislineata*) population index from Mt. Mansfield, Underhill, Vermont, 1993-2012. Capture rates are too low to draw meaningful conclusions about long-term trends for this species.

Table 1. Monitoring results from the two drift-fences at 1,200 ft. and one at 2,200 ft. on Mt. Mansfield, Underhill, Vermont during 2011. 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 19 trap-efforts were used: April 26 and 29; May 4, 15, and 24; June 10 and 23; July 7, 26, and 30; September 5, 23, and 30; October 14 and 20**. Abnormality, maximum size, and first metamorph data were taken from all **19** 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 [3]	% of group	% of total catch	# abnormal/ total [5]
Caudates (Salamanders)										
Spotted Salamander	*Ambystoma maculatum*	13	5	38%	July 30	202	0.9	8%	4%	0/13
N. Dusky Salamander	*Desmognathus fuscus*	3	0	0%	NA	102	0.2	2%	1%	0/3
N. Two-lined Salamander	*Eurycea bislineata*	14	2	14%	July 26	89	0.9	9%	5%	0/14
Spring Salamander	*Gyrinophilus porphyriticus*	2	0	0%	NA	157	0.1	1%	1%	0/2
Eastern Newt	*Notophthalmus viridescens*	15	9	60%	Sept. 23	92	1.0	9%	5%	0/17
E. Red-backed Salamander	*Plethodon cinereus*	113	0	0%	Nov 11	96	7.5	71%	38%	0/128
Group totals	Group totals	160	16	10%	NA	NA	10.7	100%	54%	0/177
Anurans (Frogs)										
American Toad	*Anaxyrus americanus*	26	1	4%	Sept. 5	90	1.7	19%	9%	0/27
Green Frog	*Lithobates clamitans*	23	12	52%	July 26	73	1.5	17%	8%	0/23
Pickerel Frog	*Lithobates palustris*	3	0	0%	NA	57	0.2	2%	1%	0/3
Wood Frog	*Lithobates sylvaticus*	68	21	31%	July 7	61	4.5	38%	10%	1/68
Spring Peeper	*Pseudacris crucifer*	15	0	0%	NA	35	1.0	0%	0%	0/16
Group totals	Group totals	135	34	25%	NA	NA	9.0	76%	46%	1/137
Amphibian totals	Amphibian totals	295	50	17%	NA	NA	19.7	NA	100%	1/314

[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), *A. americanus* (23 mm), *H. versicolor* (26 mm), *P. crucifer* (20 mm), L. *clamitans* (44 mm), *L. palustris* (34 mm), and *L. sylvaticus* (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] 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.

Table 2. Monitoring results from the two drift-fences at 1,200 ft. and one at 2,200 ft. on Mt. Mansfield, Underhill, Vermont during 2012. 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 17 of 20 trap-efforts were used: April 17 and May 2; May 8, 15, and 23; May 30, June 13, and July 5; July 16, 17, and 24; September 5, 19, and 29; October 4, 15, and 31.** Abnormality, maximum size, and first metamorph data were taken from all **20** 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 [3]	% of group	% of total catch	# abnormal/ total [5]
Caudates (Salamanders)										
Spotted Salamander	*Ambystoma maculatum*	25	10	40%	Sept. 5	195	1.5	14%	7%	0/27
N. Dusky Salamander	*Desmognathus fuscus*	9	0	0%	NA	111	0.5	5%	2%	0/9
N. Two-lined Salamander	*Eurycea bislineata*	9	1	11%	July 16	95	0.5	5%	2%	0/9
Spring Salamander	*Gyrinophilus porphyriticus*	1	0	0%	NA	86	0.1	1%	0%	1/1
Eastern Newt	*Notophthalmus viridescens*	12	5	42%	July 24	93	0.7	7%	3%	0/12
E. Red-backed Salamander	*Plethodon cinereus*	122	3	2%	Sept 5	89	7.2	69%	33%	0/133
Group totals	Group totals	178	19	11%	NA	NA	10.5	100%	48%	1/191
Anurans (Frogs)										
American Toad	*Anaxyrus americanus*	57	15	26%	Sept. 5	86	3.4	30%	15%	0/58
Green Frog	*Lithobates clamitans*	70	46	66%	July 5	57	4.1	37%	19%	1/71
Pickerel Frog	*Lithobates palustris*	8	3	38%	July 16	42	0.5	4%	2%	0/8
Wood Frog	*Lithobates sylvaticus*	52	2	4%	June 26	60	3.1	27%	14%	0/53
Spring Peeper	*Pseudacris crucifer*	3	1	33%	Sept 5	30	0.2	2%	0%	0/3
Group totals	Group totals	190	67	35%	NA	NA	11.2	100%	52%	1/193
Amphibian totals	Amphibian totals	368	86	23%	NA	NA	21.6	100%	100%	2/384

[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), *A. americanus* (23 mm), *H. versicolor* (26 mm), *P. crucifer* (20 mm), L. *clamitans* (44 mm), *L. palustris* (34 mm), and *L. sylvaticus* (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.

