Mt. Mansfield Amphibian Monitoring

Update

2016

(Covering 1993-2016/17)

August 25, 2017

For the Forest Ecosystem Monitoring Cooperative

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Amphibian Monitoring on Mt. Mansfield, Vermont
1993-2016/7

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 was made of two 50-foot sections of 20-inchwide metal flashing buried 4 inches below the surface of the ground. The two sections were placed at right angles to each other, resulting in 100 feet of flashing set upright as a 16-inch-high fence. Buckets were buried every 12.5 feet on both sides of the fence so that the top edges of the buckets were flush with the ground. The fence at 3200 feet was 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 many 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.

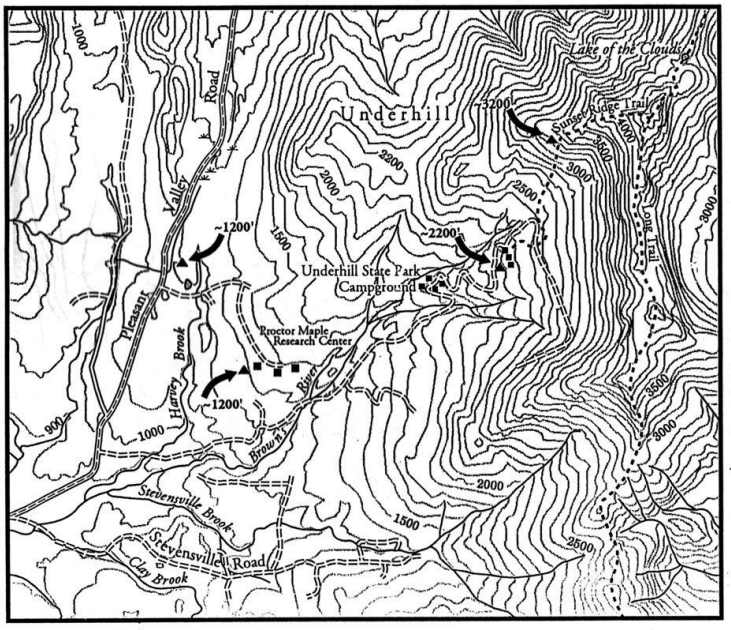

Figure 1.

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, 2009, 2015, and April and May of 2016. We also collected data from fences near the Lye Brook Wilderness in southern Vermont annually from 1994 through 2002 when funding ended. 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. Due to an anticipated break in the funding the drift fences were removed from Mt. Mansfield during the summer of 2015. Luckily, funding was restored, the fences were reinstalled in May of 2016 and data collection began in June of 2016.

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 Forest Ecosystem 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 1993 through 2012. The report in May of 2015 contained all data from 1993 through 2014. No data were collected in 2015 or April or May of 2016. This report includes all data from 1993 through June of 2017 from Mt. Mansfield.

Due to the re-installation of the fences in the summer of 2016, no data were collected in April and May 2016. In order to be able to continue comparing year-to-year results we needed to have a full year of results, including a spring migration in April and May. We chose to include the data collected during April and May 2017, as it was the closest chronologically to the 2016 field season and encompasses one full year. For the rest of this report, when we refer to amphibian data collected in 2016 in the figures and tables, we are including those two months of data from 2017. Clean and updated sets of all the drift-fence data from Mt. Mansfield, including data not used in our indices have been sent to FEMC.

Diversity of Adults and Young

In 2016/17 all the usual caudate (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.

In 2016/17 all adult anurans (frogs) were found, but no young American Toads (*Anaxyrus americanus*), Pickerel Frogs (*Lithobates palustris*) or Gray Treefrogs (*Hyla versicolor*) were found. Only one juvenile Spring Peeper (*Pseudacris crucifer*) was detected.

Long-term Trends

Linear regressions most closely fit most of the data plots, so they are used to show potential trends in the abundance indices for all species caught from 1993-2016/17 (Figures 2-7).

Increases

The data gathered show that only the Eastern Red-backed Salamander (*Plethodon cinereus*) shows a significant long-term increase (Figure 6) in our study area.

The regression line for the American Toad (Figure 3) shows a moderate long-term increase but we appear to have started monitoring during a particularly low-population period for that species and after an unusually high peak in 2013, it had a large population drop in 2014 and now shows average numbers.

