Mt. Mansfield Amphibian Monitoring

Update

2019

(Covering 1993-2019)

January 24, 2020

For the Forest Ecosystem Monitoring Cooperative

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Amphibian Monitoring on Mt. Mansfield, Vermont
1993-2019

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 remaining 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.

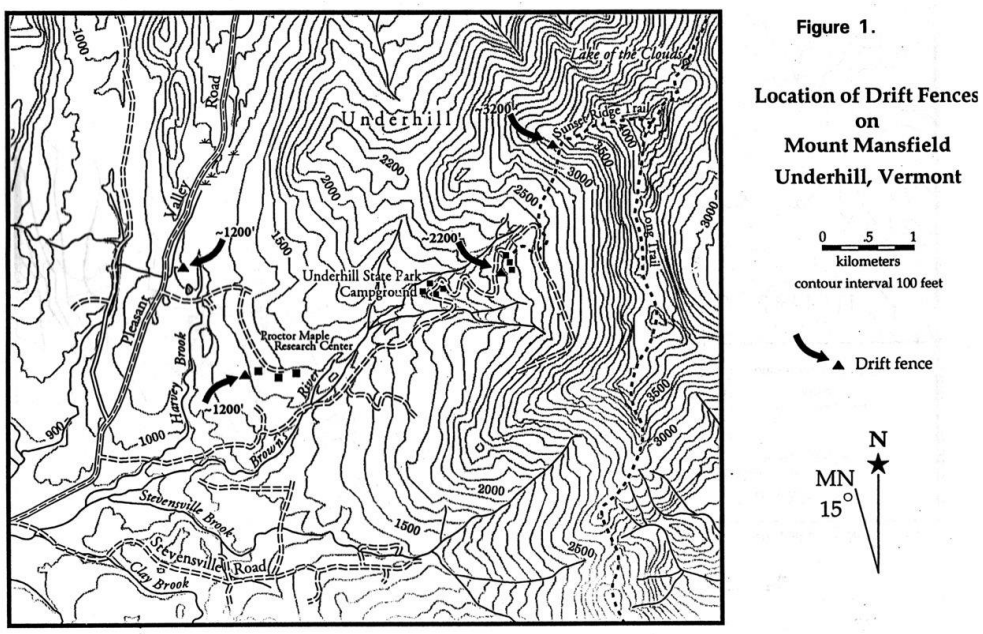

Figure 1.

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. 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 again in June of 2016.

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. We collected data from fences near the Lye Brook Wilderness in southern Vermont annually from 1994 through 2002 when funding from the Green Mountain National Forest ended. During 2008

monitoring began again at Lye Brook Wilderness and continued at Mt. Mansfield as well. 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 from the west, preventing data collection in the fall of 2011 and in 2012. A new road allowing access from Manchester has been completed. However, we would need to locate and train new staff and find additional funding before beginning monitoring again near Lye Brook.

In an effort to save money and time, we agreed in 2009 to begin an every-other-year schedule of generating indices, analyzing, and reporting on the data gathered. However, recent contracts have again required annual reports. The 2016 report included 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. The 2017 report contained all data collected in the 2017 season, as did the 2018 report, as well as this one. Cleaned and updated sets of all the drift-fence data from Mt. Mansfield, including data not used in our indices have been sent to the FEMC.

Diversity of Adults and Young

In 2019, the usual five caudate (salamander) species were caught as adults. They are Spotted Salamander (*Ambystoma maculatum*), Northern Dusky Salamander (*Desmognathus fuscus*), Northern Two-lined Salamander (*Eurycea bislineata*), Eastern Newt (*Notophthalmus viridescens*), and Eastern Red-backed Salamander (*Plethodon cinereus*). We also captured five Spring Salamanders (*Gyrinophilus porphyriticus*) in 2019; this is a species we have only caught 12 of our 24 trapping seasons. Young of four of these species (Spotted Salamander, Eastern Newt, Northern Two-lined, and Eastern Red-backed Salamander) were also caught (Table 1).

In 2019, adults of five of our normally trapped anurans (frogs) were caught. They are American Toad (*Anaxyrus americanus*), Spring Peeper (*Pseudacris crucifer*), Green Frog (*Lithobates clamitans*), Pickerel Frog (*Lithobates palustris*), and Wood Frog (*Lithobates sylvaticus*). No Gray Treefrogs (*Hyla versicolor*) were captured. Juvenile Wood Frogs were abundant (28). A relatively high number of juvenile Spring Peepers were captured (8), a few young Green Frogs (13), two juvenile American Toads, and one young Pickerel Frog (Table 1).

In 2018, the total number of salamanders and frogs detected per trapping was considerably lower than in 2017, but still above the average total number detected over the entire study period. In 2019 the total numbers were higher than in 2018. The Northern Dusky Salamander and the Wood Frog both tied with a previous highest record year (Table 2).

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 1993-2019 (Figures 2-7). In 2017, in addition to using linear regressions to show potential trends in the abundance indices, we used the Monitor.exe freeware program to determine the reliability of the apparent trends. We plan to reexamine the reliability of the trend lines every five years.

