Mt. Mansfield Amphibian Monitoring

Update

2020

(Covering 1993-2020)

April 13, 2021

For the Forest Ecosystem Monitoring Cooperative

James S. Andrews and Erin Talmage

Amphibian Monitoring on Mt. Mansfield, Vermont
1993-2020

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. In drought years, only one or two successful trap nights might need to used instead.

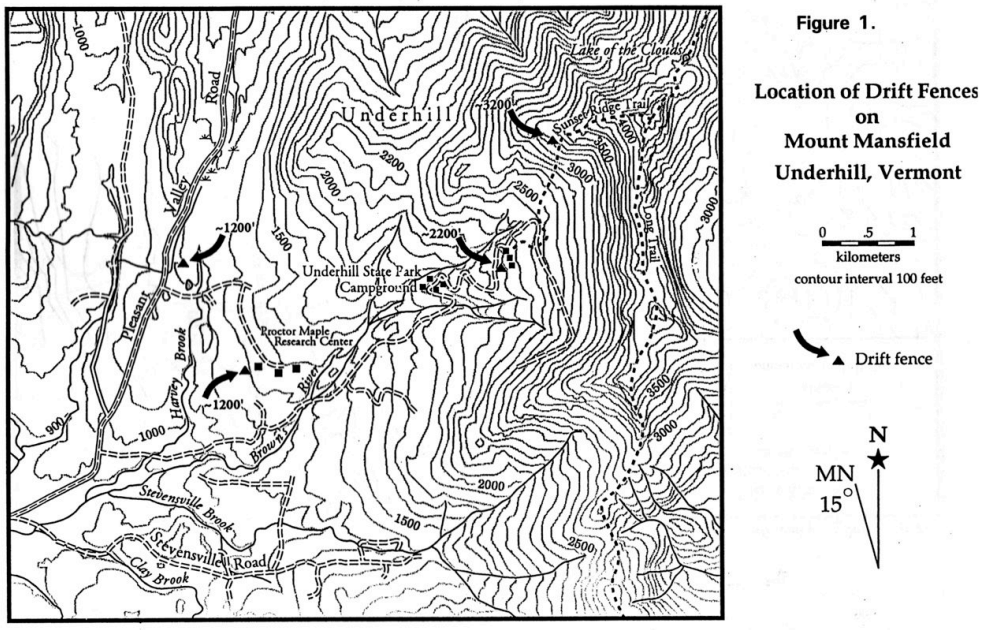

Figure 1.

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. 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 allowed us to compare data at the two locations to see if there were 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 only in the 2017 season, as have all subsequent reports. 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. 2020 was a dry year and the team was not able to open the fences as often as in previous years. They are typically opened on appropriate nights (wet and warm) and we select the top three nights per month to calculate our indices. Due to the relative lack of rain in 2020, only two nights were successful enough to be selected for April, May, and July, and only one date could be used from June.

Diversity of Adults and Young

In 2020, 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*). Spring Salamanders (*Gyrinophilus porphyriticus*) were not detected in 2020; this is a species we have only caught 12 of our 25 trapping seasons. Young of the year of only three of these species were captured: Spotted Salamander, Eastern Newt, and Northern Two-lined (Table 1).

In 2020, 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. Young of the year were captured for Wood Frogs, Green Frogs, and Pickerel Frogs(Table 1).

Combined Numbers

The total number of salamanders and frogs detected per trapping were considerably lower in 2020 as compared to 2019. The number of salamanders detected were the lowest in a decade, but still slightly above the average of the entire study. The number of frogs detected were lower than the previous two years, but also above the average of the entire study. The very dry summer may have been one reason for the fewer detections. (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 1993-2020 (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 2020, young of the year made up 12% of the total amphibians captured (Table 1). Over the course of the portion of the study where we have juvenile information (1995 – 2020) the average percentage of young of the year of total catch has been 25.3%. Since 1995 the young of the year have varied from 11% (2014) to 74% (2002). The 2020 result of 12% 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 since they spend multiple years in their aquatic larval stage. It would be more accurate 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 is 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. 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 2019, and 0.3 were detected in 2020 (Figure 2 and Table 2).

