Mt. Mansfield Amphibian Monitoring

Update

2013 and 2014

(Covering 1993-2014)

May 6, 2015

For the Vermont Monitoring Cooperative

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Amphibian Monitoring on Mt. Mansfield, Vermont
1993-2014

Background

After an initial amphibian survey and establishment of monitoring protocols, populations of amphibian species have been monitored almost 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.

Four drift fences were built at three elevations on the west slope of Mt. Mansfield: 1200 feet (2 fences), 2200 feet (1), and 3200 feet (1). With the exception of the fence at 3200 ft., each fence is made of two 50-foot sections of 20-inchwide metal flashing buried 4 inches below the surface of the ground. The two sections are placed at right angles to each other, resulting in 100 feet of flashing set upright as a 16-inch-high fence. Buckets are buried every 12.5 feet on both sides of the fence so that the top edges of the buckets are flush with the ground. The fence at 3200 feet is made of only one 50-foot section of flashing with buckets at 12.5-foot intervals. Amphibians that encounter a fence while moving through the forest must turn to one side and eventually fall into a bucket. The lids are taken off the buckets in the late afternoon on rainy days, and the captured amphibians identified and counted the following morning. The locations of these four sites are indicated in Figure 1. The fence at 3200 feet was discontinued in 1996. The other three fences continued to be monitored every year through 2014 with the exception of 2004 and 2009. The 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.

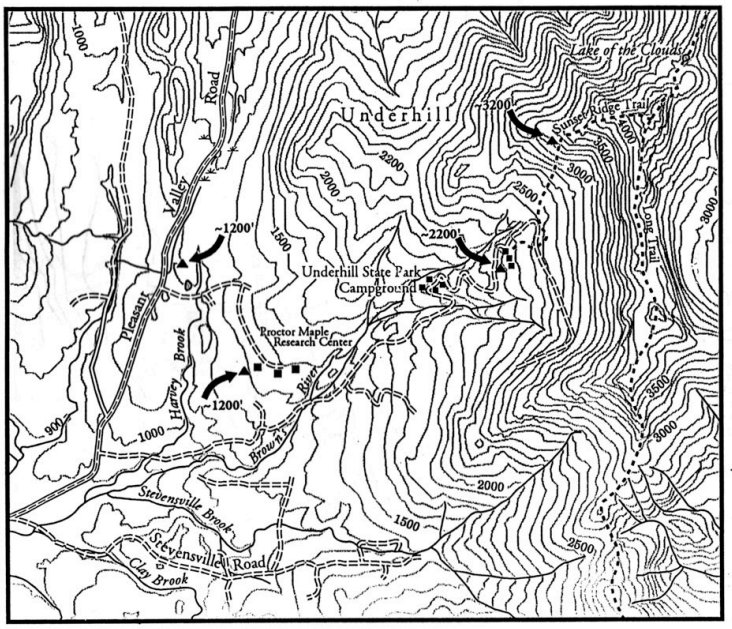

Figure 1.

Location of Drift Fences on Mount Mansfield Underhill, Vermont

We have drift-fence data from Mt. Mansfield from 1993 to the present, with the exceptions of 2004 and 2009. Although, we also have collected 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, and from 2010 to 2014. 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 needed to be completed (now completed). We would also need to locate and train new staff, and find funding. Monitoring was completed at Mt. Mansfield through 2014. As of this writing, funding for this project has been cut and it is likely the fence will be removed during the summer of 2015.

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. The 2012 report included all data from 2003 through 2012. Following the every-other-year schedule this report includes data from 2003 through 2014 from Mt. Mansfield. It is the first and only report to include the 2013 and 2014 data. Clean and updated sets of all the drift-fence data from Mt. Mansfield and Lye Brook Wilderness, including data not used in our indices have recently been sent to VMC.