Declines

The long-term decline of Spring Peepers (Figure 4) is the only significant decline shown among the species we monitor on Mt. Mansfield. During 2008 and 2010 the Spring Peeper was not detected at all. From 2011 to 2014 adult Spring Peepers were caught once again, and twenty-six were caught in this monitoring period. The increased number of adult Spring Peepers caught during the the 2016/17 monitoring (mostly in early 2017) may signal the beginning of a recovery.

The regression line for Wood Frog (*Lithobates sylvaticus*) suggests a decline (Figure 4), but if we had started monitoring a year later, that would not be the case. It has large annual variation.

The Eastern Newt (*Notopthalmus viridescens*) regression line (Figure 5) suggests a long-term decline but it is currently at peak numbers and it is also a species that has shown large annual variation.

Overall, the total number of salamanders and frogs detected per trapping is lower than last year but fairly high when measured against the last twenty-three years at Mt. Mansfield. The National Weather Service reported that 2016 was the ninth driest year on record in Vermont. However, our data include two months from the wet spring in 2017 and that has increased trapping rates.

Young of the Year

Beginning with the 1995 report we began calculating the number of young of the year, the percentage of young of the year (YOY), and recording the date of the first metamorph found in a drift fence. The cutoff lengths listed on Table 1 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 2016, young of the year made up 10% of those caught (Table 1). This is the lowest percent YOY ever. Over the course of the entire study (1995 – 2016/17) the average percentage of young of the year of total catch was 27.6%. Since the study's inception the young of the year have varied from 10% (2016/17) to 74% (2002). Table 3 and Table 4 summarize the young of the year information for salamanders and frogs respectively.

All frogs monitored except for Green Frogs 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 are laid. Other frogs metamorphose during the same year as egg laying but at a very small size. American Toads can be as small as 8-13 mm after metamorphosis. Gray Treefrogs (*Hyla versicolor*) can be 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 2). 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. Although the long-term trend line implies a slight increase overall, their numbers have decreased each year since 2012 with a near record low of 0.30 per trapping detected this monitoring year. 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 that of 2002, particularly if it was preceded and/or succeeded by wet conditions. They are also largely aquatic and require standing pools of water to rehydrate and wet conditions in which to move.

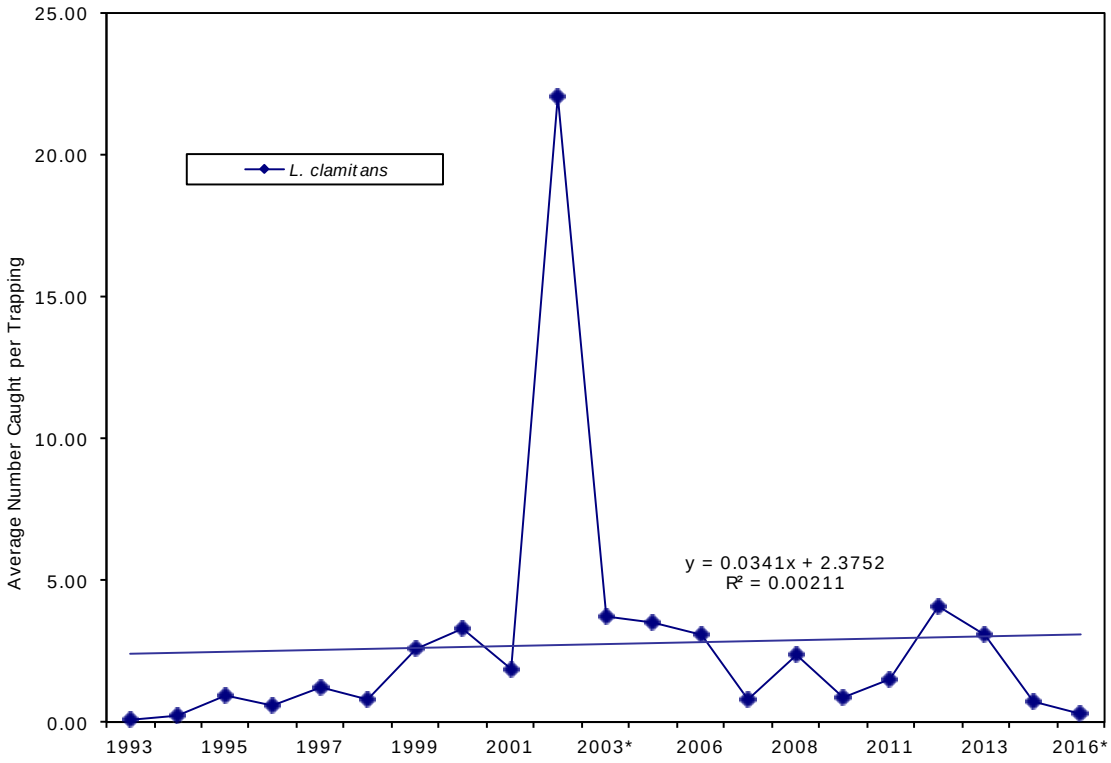

Figure 2. Green Frog (*Lithobates clamitans*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2016.