Young of the Year

Beginning with the 1995 report, we began documenting the number of young of the year, calculating the percentage of young of the year (YOY), and recording the date of the first metamorph caught by 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 below and in the table 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 2019, young of the year made up 15% of the total amphibians captured (Table 1). Over the course of the portion of the study where we have juvenile information (1995 – 2019) the average percentage of young of the year of total catch has been 25.8%. Since 1995 the young of the year have varied from 11% (2014) to 74% (2002). The 2019

result of 15% is the second lowest number we have calculated. Table 4 and Table 5 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 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 very 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 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 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. 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.

Individual Species' Trends

Northern Two-lined Salamander

We catch relatively few Northern Two-lined Salamanders. This was expected since we did not place the fences with their habitat in mind. This species prefers saturated soils and travels only a limited distance away from those areas in very wet conditions. The first decade of monitoring showed a slight increasing trend in numbers caught. In 2005 we saw a large increase from 0.3 to 1.1 caught per trapping, followed in 2006 by a drop back to 0.2, and then a slow increase until the population peaked again in 2010 with 1.1 per trapping. Since 2003, the indices have shown some large annual fluctuations, but the linear regression trend line continues to show an increase even though only 0.5 were detected per trapping in 2018 and in 2019 (Figure 2 and Table 2).

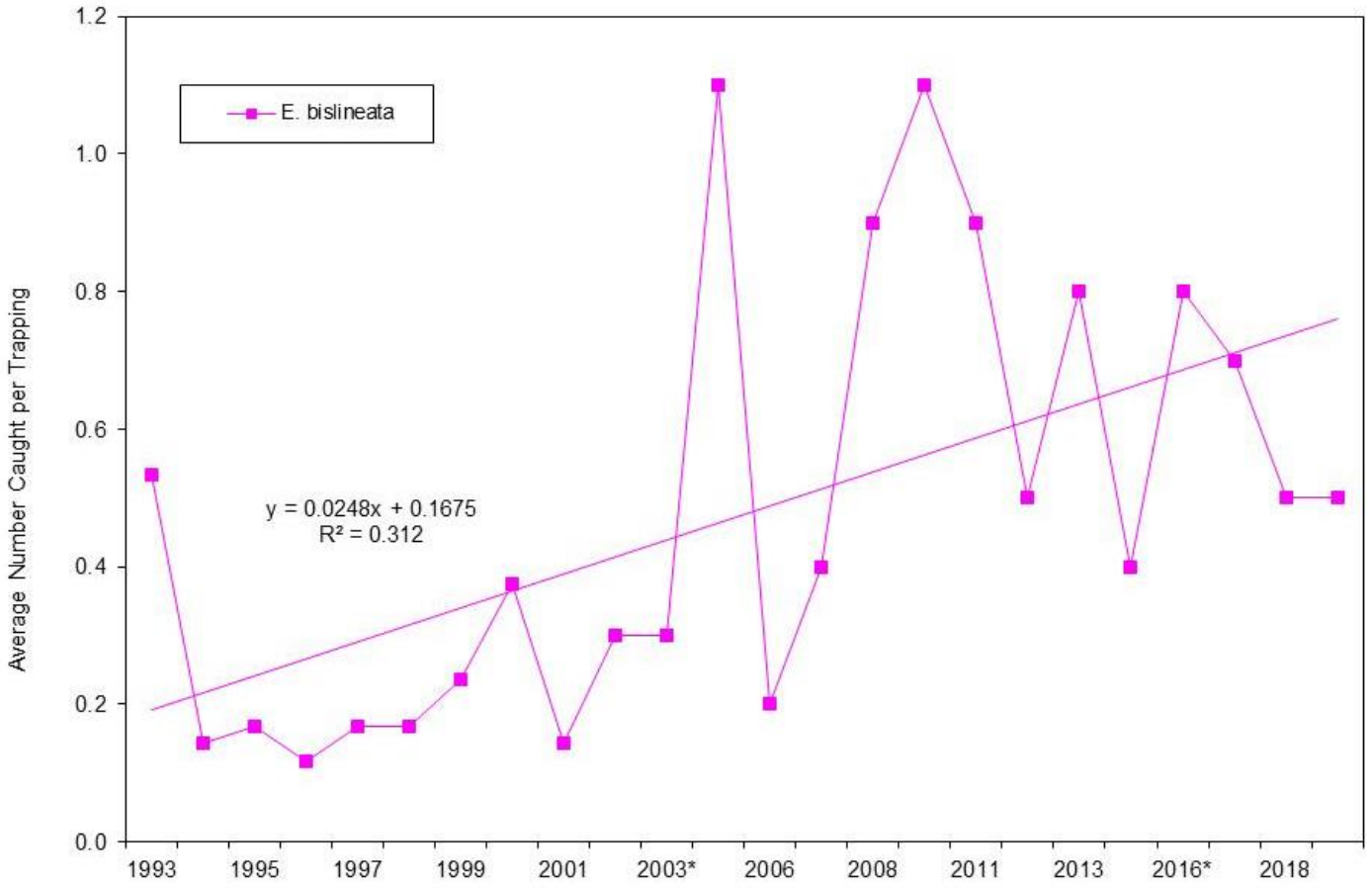

Figure 2. Northern Two-lined Salamander (*Eurycea bislineata*) population index from Mt. Mansfield, Underhill, Vermont, 1993-2019.

Spotted Salamander

The Spotted Salamander has a regression trend line showing a very slight increase, with some annual variation (Figure 3). The trapping average for 2017 of 2.9 individuals was a record high for this species and the average remained fairly high in 2018 and 2019, when 2.0 and 2.5 per trapping were detected. 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. The number of young of the year detected in 2019 was 34%, up from a recent low in 2017 (10%).