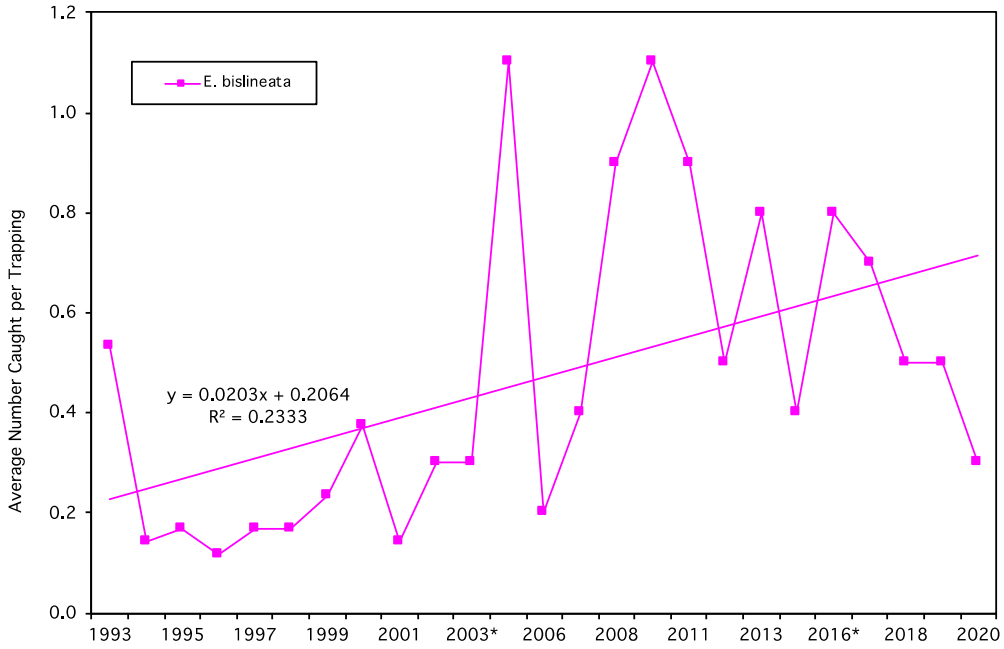

Figure 2. Northern Two-lined Salamander (*Eurycea bislineata*) population index from Mt. Mansfield, Underhill, Vermont, 1993-2020.

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, and was back to 2.8 in 2020. 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 2020 was 44%, up from a recent low in 2017 (10%) (Table 4).

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 relatively low number were detected (5.6) in 2020 (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 (such as 2020) the salamander may be farther underground. Invasive earthworms can have an effect on the depth of the leaf litter and are now being monitored at our fences.