American Toad

Only 1.7 American Toads were caught per trapping event in 2011, yet 3.4 per trapping were seen in 2012, increasing to an all time high in 2013 of 5.4 per trapping. After that year, our index dramatically fell back to 1.7 in 2014, and increased slightly to 1.9 in 2016/17. 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 have also shown large annual variations (Figure 3). This annual variation is so large that although the regression line shows that the population appears to be increasing long-term, it may be exagerrated because we began monitoring at what was a low point in their population.

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 2).

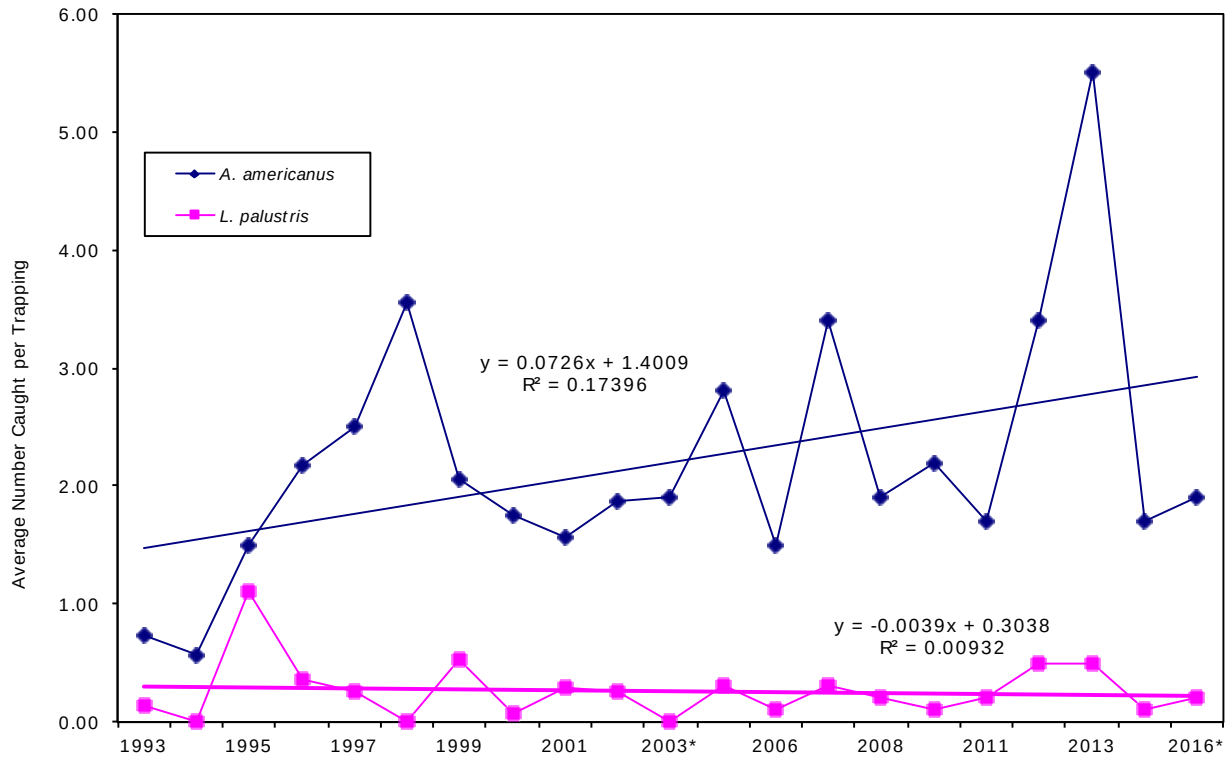

Figure 3. American Toad (*Anaxyrus americanus*) and Pickerel Frog (*Lithobates palustris*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2016. The numbers for the Pickerel Frog are too low to draw any meaningful conclusions.