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 increase, with large annual variations. In 2017, a record number (14.5) were detected, but in 2018 that number had dropped back to 7.5 and increased again in 2019 to 11.1 (Figure 3 and Table 2).

This species is reported to do well in mature hardwood forests with abundant coarse woody debris and deep deciduous leaf litter. Unlike the Wood Frog and Spring Peeper it overwinters deep in the soil below the frost line, so it is likely less subject to overwintering mortality. Also, unlike Wood Frogs and Spring Peepers, it does not require wetlands in any stage of its development, so hydro period or other conditions in breeding ponds would not have any direct impact on their numbers, although soil moisture could. The overall increase in this species could be a result of the leaf litter becoming deeper, the leaf litter holding moisture better, an increasing amount of course woody debris, or some a combination of these factors. These could all be a result of a maturing hardwood forest. The annual variation could be related to changes in moisture in the top layers of leaf litter, and in drier years the salamander may be farther underground.

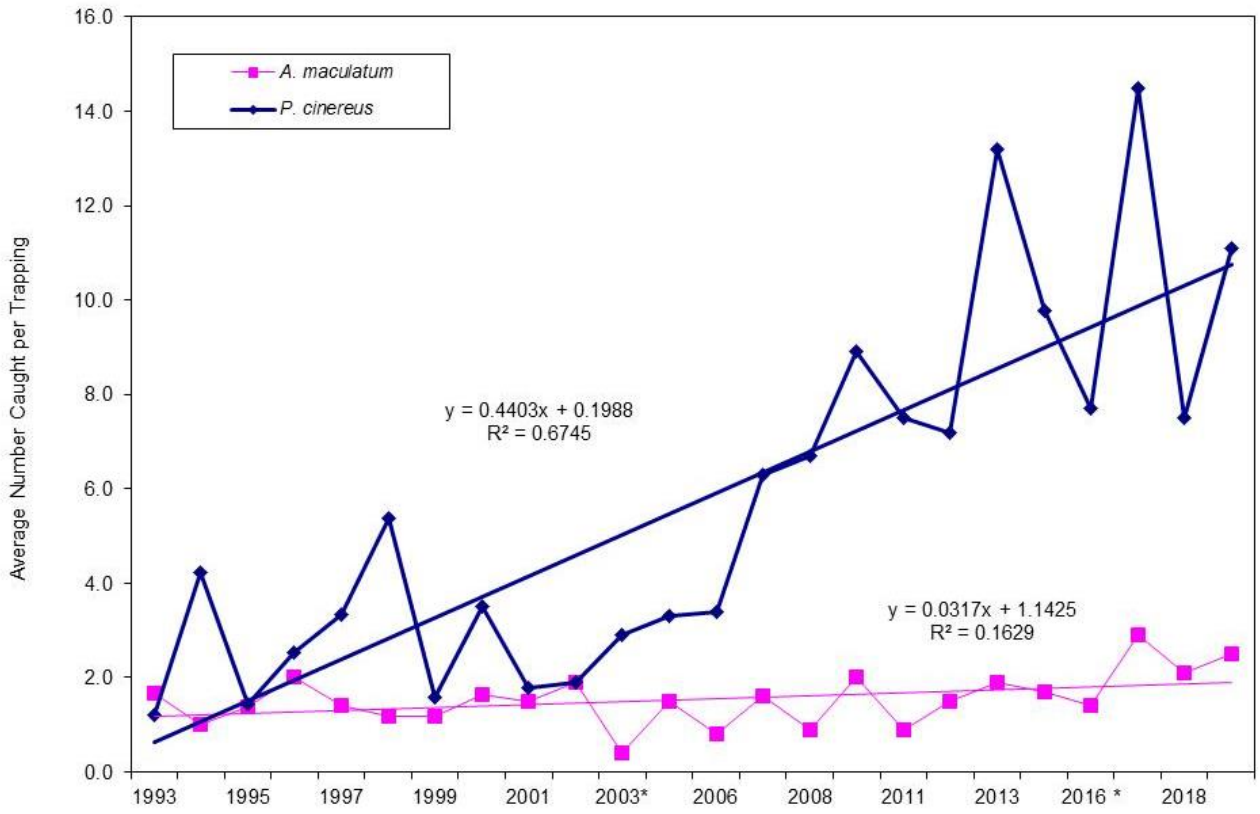

Figure 3. Spotted Salamander (*Ambystoma maculatum*) and Eastern Red-backed (*Plethodon cinereus*) Salamander population indices from Mt. Mansfield, Underhill, Vermont, 1993-2019.

Eastern Newt

The trapping rate for the Eastern Newt in 2018 was 1.5 animals per trapping, slightly higher than the 1.4 detected in 2017, but in 2019 only 0.8 animals were captured/per trapping. The long-term trend shows a slight downward regression line with a great deal of annual variation (Figure 4). Of the animals captured, a relatively high percentage (67%) were considered young of the year.