Population Trends at Mt. Mansfield

In 2013 and 2014 all the usual salamander species were caught as adults, including Spring Salamanders (*Gyrinophilus porphyriticus*). 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. From 2011 to 2014 adult Spring Peepers were caught once again, and one young of the year was caught in 2012. In 2013 and 2014 all anuran young of the year were found except Pickerel Frogs (*Lithobates palustris*) and Spring Peeper.

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 1993-2014 (Figures 2-7). The data gathered suggest that only the Eastern Red-backed Salamander (*Plethodon cinereus*) shows a significant increase combined with smaller annual variation. The American Toad continues to show a long-term increase but a large drop during the last year monitored. Although we have recently seen more Spring Peepers, they continue to show a long-term decline. During a few years between 1993 and 2010 the Spring Peeper was not detected at all. The trend lines for Wood Frog (*Lithobates sylvaticus*) and the Eastern Newt (*Notopthalmus viridescens*) both suggest long-term declines at these fences; however, their large annual variations could turn things around very quickly and these trend lines could easily be misleading and I do not consider them significant.

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 2013 and 2014, young of the year made up 18% and 10% of those caught (Table 1 and 2). Over the course of the entire study (1995 – 2014) the percentage of young of the year of total catch was 28.6%. 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 their terrestrial phase*. The Eastern Newt 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 summers 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 2002, with a high of 4.1 in 2012 and a low of 0.7 in 2014. 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. Since this species overwinters as a tadpole, a winter that allowed high survival in a nearby breeding pond could generate a short spike like 2002, particularly if it was preceded and/or succeeded by wet conditions.

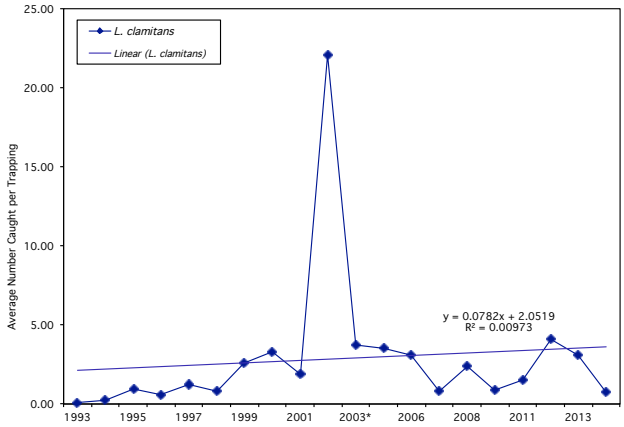

Figure 2. Green Frog *(Lithobates clamitans)* population indices from Mt. Mansfield, Underhill, Vermont, 1993-2014.

American Toad

Only 1.7 per trapping American Toads were caught in 2011, and a large increase to 3.4 per trapping was seen in 2012, increasing to all time high in 2013 to 5.4 then our index dramatically fell back to 1.7 in 2014. In a previous 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, since then the data has also shown large annual variations (Figure 3). The only consistent trend is after a high year the population falls back and stays low for one or more years. This annual variation is so large that although the population appears to be increasing overall, it could change quickly. It is possible that we began our monitoring immediately after a crash. In any case, it has been increasing during our watch.

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 3 and Table 3).