Wood Frog

Wood Frogs continue to have large year-to-year fluctuations (Figure 4 and Table 2). Although the regression line appears to show a slight long-term decline, it would not appear that way if we had begun monitoring a year later when the population was at a low point. We had a high of 7 per trapping in 1997 and are currently seeing 4.8 per trapping.

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, we have not seen any significant declines.

Spring Peeper

Although the numbers vary from year-to-year, the overall trend for Spring Peepers had been clearly downward from 1993 to 2010 (Figure 4 and Table 3). In 2012, 0.2 were caught per trapping 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. In 2016/17 the rate per trapping jumped to 1.4. This is the highest rate of capture since 2000 and may indicate the beginning of a recovery. Still, only one young of the year was detected.

Local changes in breeding habitat are one possible explanation for declines, 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. The importance of nearby breeding habitat 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, changes in appropriate breeding habitat, perhaps as a result of forest succession, or changes in local beaver activity could potentially be driving population changes.

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 could also bring about declines. Invasive worms and disease are other potentially significant variables. In any case, this was the most significant decline shown at this site. Hopefully it has now ended.

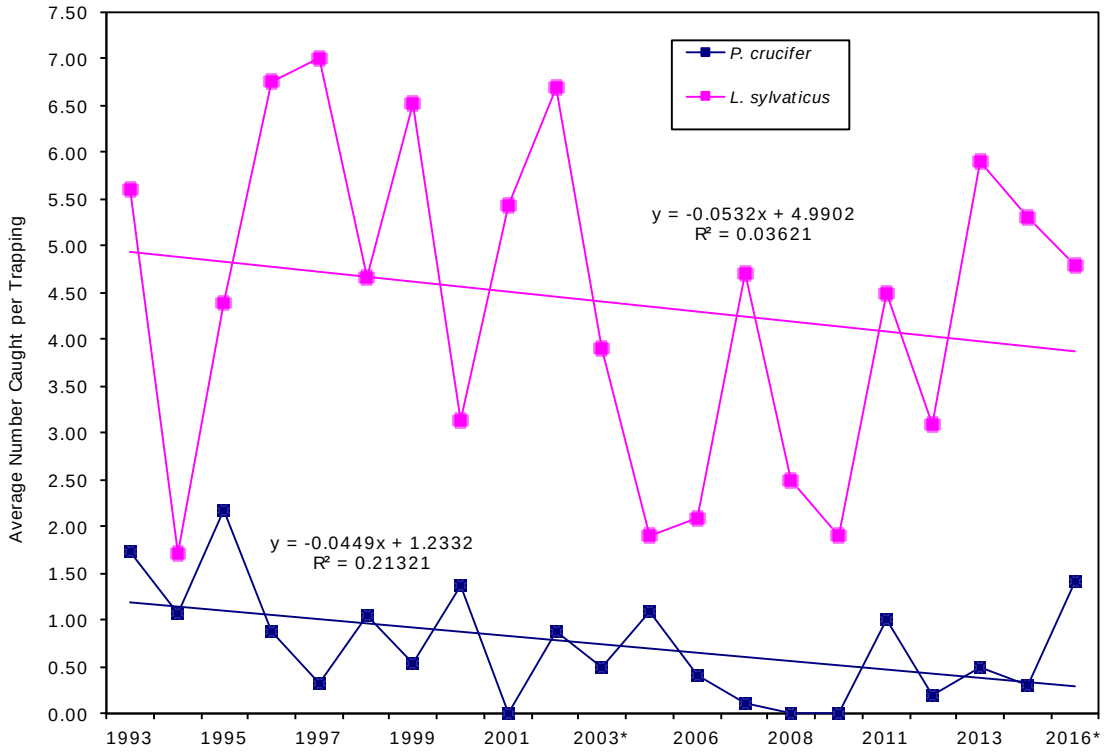

Figure 4. Wood Frog (*Lithobates sylvaticus*) and Spring Peeper (*Pseudacris crucifer*) indices from Mt. Mansfield, Underhill, Vermont, 1993-2016.

Eastern Newt

The trapping rate for the Eastern Newt is currently at an all time high of 1.9 per trapping. The long-term trend still shows a downward regression line, but given the high current numbers and the large annual variation, that line could shift in the next couple years. As a result we are not currently concerned about the suggested trend.