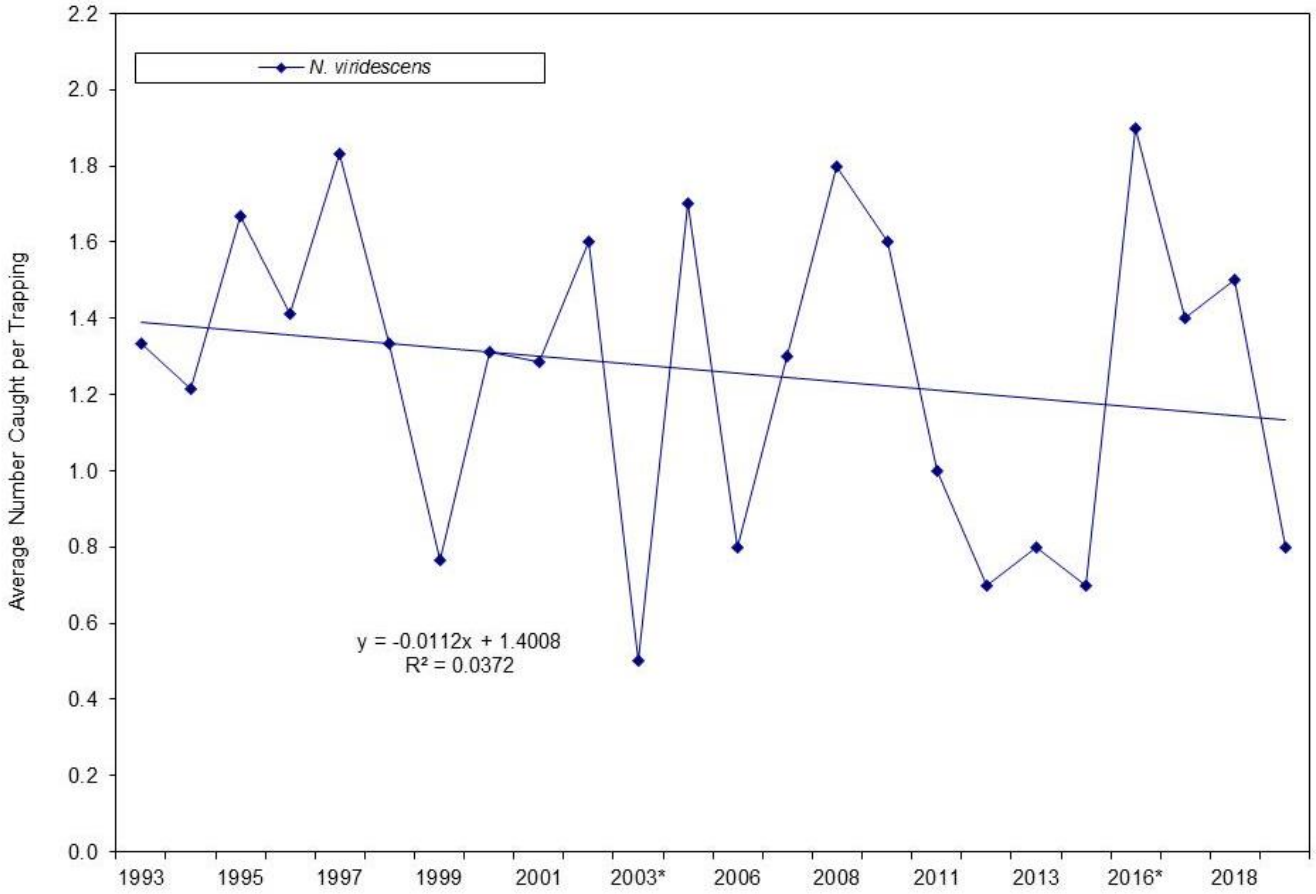

Figure 4. Eastern Newt (*Notophthalmus viridescens*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2019.

American Toad

American Toad captures have fluctuated with large annual variations (Figure 5). An all-time high of 5.5 American Toads per trapping was detected in 2013. After that year, our index dramatically fell back to a low of 1.2 in 2017. The numbers appear to be coming back up and 1.9 per trapping were detected in 2019. The regression line shows that the population appears to be increasing, but that may be based on a few very productive years. However, a careful look at Figure 5 shows that we began monitoring this species at a low point in its numbers. A long-term regression line for the last twenty years would look fairly level for this species, despite the large annual variation.

Pickerel Frog

We catch so few Pickerel Frogs (less 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 5 and Table 2). This is not surprising. Our fences were not located in the preferred foraging habitat (open annual vegetation near water) for this species.