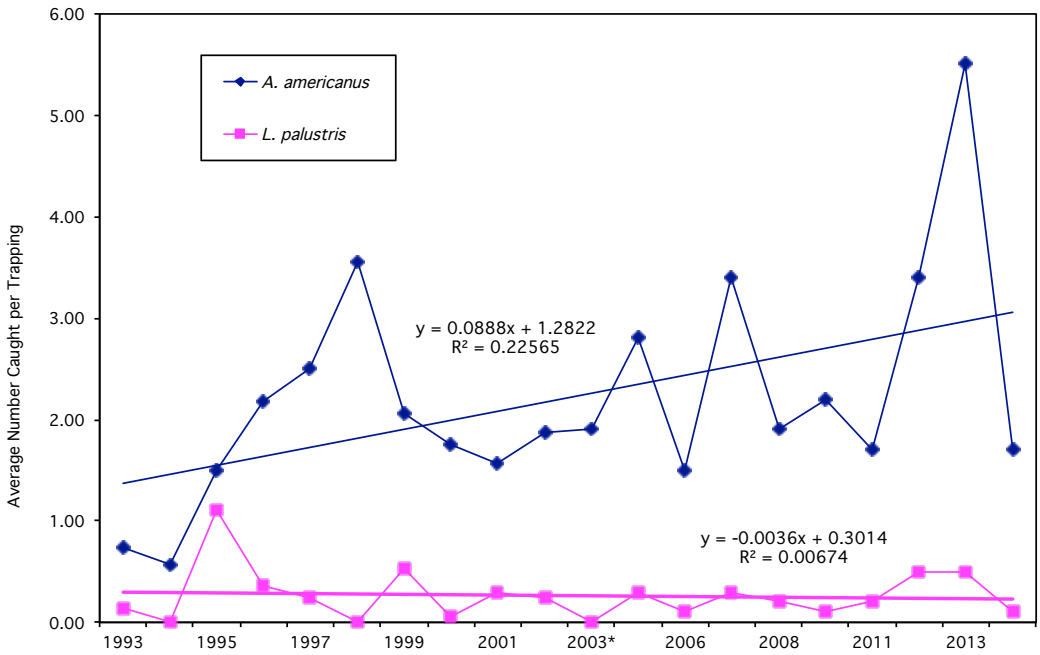

Figure 3. American Toad *(Anaxyrus americanus)* and Pickerel Frog (*Lithobates palustris*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2014. The numbers for the Pickerel Frog are too low to draw any meaningful conclusions.

Wood Frog

Wood Frogs continue to have large year-to-year fluctuations (Figure 4 and Table 3) so the long-term decline suggested by the trend line is not particularly concerning. We had a high of 7 per trapping in 1997. Over the years the numbers are varied, and although a relatively large number were captured in 2013 (5.9) the overall trend is still negative. It is interesting to note that although only 4% of the Wood Frogs detected in 2012 were young of the year, the next year (2013) there was a higher than average number of Wood Frogs captured (Table 5).

The species is showing a downward trend. However, annual variation is so great and our ending index so close to our starting index that we are not particularly concerned. Since this species grows from egg to metamorph in a matter of months, short-term droughts of only a couple weeks duration could have a large impact on an annual population. In addition, since this species overwinters in the leaf litter, depth of freeze could also have

immediate and pronounced impacts on populations. At a privately funded site in Lincoln (Colby Hill Ecological Preserve) where we are monitoring egg-mass numbers, rather than the frogs themselves, we have not seen any declines.

Spring Peeper

Although the numbers vary from year-to-year, the overall trend for Spring Peepers has been steadily downward since 1993 (Figure 4 and Table 3). In 2012, 0.2 per trapping were found and the first young of the year were detected since 2003. In 2013 and 2014 adults were detected at a rate of 0.5 and 0.3 respectively, but no young of the year were captured. 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. In our minds, appropriate breeding habitat, perhaps as a result of forest succession, or changes in local beaver activity could potentially be responsible for this decline.

Spring Peeper is another species that overwinters in the leaf litter. Changes in the depth of frost during winter, or changes in the depth of the leaf litter (not supported by other evidence) could also bring about declines.

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; as Green Frogs are showing a slight decrease over the last few years, while Spring Peepers are showing a slight increase. We did not see this decline at Lye Brook Wilderness during the years we collected data there, so the peeper decline may be a local (or temporary) phenomenon. In any case, this is the most significant trend shown at this site.