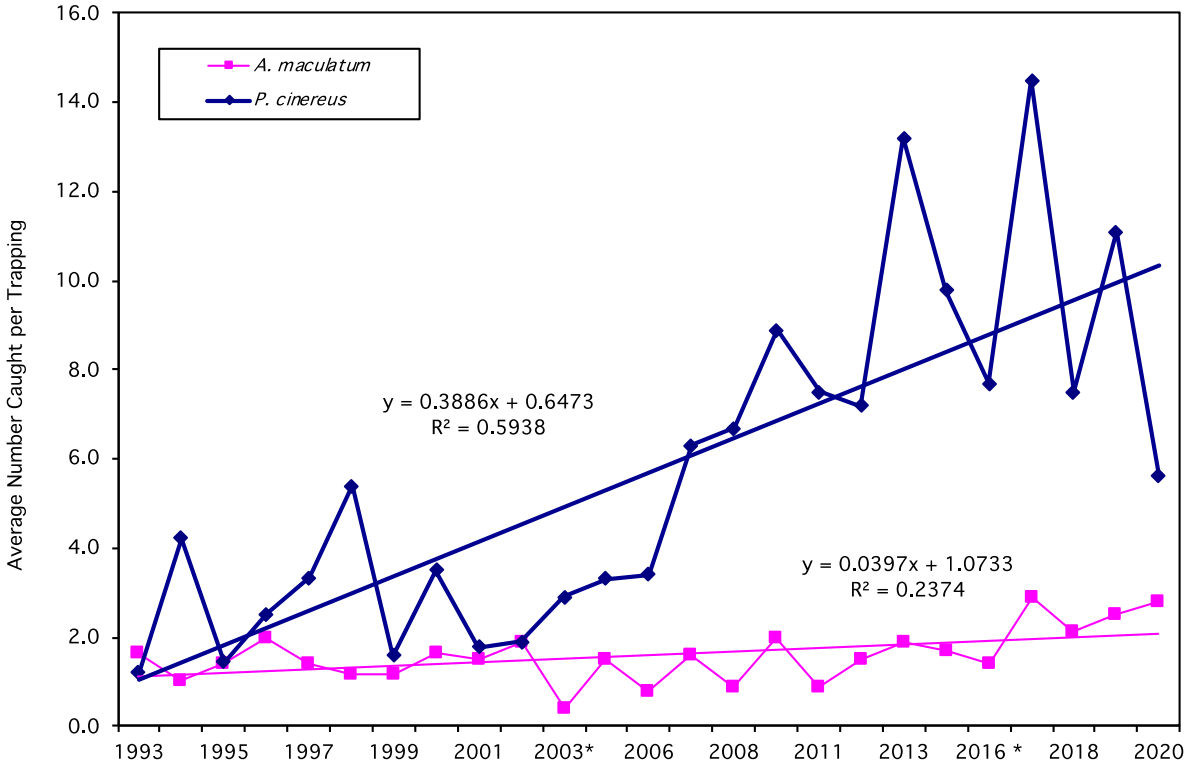

Figure 3. Spotted Salamander (*Ambystoma maculatum*) and Eastern Red-backed (*Plethodon cinereus*) Salamander population indices from Mt. Mansfield, Underhill, Vermont, 1993-2020.

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 and 2020 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, (45%) were considered young of the year (Table 1 and Table 4).