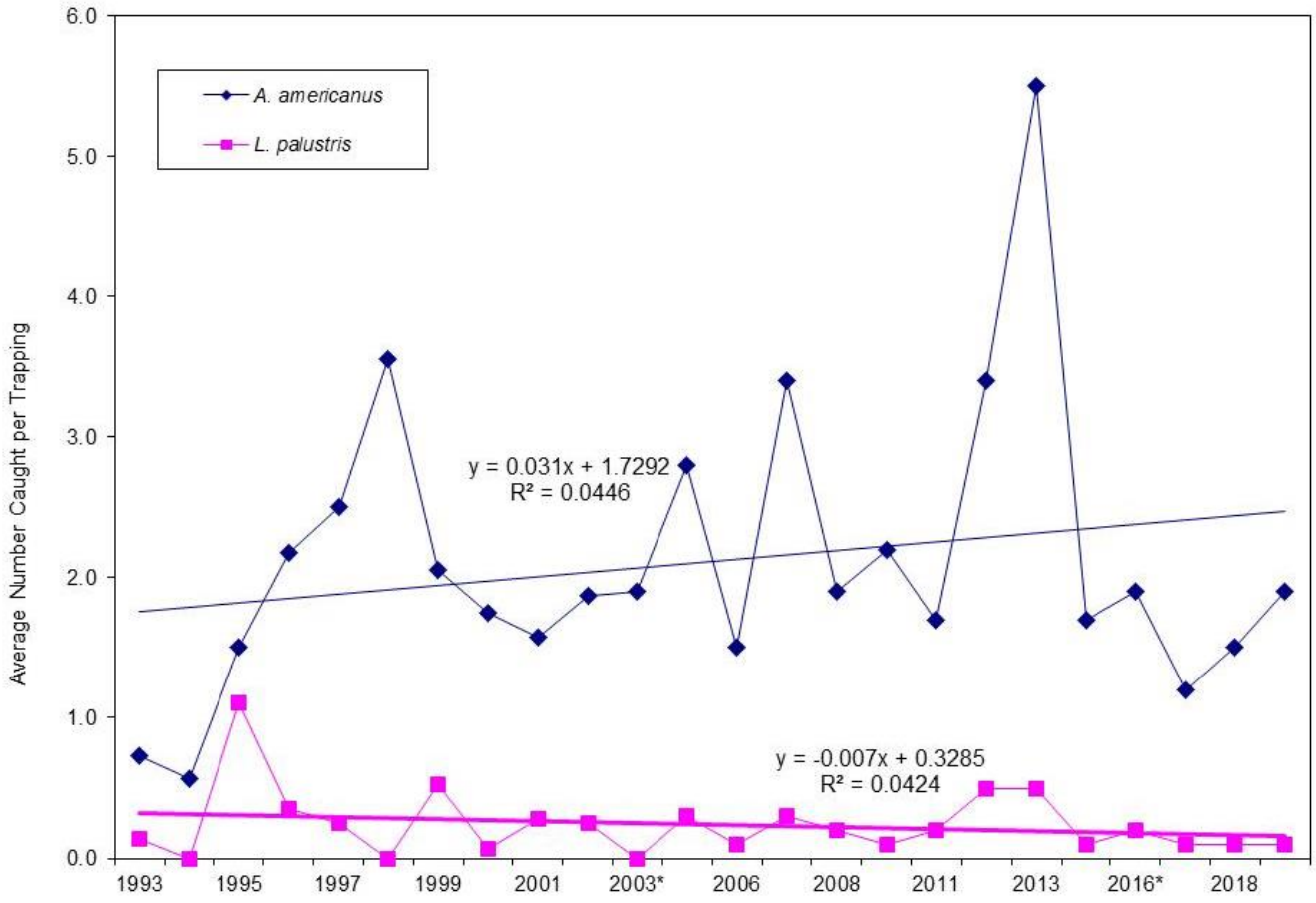

Figure 5. American Toad (*Anaxyrus americanus*) and Pickerel Frog (*Lithobates palustris*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2019. The numbers for the Pickerel Frog are too low to draw any meaningful conclusions.

Wood Frog

Wood Frogs continue to have large year-to-year fluctuations (Figure 6 and Table 2). The regression line appears to show a slight long-term increase, although that is largely the result of the last few years with a record number of Wood Frogs per trapping (11.3) detected in both 2017 and 2019. In 2017, a relatively high percentage of Wood Frogs detected were young of the year (42%), while in 2018, 27% were young of the year, and in 2019 only 17% were young of the year.

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 a 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 research site in Lincoln (Colby Hill Ecological Preserve) where we are monitoring egg-mass numbers, we have not seen any significant trends for this species.

Spring Peeper

In 2017, using Power analysis, we showed that the Spring Peeper was showing an annual decline of 1.6%. It was the only decline shown among the species we monitor on Mt. Mansfield that we confidently (100%) had the power to claim. However, at that time it appeared that their population was beginning to recover after completely disappearing from our fences back in 2008. By 2017 their numbers had bounced back to those seen at the very beginning of our monitoring back in 1993. Since 2017, their numbers are dropping once again. (Table 2 and Figure 6).

Local changes in breeding habitat are one possible explanation for this population variation, 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 would 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, snow pack, or changes in the depth of the leaf litter could also bring about declines. Invasive worms and disease are other potentially significant variables.