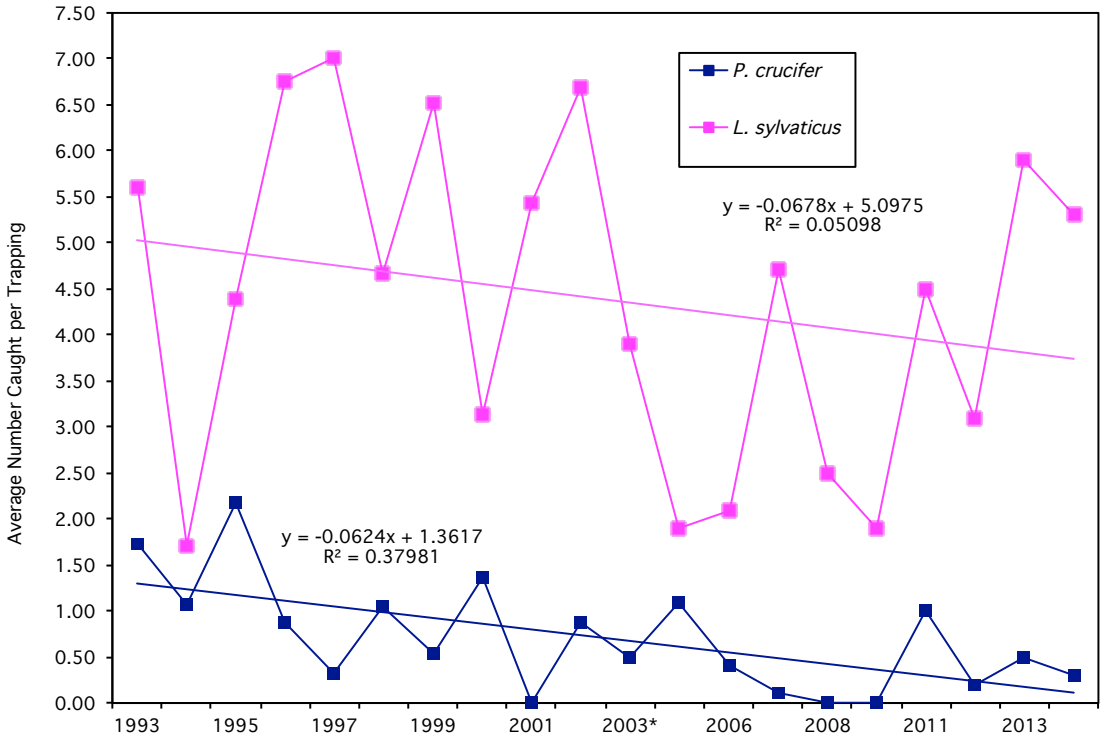

Figure 4. Wood Frog *(Lithobates sylvaticus*) and Spring Peeper (*Pseudacris crucifer*) indices from Mt. Mansfield, Underhill, Vermont, 1993-2014.

Eastern Newt

Although the Eastern Newt has also shown large annual fluctuations over periods of the study, there was relatively little variation in the last few years (Figure 5). The 2012 rate was the second lowest found since the inception of the study, and 2013 and 2014 were still relatively low (0.8 and 0.8). The long-term trend line shows a decrease in the population between 1993 and 2014 (Figure 5), but as we know there can be large annual variation, this trend could easily change over the course of a year or two.