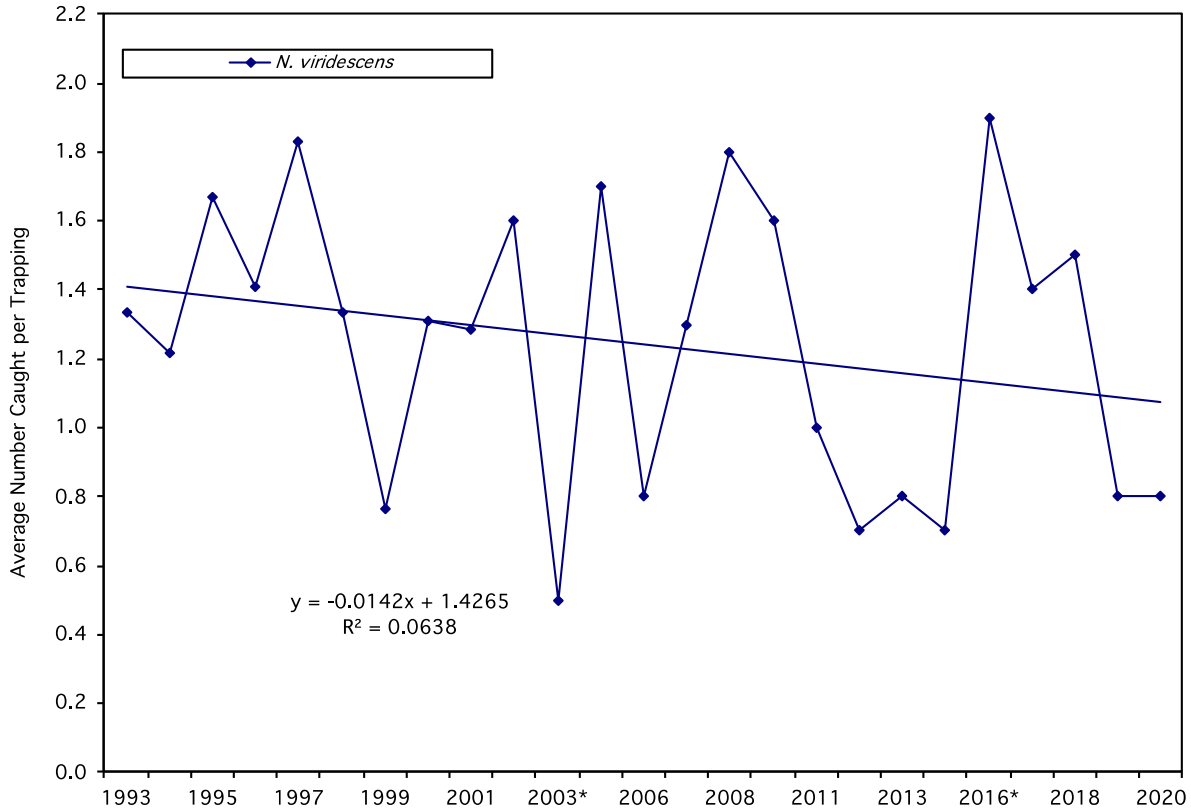

Figure 4. Eastern Newt (*Notophthalmus viridescens*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2020.

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, went up for two years and then dropped back to 1.1 in 2020. The regression line shows that the population appears to be fairly steady with a slight increase, but that may be the result of a few very productive years and an unusually low population when we started monitoring.

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.

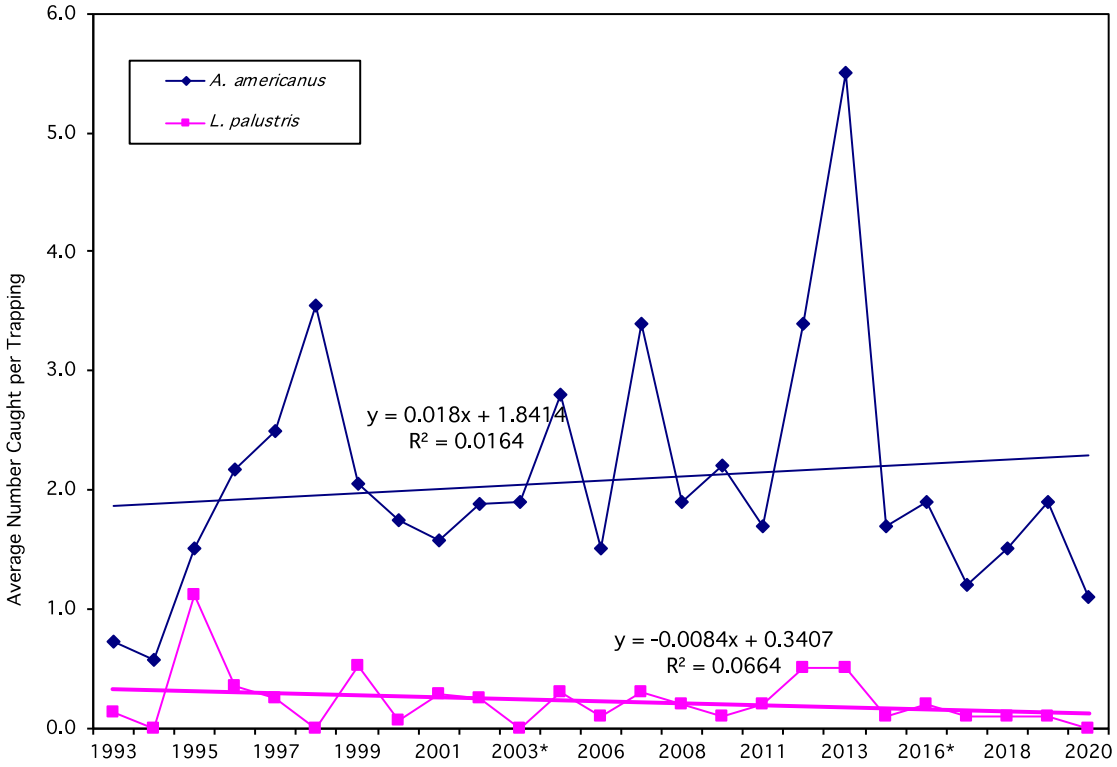

Figure 5. American Toad (*Anaxyrus americanus*) and Pickerel Frog (*Lithobates palustris*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2020. The numbers for the Pickerel Frog are too low to draw any meaningful conclusions.