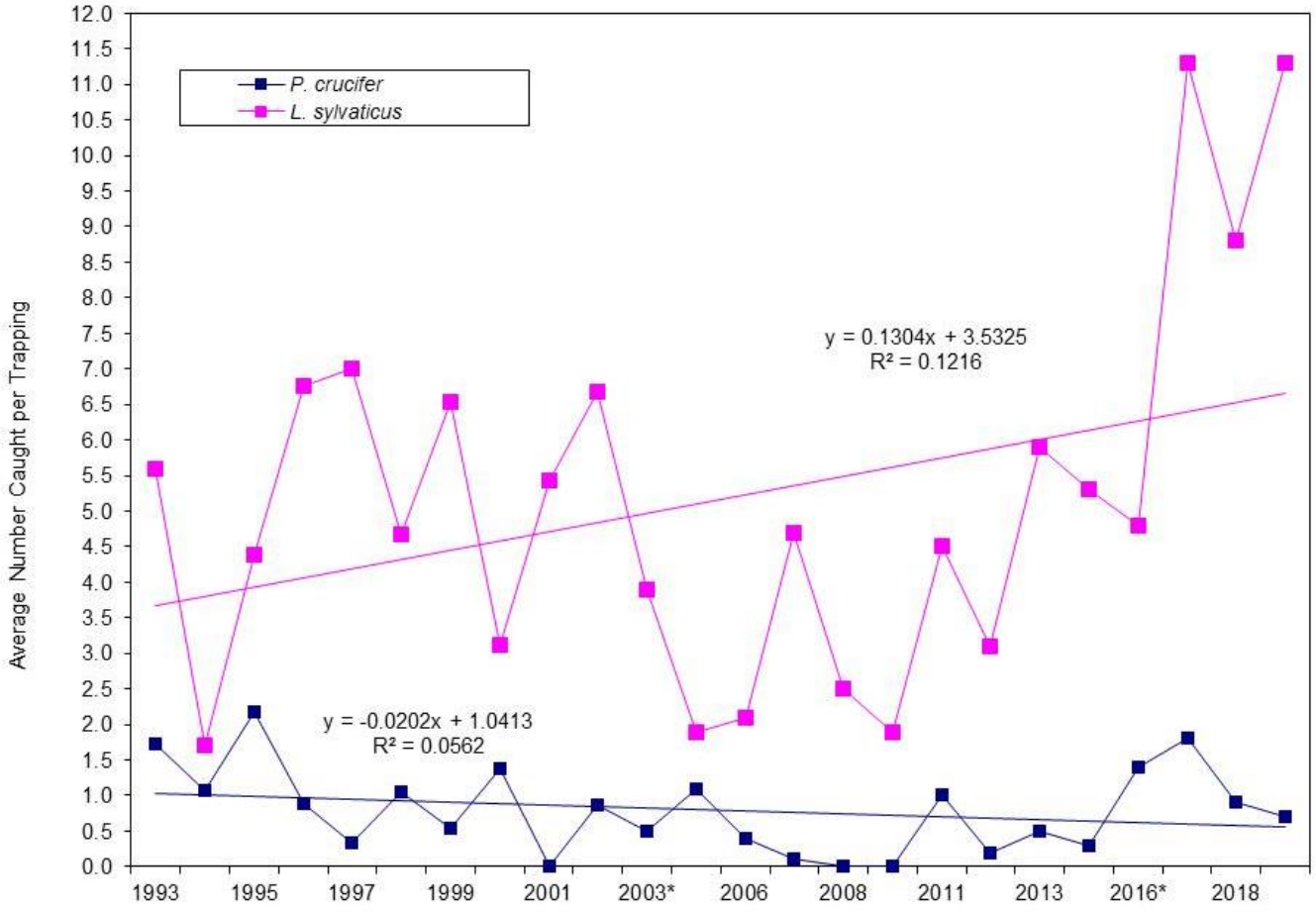

Figure 6. Wood Frog (*Lithobates sylvaticus*) and Spring Peeper (*Pseudacris crucifer*) indices from Mt. Mansfield, Underhill, Vermont, 1993-2019.

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 7). 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 very slight increase overall, Green Frog numbers have decreased each year since 2012 with a near record low of 0.30 per trapping detected in 2016/17. Increases have continued since that low with 3.1 detected per trapping in 2019. We can see that this species can 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 spike like that seen in 2002, particularly if it was preceded and/or succeeded by wet conditions. Green Frogs are also largely aquatic and require standing pools of water to rehydrate and wet conditions in which to move. Although higher numbers of animals were seen in 2019 the percentage of young of the year was lower in 2019 (28%) than the previous few years.