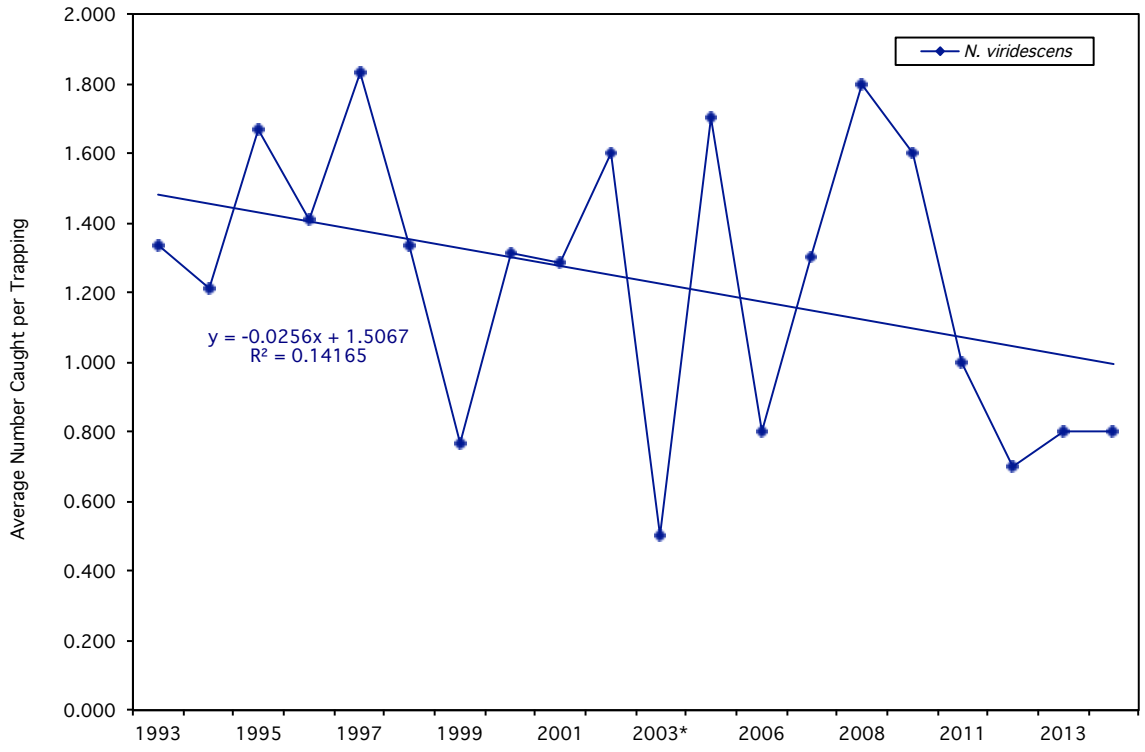

Figure 5. Eastern Newt *(Notophthalmus viridescens)* population indices from Mt. Mansfield, Underhill, Vermont, 1993-2014.

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 a rate of 6 and higher since 2007, with the two highest capture rates in 2013 (13.2) and 2014 (9.8) (Figure 6 and Table 3). 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, although soil moisture could. The success of this species strongly suggests that the leaf litter is healthy and deep, holds moisture well, and that the forest is maturing.

Spotted Salamander

The Spotted Salamander has a virtually flat trend line, with some annual variation (Figure 6). In 2010, 2.0 animals were captured per trapping. The second time this many animals have been found since the study began. The numbers continue to show a small annual variation with 1.5 per trapping found in 2012, 1.9 in 2013, and 1.7 in 2014. 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 annually 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 5 shows that Spotted Salamander breeding in these pools was fairly successful in 2013 and 2014 as 25% and 33% were young of the year. One might assume that Wood Frog recruitment should follow similar trends as the Spotted Salamander, but Table 4 shows that recruitment of Wood Frogs has been low since a high in 2003 when 59% of those caught were young of the year, with the lowest number found in 2012 (4%), and 38% and 17% were detected in 2013 and 2014. 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 low enough. 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 Spring Peepers at the same time that we see increases in other species such as Eastern Red-backed Salamanders.