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[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.

Table 3. A comparison of drift-fence data from 1993 through 2012 (no data were collected in 2004 and 2009) 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]																	
	93	94	95	96	97	98	99	00	01	02[2]	03[2]	05[2]	06	07	08	10	11	12
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	0.8	1.6	0.9	2.0	0.9	1.5
N. 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	0.0	0.1	0.3	0.6	0.2	0.5
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	0.2	0.4	0.9	1.1	0.9	0.5
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	0.0	0.0	0.2	0.1	0.1	0.1
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	0.8	1.3	1.8	1.6	1.0	0.7
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	3.4	6.3	6.7	8.9	7.5	7.2
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	5.2	9.6	10.8	14.3	10.7	10.5
Anurans (Frogs)																		
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	1.5	3.4	1.9	2.2	1.7	3.4
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	0.0	0.0	0.0	0.0	0.0	0.0
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	3.1	0.8	2.4	0.9	1.5	4.1
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	0.1	0.3	0.2	0.1	0.2	0.5
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	2.1	4.7	2.5	1.9	4.5	3.1
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	0.4	0.1	0.0	0.0	1.0	0.2
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	7.2	9.3	7.0	5.1	9.0	11.2
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	12.4	18.9	17.8	19.4	19.7	21.6

[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 t 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 i 2001, 16 in 2002, 15 in 2003, 16 in 2005, 16 in 2006, 15 in 2007, 14 in 2008, 15 in 2010, 15 in 2011, and 17 in 2012. Trappings counted were on those nights when at least 2 the three traps were opened under appropriate weather conditions for amphibian movement.

[2] For three years we used dowels to reduce small mammal mortality. In order to compare those year's with other year's data, we converted all numbers to approximate no 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.

3 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 su of the individual species' values.

Table 4. A comparison of young-of-the-year from drift-fence data from 1995 through 2012 (no data were collected in 2004 and 2009) 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	# young of the year/ total amphibians captured (% of young of the year) [1,2]															
	95	96	97	98	99	00	01	02[3]	03[3]	05[3]	06	07	08	10	11	12
Caudates (Salamanders)																
Spotted Salamander	3/25 (12%)	16/34 (47%)	0/17 (0%)	4/21 (19%)	0/20 (0%)	12/26 (46%)	6/21 (29%)	5/25 (20%)	5/10 (50%)	3/20 (15%)	6/12 (50%)	4/24 (17%)	4/12 (33%)	16/28 (57%)	5/13 (38%)	10/25 (40%)
N. Dusky Salamander	0/6 (0%)	0/0 (0%)	0/0 (0%)	0/10 (0%)	0/2 (0%)	0/7 (0%)	0/4 (0%)	0/7 (0%)	0/1 (0%)	0/1 (0%)	0/0 (0%)	0/1 (0%)	0/4 (0%)	0/9 (0%)	0/3 (0%)	0/9 (0%)
N. Two-lined Salamander	0/3 (0%)	0/2 (0%)	0/2 (0%)	0/3 (0%)	0/4 (0%)	0/6 (0%)	0/2 (0%)	1/2 (50%)	1/2 (50%)	1/8 (13%)	0/3 (0%)	0/7 (0%)	2/13 (15%)	3/15 (20%)	2/14 (14%)	1/9 (11%)
Spring Salamander	0/0 (0%)	0/1 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/3 (0%)	0/0 (0%)	0/0 (0%)	0/3 (0%)	0/2 (0%)	0/2 (0%)	0/1 (0%)
Eastern Newt	13/30 (43%)	3/24 (13%)	1/22 (5%)	0/24 (0%)	0/13 (0%)	5/21 (24%)	6/18 (33%)	14/19 (74%)	0/5 (0%)	4/16 (25%)	4/13 (31%)	10/19 (53%)	4/25 (16%)	17/23 (74%)	9/15 (60%)	5/12 (42%)
E. Red-backed Salamander	0/24 (0%)	0/42 (0%)	2/40 (5%)	1/97 (1%)	0/27 (0%)	2/56 (4%)	0/25 (0%)	0/19 (0%)	0/24 (0%)	1/27 (4%)	1/55 (2%)	6/94 (6%)	1/94 (1%)	6/125 (5%)	0/113 (7.5%)	3/22 (2%)
Salamander group totals	16/88 (18%)	19/103 (18%)	3/81 (4%)	5/155 (3%)	0/66 (0%)	19/116 (16%)	12/70 (17%)	19/72 (26%)	6/42 (14%)	9/75 (12%)	11/83 (13%)	20/144 (14%)	11/151 (7%)	42/202 (21%)	16/160 (10%)	19/178 (11%)
Frog group totals	92/182 (51%)	67/183 (37%)	52/136 (38%)	48/182 (26%)	67/208 (32%)	74/156 (47%)	45/128 (35%)	369/454 (81%)	62/113 (55%)	49/102 (48%)	69/114 (61%)	28/146 (20%)	30/98 (31%)	21/72 (29%)	34/135 (25%)	67/190 (35%)
Amphibian totals	108/270 (40%)	86/286 (30%)	55/217 (25%)	53/337 (16%)	67/274 (24%)	93/272 (34%)	57/198 (29%)	389/526 (74%)	68/155 (44%)	58/177 (33%)	80/197 (41%)	48/290 (17%)	41/249 (16%)	63/274 (23%)	50/295 (17%)	86/368 (23%)