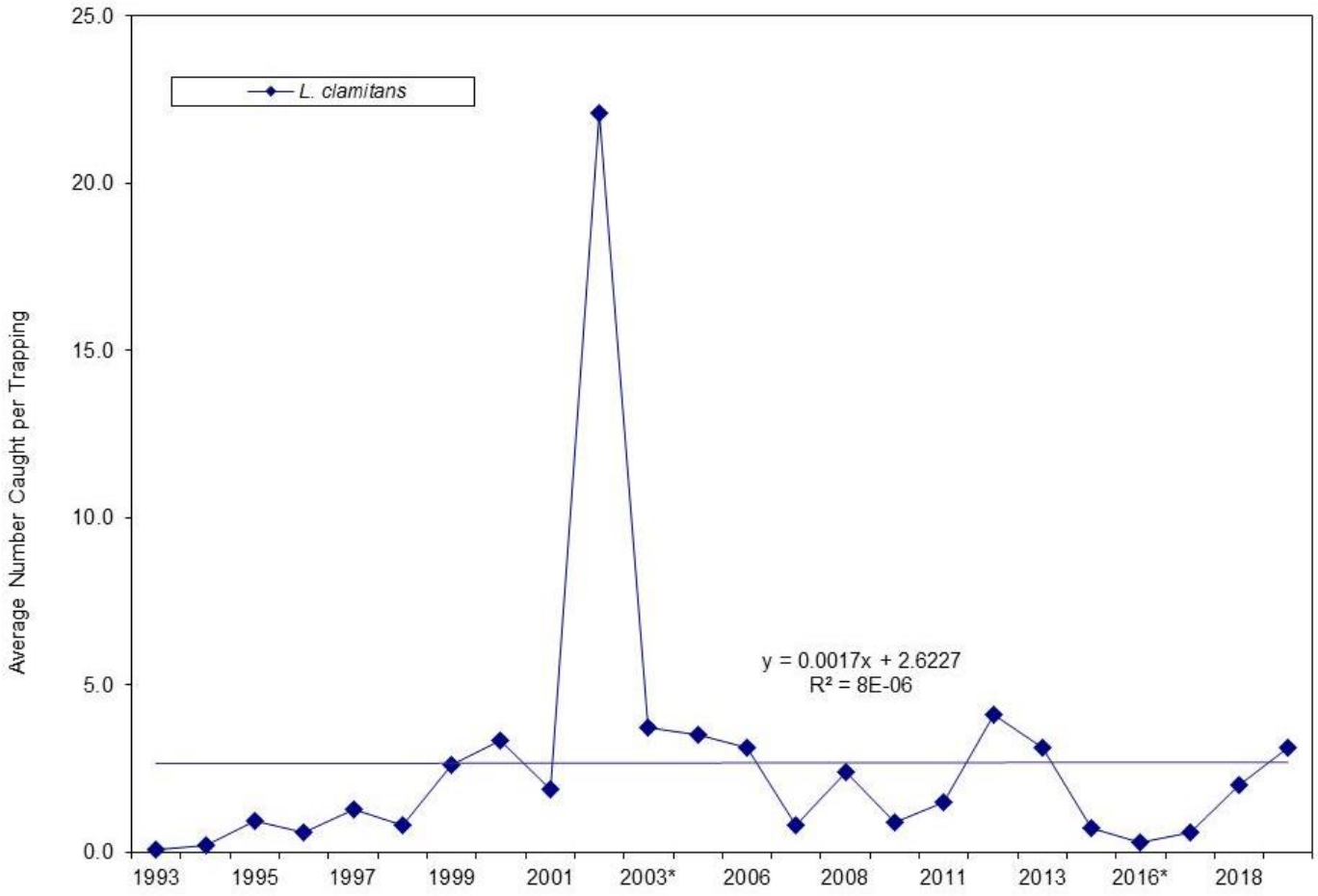

Figure 7. Green Frog (*Lithobates clamitans*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2019.

Abnormalities

The number of abnormalities continues to be low, with no abnormalities detected in 2019 out of 505 animals captured.

There were no abnormalities seen in 2007, 2008, 2009, 2010, 2013, 2014, 2016/17, or in 2019. In 2011, one abnormality was detected in the 314 animals captured. It was a Wood Frog that 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. In 2018 a Spotted Salamander was found with an adventitous tail

The numbers of abnormalities at this site have always been well below the level of concern. From 1998 through 2019, the total number of amphibians showing abnormalities from all captures has been 16 individuals.

Data

Data from these efforts are exported in Excel format and sent via E-mail to FEMC.

Non-target Mortality

Small mammals fall into the pitfall traps along with amphibians. Sadly, mammals smaller than a chipmunk are unable to escape the traps and most die. We experimented with installing dowels in ½ of the pitfalls to allow small mammals to climb out, unfortunately many Spring Peepers and all Eastern Red-backed Salamanders also escaped, making it impossible to continue to monitor Eastern Red-backed Salamanders. As a result, we removed the dowels from all the traps. We monitor small mammal mortalities looking for any declines in any of the species that might be the result of our traps. We have not seen any declines in any of those species. This year (2019), although total small-mammal mortalities dropped from 411 to 372, there was an unusual increase in the number of Woodland Jumping Mice (*Napaeozapus insignis*) found in the traps. We totaled 172 Woodland Jumping Mice. Last year, there were 75 and the previous high recorded in the last decade was 139 back in 2011. This suggests that for some unknown reason the population of this species is the highest since we started monitoring. Although this shows that their population increased this year despite the traps, it has raised some concerns with Vermont Fish and Wildlife who issue the permits for this work. We plan to look into alternative strategies for minimizing small mammal mortality this winter. This may result in some changes in our pit-fall trap design.

Summary

The drift-fence array at Mt. Mansfield has generated the longest-running set of amphibian-monitoring data in the state. It is the only amphibian drift-fence location in Vermont that has been monitored almost continuously from 1993 through 2019.

The overall number of suitable nights to open the drift fence was low in 2019; although the total number of amphibians captured was still higher than most of the previous years of the study.

- Populations of **Spring Peeper** have declined over the long-term duration of this study; they had rebounded in 2016 and 2017, but their numbers fell again in 2018 and 2019.
- Populations of the **Eastern Red-backed Salamander** have increased dramatically over the length of the study.
- Populations of **Spotted Salamander** remain fairly stable.
- Populations of **Eastern Newt** have decreased but show large annual variations. Relatively few were seen in 2019.
- Populations of the **Northern Two-lined Salamander** have increased, although we continue to catch relatively few.

- Populations of **Green Frog** remain fairly stable, except for 2002 when there was a large increase in young of the year.

- Populations of **Wood Frog** are showing a slight increase over the long term and a large increase since 2004.

- Populations of **American Toad** have increased slightly over the duration of the study; however, we began gathering data at a very low-point in their populations. If we had begun monitoring five years later, the population trend line would appear fairly level.

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

Long-term monitoring at Mt. Mansfield during 2019 was supported by a cost-sharing grant from the Vermont Department of Forests, Parks, and Recreation through the Forest Ecosystem Monitoring Cooperative (FEMC) to Vermont Family Forests. Field personnel at Mt. Mansfield were Warren Ellison, Karl Riemer, and Robert Robbins. Cynthia Brown entered all the data and Erin Talmage reviewed the data, generated the tables and figures, and drafted the report.