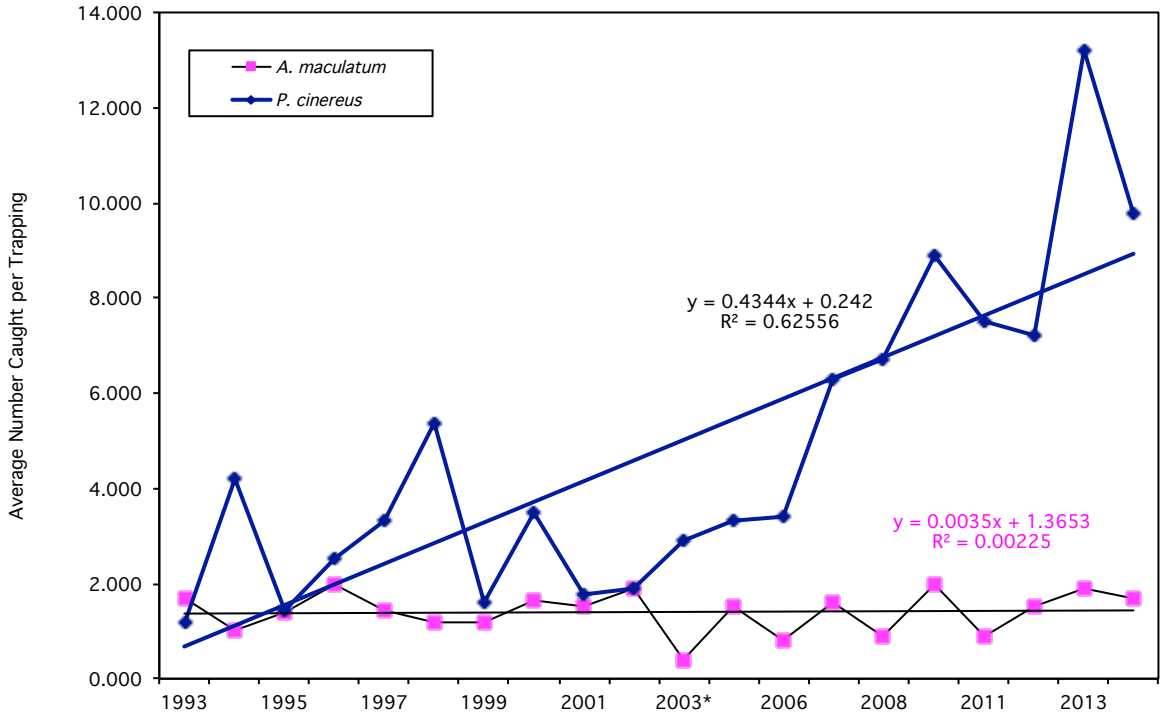

Figure 6. Spotted (*Ambystoma maculatum*) and Eastern Red-backed (*Plethodon cinereus*) Salamander population indices from Mt. Mansfield, Underhill, Vermont, 1993-2014.

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 index has decreased to 0.8 and 0.4 in 2013 and 2014 respectively (Figure 7 and Table 3). However, the fences are not located in appropriate locations/habitat 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 7 represents a very small sample size and could change quickly.

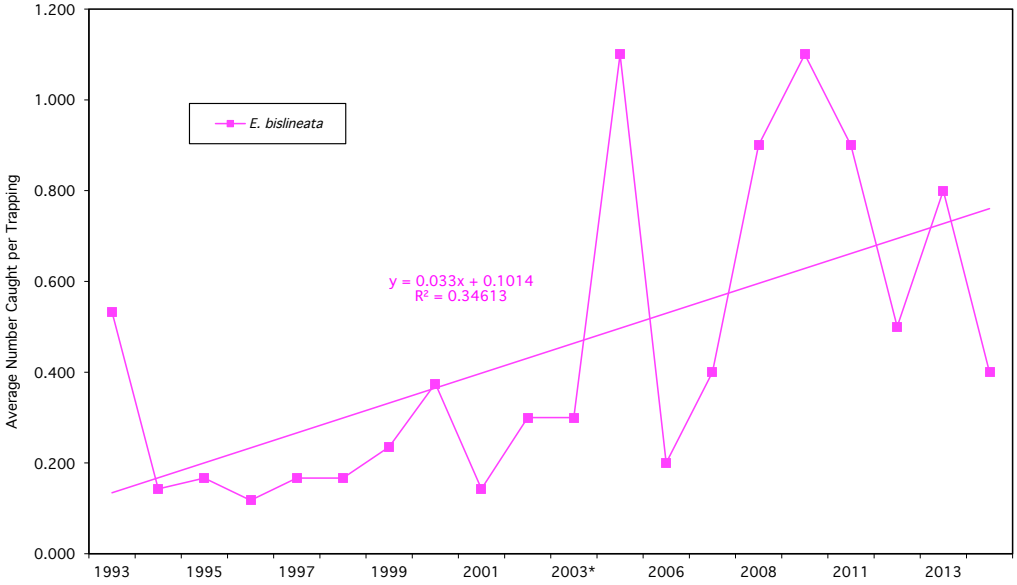

Figure 7. Northern Two-lined Salamander (*Eurycea bislineata*) population index from Mt. Mansfield, Underhill, Vermont, 1993-2014. Capture rates are too low to draw meaningful conclusions about long-term trends for this species.