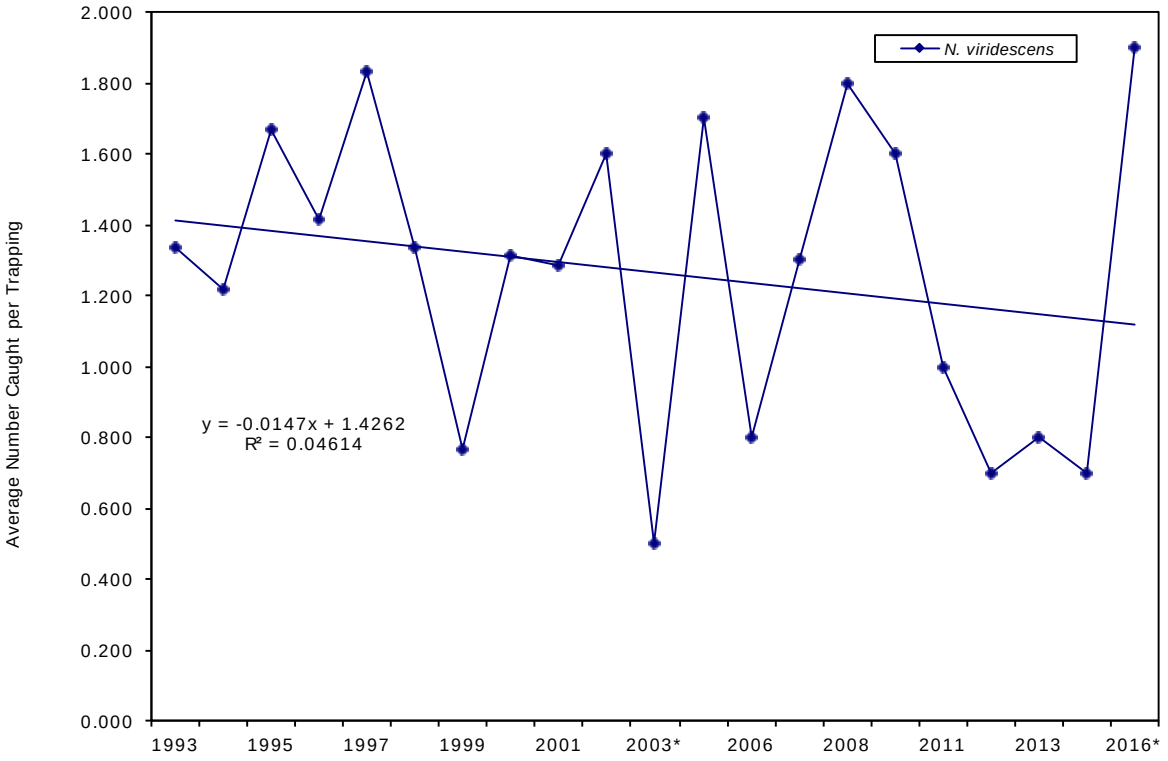

Figure 5. Eastern Newt (*Notophthalmus viridescens*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2016.

Eastern Red-backed Salamander

This species shows a clear long-term increase. Like the other amphibian species found at this site, the Eastern Red-backed Salamander population occasionally shows large annual fluctuations; however, between 2001 and 2014 this species had been showing a steady, and on occasion, dramatic increase. After an all-time high in 2013, the numbers have decreased fairly dramatically over the past few years (Figure 6 and Table 2). Still, trapping numbers are much higher than average.

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 be less 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. The recent drop, although dramatic, will not be of concern unless it continues.

Spotted Salamander

The Spotted Salamander has a virtually flat trend line, with some annual variation (Figure 6). The trapping average for 2016/17 of 1.4 individuals lays right on this flat line. 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 the Spotted Salamander breeds in the same pools as the Wood Frog. Table 3 shows that Spotted Salamander breeding in these pools was fairly successful in 2014 and 2016. They showed 33% and 42% young of the year respectively. In 2016/17 there were a relatively high number of young salamanders caught (11).

One might assume that Wood Frog recruitment should follow similar trends as the Spotted Salamander, but Table 4 shows that recruitment of Wood Frogs does not always change in sync with Spotted Salamander. Wood Frog YOY showed a high in 2003 of 59% when Spotted Salamander YOY were also high at 50% during the same year. In contrast, Wood Frogs showed their lowest percentage of YOY in 2012 (4%) while Spotted Salamanders were at a fairly high 40%. One possible difference is that Spotted Salamanders are more resistant than Wood Frogs to a variety of potentially threatening conditions such as predation, short-term draught, winter kill 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 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 long-term increases in other species such as Eastern Red-backed Salamanders.