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 2019. 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 17 trap-efforts were used: April 20, May 20, and May 26; June 6, 11, and 21, July 12, 23, and 31; September 3, 24, 1 29; and October 7, 23, and Nov 1.** Abnormality, maximum size, and first metamorph

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*	38	13	34%	Sept. 3	173	2.5	16%	8%	0/38
N. Dusky Salamander	*Desmognathus fuscus*	14	0	0%	N/A	98	0.9	6%	3%	0/14
N. Two-lined Salaman	*Eurycea bislineata*	8	2	25%	June 11	77	0.5	3%	2%	0/8
Spring Salamander	*Gyrinophilus porphyriticus*	5	0	N/A	N/A	181	0.3	2%	1%	0/5
Eastern Newt	*Notophthalmus viridescens*	12	8	67%	Sept. 24	79	0.8	5%	2%	0/12
E. Red-backed Salama	*Plethodon cinereus*	167	1	1%	Nov. 1	95	11.1	68%	33%	0/170
Group totals	Group totals	244	24	10%	NA	NA	16.3	100%	49%	0/247
Anurans (Frogs)										
American Toad	*Anaxyrus americanus*	29	2	7%	Sept. 24	88	1.9	11%	6%	0/29
Green Frog	*Lithobates clamitans*	47	13	28%	Sept. 3	77	3.1	18%	9%	0/47
Pickerel Frog	*Lithobates palustris*	1	1	100%	Sept. 24	32	0.1	0%	0%	0/1
Wood Frog	*Lithobates sylvaticus*	169	28	17%	July 12	63	11.3	66%	34%	0/169
Spring Peeper	*Pseudacris crucifer*	11	8	73%	Sept. 24	36	0.7	4%	2%	0/12
Group totals	Group totals	257	52	20%	NA	NA	17.1	100%	51%	0/258
Amphibian totals	Amphibian totals	501	76	15%	NA	NA	33.4	100%	100%	0/505

[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.

Table 2. A comparison of drift-fence data (numbers per trapping) from 1993 through 2019 (no data were collected in 2004, 2009, nor 2015) field seasons at Mt. Mansfield, Underhill, Vermont. Data used are from two fences at 1,200 ft. and one fence at 2,200

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]	17	18	19
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	2.9	2.1	2.5
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	0.8	0.9	0.6	0.7	0.6	0.9
N. Two-lined Salamar	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	0.7	0.5	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	0.2	0.1	0.2	0.6	0.0	0.3
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	1.4	1.5	0.8
E. Red-backed Salama	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	14.5	7.5	11.1
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	20.8	12.2	16.1
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	1.2	1.5	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	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	3.1	0.7	0.3	0.6	2.0	3.1
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	0.5	0.1	0.2	0.1	0.1	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	4.8	11.3	8.8	11.3
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	0.0	1.4	1.8	0.9	0.7
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	7.9	8.7	15.0	13.3	17.1
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	21.5	21.3	35.8	25.5	33.2

[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[4], 18 in 2017, 18 in 2018, and 15 in 2019. 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.

Table 3. A comparison of young-of-the-year salamanders from drift-fence data from 1995 through 2019 (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]	17	18	19
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%)	11/16 (69%)	5/52 (10%)	7/35 (20%)	13/38 (34%)
N. Dusky Salamande	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%)	0/5 (0%)	0/12 (0%)	0/11 (0%)	0/14 (0%)
N. Two-lined Salaman	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%)	3/12 (25%)	0/13 (0%)	3/8 (38%)	2/8 (25%)
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%)	0/2 (0%)	0/10 (0%)	0/0 (0%)	0/5 (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%)	11/26 (42%)	5/26 (19%)	6/26 (23%)	8/12 (67%)
E. Red-backed Salama	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%)	2/97 (2%)	3/261 (1%)	1/127 (1%)	1/167 (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%)	27/158 (17%)	13/374 (3%)	17/206 (8%)	24/244 (10%)
Amphibian totals	0 (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%)	40/226 (18%)	110/642 (17%)	98/432 (23%)	76/501 (15%)

[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, 18 in 2016[4], 18 in 2017, 18 in 2018, and 15 in 2019. 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] April and May data were gathered in the spring of 2017.

Table 4. A comparison of young-of-the-year frogs from drift-fence data from 1995 through 2019 (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]	17	18	19
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%)	0/27 (0%)	1/22 (5%)	0/26 (0%)	2/29 (7%)
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%)	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 (55%)	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%)	1/1 (100%)	4/32 (13%)	0/15 (7%)	8/11 (73%)
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%)	7/10 (70%)	22/34 (65%)	13/47 (28%)
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%)	0/3 (0%)	0/1 (0%)	0/1 (0%)	1/1 (100%)
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%)	10/31 (32%)	85/203 (42%)	58/150 (39%)	28/169 (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%)	13/68 (19%)	97/268 (36%)	81/226 (36%)	52/257 (20%)
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%)	40/226 (18%)	110/642 (17%)	98/432 (23%)	76/501 (15%)

[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, 18 in 2016[4], 18 in 2017, 18 in 2018, and 15 in 2019. 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] April and May data were gathered in the spring of 2017.