Abnormalities

The number of abnormalities continues to be low. There were no abnormalities from 2007 to 2010. 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 and could well have been the result of an injury. 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. There were no abnormalities detected in 2013 or 2014. From 1998 through 2014, 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 2014. During 2009 monitoring took place only at Lye Brook. Due to budget cuts, 2014 may be the last year of monitoring at Mt. Mansfield. If this appears to be the case, drift fences will be removed and marked in the summer of 2015. Data from these efforts has been exported in Excel format and sent via E-mail to VMC.

Although we have not used power analysis to evaluate apparent trends in species populations since 2001 (see 2001 VForEM annual report), anyone carefully examining and using our data may well want to do so. However, despite the lack of the more statistically rigorous power analysis recently, the linear regressions strongly suggest that the most significant long-term trends are the decrease in the Spring Peepers and the increase in the Eastern Red-backed Salamander variation. The downward trend for Spring Peepers continues, even though some animals were found the last four years. Eastern Red-backed Salamanders were found in record numbers in 2013 and 2014, and the overall trend is increasing. 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.

We have been grateful for the opportunity to collect these data for the last two decades. Long-term monitoring studies are very valuable. There are many questions that these data may still be able answer including questions about: how numbers of young of year relate to adult population numbers, correlations and interactions between species, and how climate change effects local populations of amphibians. We hope these data are stored and used by any scientist interested in these and other questions.

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 2013 and 2014. Field personnel were Karl Riemer, Robert Robbins, and Warren Ellison.

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 2013. 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 19 trap-efforts were used: April 10 and April 17; May 9, 20, and 30; June 7, 11, and 23; July 19, 24, and 29; September 3, 12, and 22; October 7, 17, and November 1.** 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*	32	8	25%	Sept. 3	210	1.9	11%	6%	0/32
N. Dusky Salamander	*Desmognathus fuscus*	13	0	0%	N/A	104	0.8	4%	2%	0/13
N. Two-lined Salamander	*Eurycea bislineata*	13	3	23%	July 24	92	0.8	4%	2%	0/13
Spring Salamander	*Gyrinophilus porphyriticus*	4	0	0%	N/A	144	0.2	1%	1%	0/5
Eastern Newt	*Notophthalmus viridescens*	14	5	36%	Sept. 3	81	0.8	5%	2%	0/14
E. Red-backed Salamander	*Plethodon cinereus*	224	9	4%	Sept. 22	92	13.2	75%	40%	0/227
Group totals	Group totals	300	25	8%	NA	NA	17.6	100%	53%	1/304
Anurans (Frogs)										
American Toad	*Anaxyrus americanus*	93	1	1%	Sept. 12	80	5.5	35%	17%	0/95
Green Frog	*Lithobates clamitans*	52	39	75%	July 24	65	3.1	20%	9%	0/52
Pickerel Frog	*Lithobates palustris*	8	0	0%	N/A	52	0.5	3%	1%	0/8
Wood Frog	*Lithobates sylvaticus*	101	38	38%	July 24	60	5.9	39%	18%	0/102
Spring Peeper	*Pseudacris crucifer*	8	0	0%	N/A	33	0.5	3%	0%	0/8
Group totals	Group totals	262	78	30%	NA	NA	15.4	100%	47%	0/265
Amphibian totals	Amphibian totals	562	103	18%	NA	NA	33.1	100%	100%	0/569