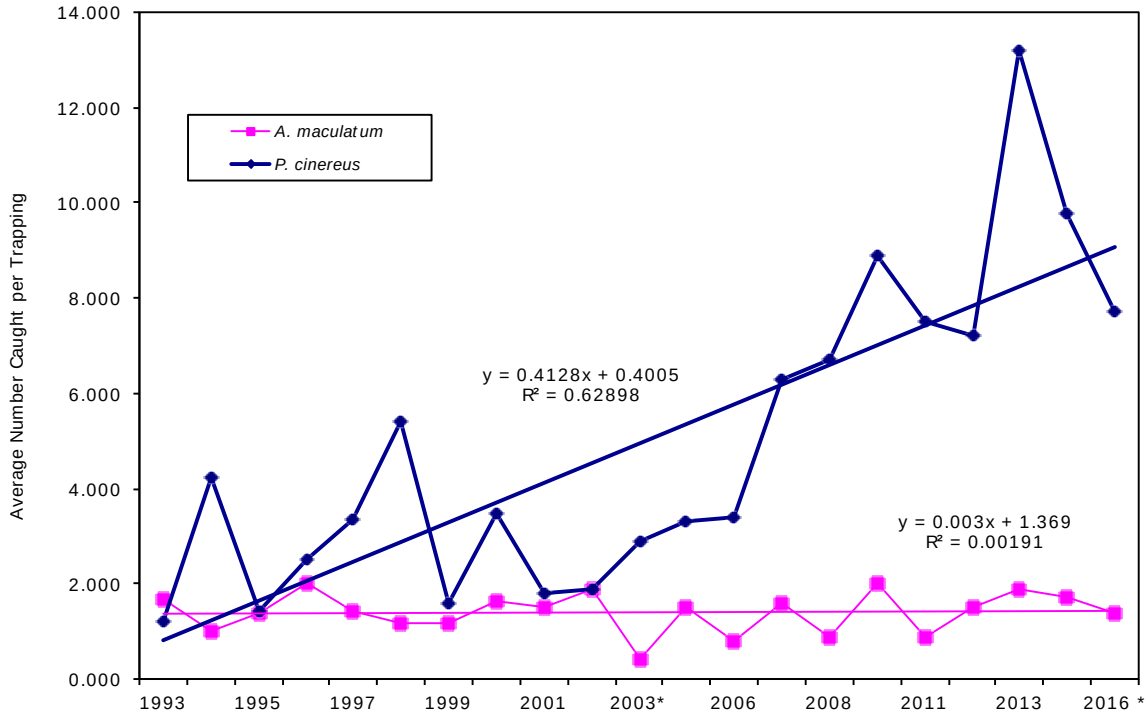

Figure 6. Spotted Salamander (*Ambystoma maculatum*) and Eastern Red-backed (*Plethodon cinereus*) Salamander population indices from Mt. Mansfield, Underhill, Vermont, 1993-2016.

Northern Two-lined Salamander

In the past, we have caught very few Northern Two-lined Salamanders. In 2005 we saw a large 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 2003, the indices have shown noticably larger annual fluctuations (Figure 7 and Table 2). 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. The increasing trend line shown in Figure 7 represents a very small sample size and could change quickly.