Wood Frog

Wood Frogs continue to have large year-to-year fluctuations (Figure 6 and Table 2). The regression line appears to show a 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, and 11.4 in 2020. In 2017, a relatively high percentage of Wood Frogs detected were young of the year (42%), this has dropped the last three field seasons to the second lowest number (9%) seen since the beginning of the study.

Since this species grows from egg to metamorph in a matter of months, seasonal droughts (such as seen in 2020) 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 have stayed relatively low in 2018, 2019, and 2020 (0.9, 0.7, and 0.8). (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.

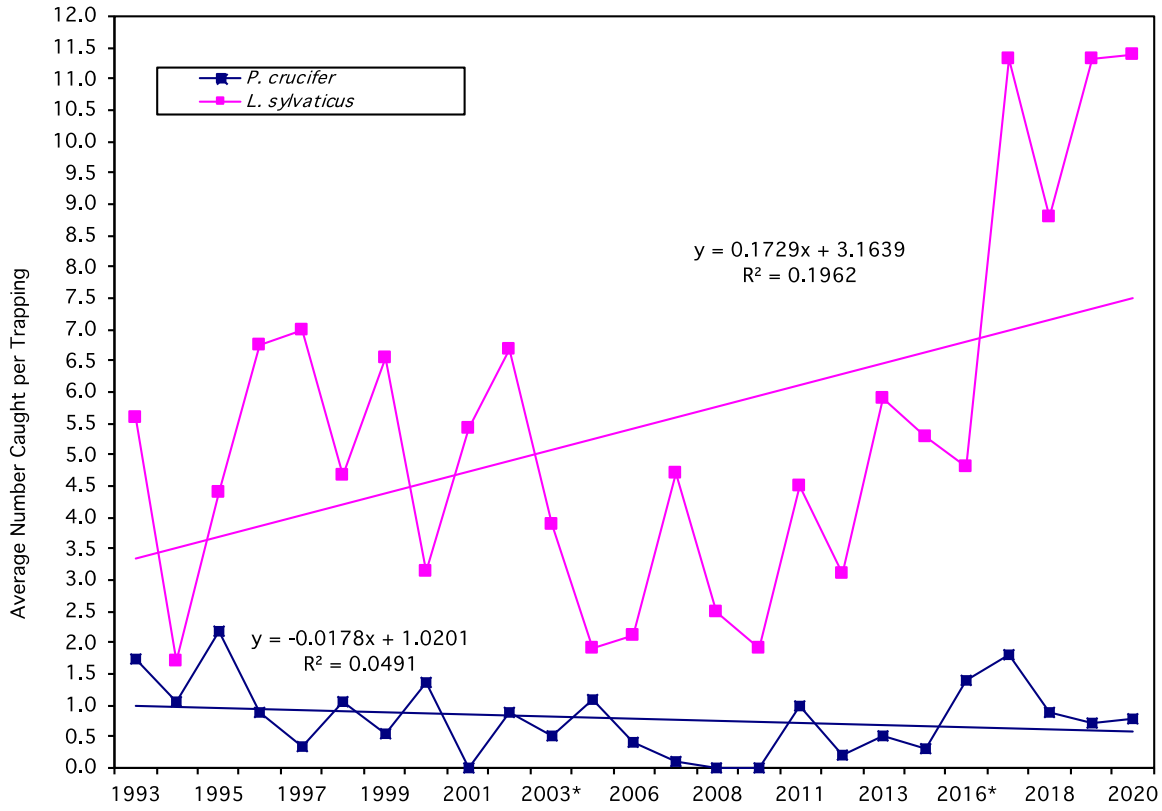

Figure 6. Wood Frog (*Lithobates sylvaticus*) and Spring Peeper (*Pseudacris crucifer*) indices from Mt. Mansfield, Underhill, Vermont, 1993-2020.