[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 2014. 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 18 of 20 trap-efforts were used: April 22 and 23, and May 2; May 10, 17, and 23; June 4, 12, and 18; June 26, July 16 and 24; September 7, 14, and 22; October 5, 17, and 29.** 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*	30	10	33%	Sept. 7	184	1.7	14%	8%	0/30
N. Dusky Salamander	*Desmognathus fuscus*	17	0	0%	NA	117	0.9	8%	5%	0/18
N. Two-lined Salamander	*Eurycea bislineata*	8	1	13%	Spet. 22	95	0.4	4%	2%	0/9
Spring Salamander	*Gyrinophilus porphyriticus*	1	0	0%	NA	180	0.1	0%	0%	0/1
Eastern Newt	*Notophthalmus viridescens*	14	4	29%	Sept. 7	78	0.8	6%	4%	0/14
E. Red-backed Salamander	*Plethodon cinereus*	176	2	1%	Oct. 17	93	9.8	80%	48%	0/176
Group totals	Group totals	246	17	7%	NA	NA	13.7	112%	63%	1/248
Anurans (Frogs)										
American Toad	*Anaxyrus americanus*	31	5	16%	July 24	83	1.7	21%	8%	0/32
Green Frog	*Lithobates clamitans*	13	3	23%	Sept. 7	55	0.7	9%	4%	0/13
Pickerel Frog	*Lithobates palustris*	1	0	0%	NA	62	0.1	1%	0%	0/1
Wood Frog	*Lithobates sylvaticus*	95	16	17%	June 26	60	5.3	65%	26%	0/95
Spring Peeper	*Pseudacris crucifer*	6	0	0%	NA	30	0.3	4%	2%	0/6
Group totals	Group totals	146	24	16%	NA	NA	8.1	100%	37%	0/147
Amphibian totals	Amphibian totals	392	41	10%	NA	NA	21.8	100%	100%	0/395

[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 3. A comparison of drift-fence data (numbers per trapping) from 1993 through 2014 (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	13	14
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	1.9	1.7
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	0.8	0.9
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	0.8	0.4
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	0.2	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	0.8	0.8
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	13.2	9.8
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	17.1	13.7
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	5.5	1.7
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	0.0	0.1
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	3.1	0.7
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	0.5	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	2.1	4.7	2.5	1.9	4.5	3.1	5.9	5.3
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	0.5	0.3
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	15.5	8.2
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	32.6	21.9

[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 th 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 i 2002, 15 in 2003, 16 in 2005, 16 in 2006, 15 in 2007, 14 in 2008, 15 in 2010, 15 in 2011, 17 in 2012, 17 in 2013, and 18 in 2014. Trappings counted were on those nights when a least 2 of the three traps were opened under appropriate weather conditions for amphibian movement.

[2] For three years we used dowels in half of the traps to reduce small mammal mortality. In order to compare those year's with other year's data, we converted all numbers t 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.

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 th individual species' values.

Table 4. A comparison of young-of-the-year from drift-fence data from 1995 through 2014 (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	13	14
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%)	1/93 (1%)	5/31 (16%)
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%)	0/0 (0%)	1/1 (100%)
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%)	0/8 (0%)	0/6 (0%)
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%)	39/52 (75%)	3/13 (23%)
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%)	0/8 (0%)	0/1 (0%)
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%)	38/101 (38%)	16/95 (17%)
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%)	78/262 (30%)	24/146 (16%)
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%)	25/300 (8%)	17/246 (7%)
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%)	103/562 (18%)	41/392 (10%)

[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, 17 in 2012, 17 in 2013, and 18 in 2014. 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 in half of the traps 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 2014 (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]																	
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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%)	1/93 (1%)	5/31 (16%)
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%)	0/0 (0%)	1/1 (100%)
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%)	0/8 (0%)	0/6 (0%)
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%)	39/52 (75%)	3/13 (23%)
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%)	0/8 (0%)	0/1 (0%)
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%)	38/101 (38%)	16/95 (17%)
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%)	78/262 (30%)	24/146 (16%)
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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%)	103/562 (18%)	41/392 (10%)

[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, 17 in 2012, 17 in 2013, and 18 in 2014. 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.

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