[1] There were a total of 18 trappings 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, 16 in 2005, 16 in 2006, 15 in 2007, 14 in 2008, 15 in 2010, 15 in 2011, and 17 in 2012. Trappings counted were on those nights when at least 2 of the three traps were opened under appropriate weather conditions for amphibian movement. Data from 1993 and 1994 are not included in this chart as not all individuals were measured.

[2] 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), A. americanus (23 mm), H. versicolor (26 mm), P. crucifer (20 mm), L. clamitans (44 mm), L. palustris (34 mm), and L. sylvaticus (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.

[3] For three years we used dowels to reduce small mammal mortality. In order to compare those year's with other 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 5. A comparison of young-of-the-year from drift-fence data from 1995 through 2012 (no data were collected in 2004 and 2009) 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	# young of the year/ total amphibians captured (% of young of the year) [1,2]															
	95	96	97	98	99	00	01	02[3]	03[3]	05[3]	06	07	08	10	11	12
Anurans (Frogs and Toads)																
American Toad	25/27 (93%)	10/37 (27%)	6/30 (20%)	12/64 (19%)	2/35 (6%)	4/28 (14%)	6/22 (27%)	4/20 (20%)	3/19 (16%)	11/32 (34%)	12/24 (50%)	0/51 (0%)	0/26 (0%)	4/31 (13%)	1/26 (4%)	15/57 (26%)
Gray Treefrog	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/1 (0%)	0/0 (0%)	1/2 (50%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/7 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)	0/0 (0%)
Spring Peeper	3/39 (8%)	2/15 (13%)	2/4 (50%)	0/19 (0%)	0/9 (0%)	12/22 (0%)	0/0 (0%)	4/11 (36%)	2/6 (33%)	0/9 (0%)	0/7 (0%)	0/2 (0%)	0/0 (0%)	0/0 (0%)	0/15 (0%)	1/3 33%)
Green Frog	14/17 (82%)	4/10 (40%)	10/15 (67%)	9/14 (64%)	27/44 (61%)	42/53 (79%)	21/26 (81%)	340/350 (97%)	31/44 (70%)	28/36 (78%)	43/49 (88%)	6/12 (50%)	25/34 (74%)	11/12 (92%)	12/23 (52%)	46/70 (66%)
Pickerel Frog	19/20 (95%)	1/6 (17%)	0/3 (0%)	0/0 (0%)	0/9 (0%)	1/1 (100%)	4/4 (100%)	2/2 (100%)	0/0 (0%)	2/2 (100%)	1/1 (100%)	2/4 (50%)	1/3 (33%)	0/2 (0%)	0/3 (0%)	6/11 (55%)
Wood Frog	31/79 (39%)	50/115 (43%)	34/84 (40%)	27/84 (32%)	38/111 (34%)	14/50 (28%)	14/76 (18%)	19/76 (27%)	26/44 (59%)	8/23 (35%)	13/23 (39%)	20/70 (29%)	4/35 (11%)	6/27 (22%)	21/68 (31%)	02/52 (4%)
Frog group totals	92/182 (51%)	67/183 (37%)	52/136 (38%)	48/182 (26%)	67/208 (32%)	74/156 (47%)	45/128 (35%)	369/454 (81%)	62/113 (55%)	49/102 (48%)	69/114 (61%)	28/146 (20%)	30/98 (31%)	21/72 (29%)	34/135 (25%)	67/190 (35%)
Salamander group totals	16/88 (18%)	19/103 (18%)	3/81 (4%)	5/155 (3%)	0/066 (0%)	19/116 (16%)	12/70 (17%)	19/72 (26%)	6/42 (14%)	9/75 (12%)	11/83 (13%)	20/144 (14%)	11/151 (7%)	42/202 (21%)	16/160 (10%)	19/178 (11%)
Amphibian totals	108/270 (40%)	86/286 (30%)	55/217 (25%)	53/337 (16%)	67/274 (24%)	93/272 (34%)	57/198 (29%)	389/526 (74%)	68/155 (44%)	58/177 (33%)	80/197 (41%)	48/290 (17%)	41/249 (16%)	63/274 (23%)	50/295 (17%)	86/368 (23%)

[1] There were a total of 18 trappings 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, 16 in 2005, 16 in 2006, 15 in 2007, 14 in 2008, 15 in 2010, 15 in 2011, and 17 in 2012. Trappings counted were on those nights when at least 2 of the three traps were opened under appropriate weather conditions for amphibian movement. Data from 1993 and 1994 are not included in this chart as not all individuals were measured.

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[3] For three years we used dowels to reduce small mammal mortality. In order to compare those year's with other 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.