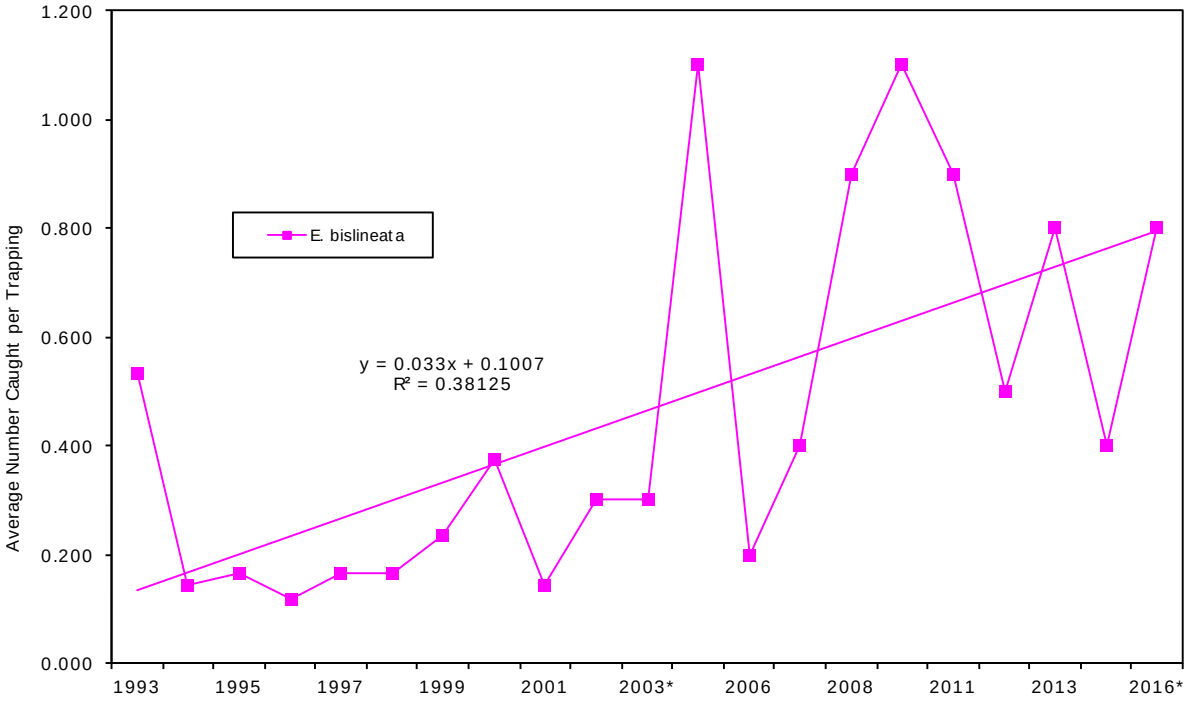

Figure 7. Northern Two-lined Salamander (*Eurycea bislineata*) population index from Mt. Mansfield, Underhill, Vermont, 1993-2016. Capture rates are too low to draw meaningful conclusions about long-term trends for this species.

Abnormalities

The number of abnormalities continues to be low, with no abnormalities detected in 2016/17. 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. This 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, 2014, or 2016/17. 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 2016. During 2009 monitoring took place only at Lye Brook. Due to budget cuts, we thought 2014 was the last year of monitoring at Mt. Mansfield. Drift fences were removed and marked in the summer of 2015. However, due to restored funding the drift fences were put back in the spring of 2016 and data collection began again in June. Data from these efforts are exported in Excel format and sent via E-mail to FEMC soon after reports are written.

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 data still show that populations of Spring Peeper had been declining steadily since monitoring began in 1993 through 2010 but they increased significantly in 2016/17. Populations of the Eastern Red-backed Salamander have increased dramatically. Despite recent declines in the past two monitoring years, capture rates are still very high. 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

Long-term monitoring at Mt. Mansfield during 2016 and the begining of 2017 was supported by a cost-sharing grant from the the Vermont Department of Forests, Parks, and Recreation through the Forest Ecosystem Monitoring Cooperative (FEMC) and Vermont Family Forests. 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 2016-17. Traps were opened whenever conditions were appropriate for amphibian movement from June 2016 through November 2016 excluding August, and April and May of 2017. 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 21 trap-efforts were used: in 2016; June 6, 12, and 21; June 29, July 23 and August 2; September 9, 18, and 27; October 14, 21, and Nov 4, were used. In 2017; April 12, 16, and 26; May 2, 14, and 26 were used.** Abnormality, maximum size, and first metamorph data were taken from all **21** 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 [4]
Caudates (Salamanders)										
Spotted Salamander	*Ambystoma maculatum*	26	11	42%	July 23	188	1.4	11%	7%	0/26
N. Dusky Salamander	*Desmognathus fuscus*	11	0	0%	NA	116	0.6	5%	3%	0/12
N. Two-lined Salamander	*Eurycea bislineata*	14	3	21%	Sept. 9	93	0.8	6%	4%	0/15
Spring Salamander	*Gyrinophilus porphyriticus*	4	0	0%	NA	144	0.2	2%	1%	0/4
Eastern Newt	*Notophthalmus viridescens*	34	11	32%	July 23	85	1.9	15%	9%	0/41
E. Red-backed Salamander	*Plethodon cinereus*	138	2	1%	Aug. 2	94	7.7	61%	36%	0/141
Group totals	Group totals	227	27	12%	NA	NA	12.6	100%	59%	0/239
Anurans (Frogs)										
American Toad	*Anaxyrus americanus*	35	0	0%	NA	83	1.9	22%	9%	0/36
Green Frog	*Lithobates clamitans*	6	2	33%	July 23	72	0.3	4%	2%	0/6
Pickerel Frog	*Lithobates palustris*	4	0	0%	NA	36	0.2	3%	1%	0/4
Wood Frog	*Lithobates sylvaticus*	86	10	12%	July 23	60	4.8	55%	22%	0/87
Spring Peeper	*Pseudacris crucifer*	26	1	4%	Sept. 27	36	1.4	17%	7%	0/26
Group totals	Group totals	157	13	8%	NA	NA	8.7	100%	41%	0/159
Amphibian totals	totals	384	40	10%	NA	NA	21.3	100%	100%	0/398

[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.

[4] 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.

[5] Data from April and May were gathered in the spring of 2017.

Table 2. A comparison of drift-fence data (numbers per trapping) from 1993 through 2016-17 (no data were collected in 2004, 2009, and 2015) 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	16[4]
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	1.4
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	0.6
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	0.8
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	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	0.8	1.3	1.8	1.6	1.0	0.7	0.8	0.7	1.9
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	3.4	6.3	6.7	8.9	7.5	7.2	13.2	9.8	7.7
Group totals	5.0	6.8	4.9	6.1	6.7	8.7	3.9	7.2	5.0	6.1	4.2	7.8	5.2	9.7	10.8	14.3	10.6	10.5	17.7	13.6	12.6
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	1.9
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	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	3.1	0.7	0.3
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	0.2
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	4.8
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	1.4
Group totals	8.1	3.6	10.1	10.8	11.4	10.3	12.2	9.8	9.2	31.9	10.0	9.5	7.2	9.3	7.0	5.1	8.9	11.3	15.5	8.2	8.7
Amphibian totals	13.1	10.4	15.0	16.9	18.1	19.0	16.1	17.0	14.2	38.0	14.2	17.4	12.4	19.0	17.8	19.4	19.5	21.8	33.2	21.8	21.3

[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, 16 in 2005, 16 in 2006, 15 in 2007, 14 in 2008, 15 in 2010, 15 in 2011, 17 in 2012, 17 in 2013, 18 in 2014, 18 in 2016-17. Trappings counted were on those nights when at 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 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.

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.

[4] Data from April and May were gathered in the spring of 2017.

Table 3. A comparison of young-of-the-year from drift-fence data from 1995 through 2016-17 (no data were collected in 2004, 2009, and 2015) 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 (% young of the year) [1,2,3,4]																		
	95	96	97	98	99	00	01	02[3]	03[3]	05[3]	06	07	08	10	11	12	13	14	16[4]
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%)	8/32 (25%)	10/30 (33%)	11/26 (42%)
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%)	0/13 (0%)	0/17 (0%)	0/11 (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%)	3/13 (23%)	1/8 (13%)	3/14 (21%)
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%)	0/4 (0%)	0/1 (0%)	0/4 (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%)	5/14 (36%)	4/12 (33%)	11/34 (32%)
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 (0%)	3/22 (2%)	9/224 (4%)	2/176 (1%)	2/138 (1%)
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%)	25/300 (8%)	17/244 (7%)	27/227 (12%)
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%)	13/157 (8%)
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%)	41/390 (11%)	40/384 (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, 18 in 2014, and 21 in 2016-17. 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.

[4] Data from April and May were gathered in the spring of 2017.

Table 4. A comparison of young-of-the-year from drift-fence data from 1995 through 2016-17 (no data were collected in 2004, 2009, and 2015) 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	16[4]
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%)	0/35 (0%)
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%)	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%)	0/8 (0%)	0/6 (0%)	1/26 (4%)
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%)	2/6 (33%)
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%)	0/4 (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%)	10/86 (12%)
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%)	25/147 (17%)	13/157 (8%)
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%)	17/244 (7%)	27/227 (12%)
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%)	41/390 (11%)	40/384 (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, 18 in 2014, and 21 in 2016-17. 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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[4]Data from April and May were gathered in the spring of 2017.