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. The long-term trend line implies a very slight decrease overall. In 2020, 1.8 Green Frogs were detected/trapping. 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.

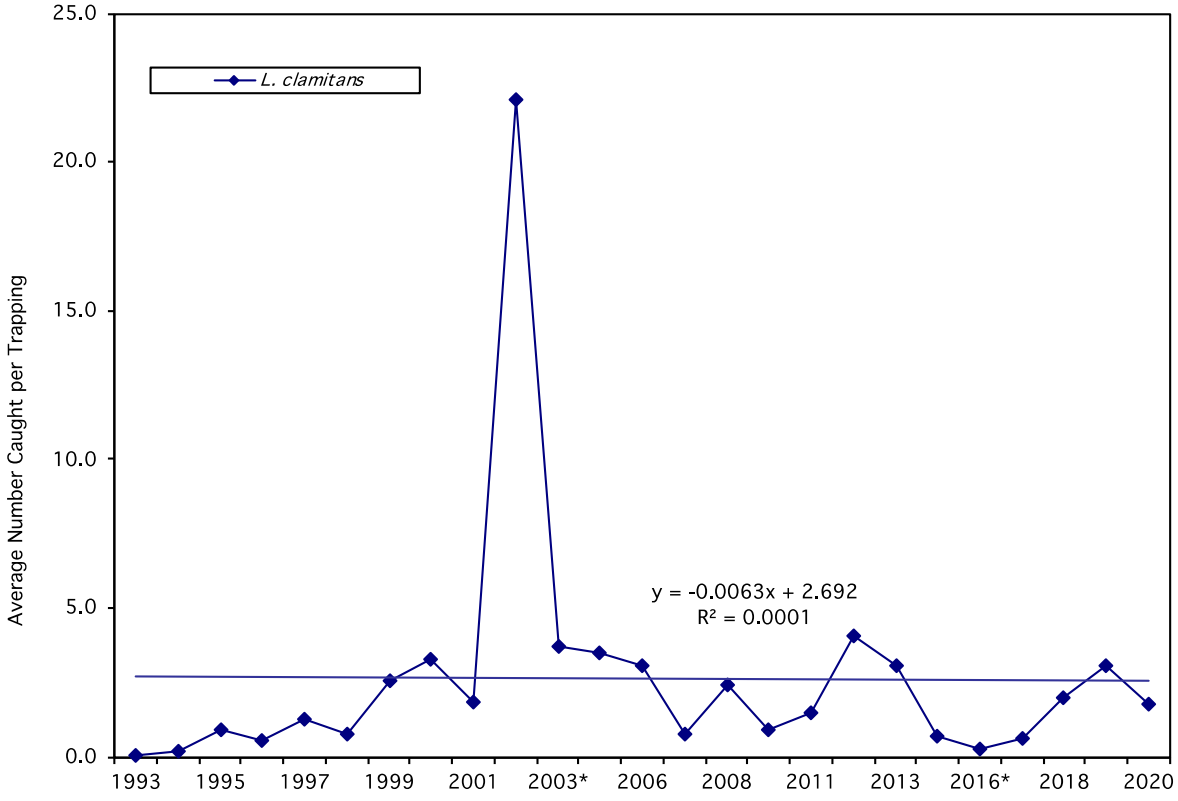

Figure 7. Green Frog (*Lithobates clamitans*) population indices from Mt. Mansfield, Underhill, Vermont, 1993-2020.

Abnormalities

The number of abnormalities continues to be low, with no abnormalities detected in 2020 out of 329 animals captured.

Very few abnormalities have been seen at this site. 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 adventitious tail.

The numbers of abnormalities at this site have always been well below the level of concern. From 1998 through 2020, 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 annually.

Amphibian mortality

Amphibian mortality at the fences at Mt. Mansfield totaled 9 (out of 329) amphibians (last year 27): one Wood Frog, two Northern Dusky Salamanders (*Desmognathus fuscus*), five Eastern Red-backed Salamanders, and one Green Frog (*Lithobates clamitans*). The population of Eastern Red-backed Salamanders near these fences has been growing and it is the most terrestrial of the species monitored, so it makes sense that it would have the highest mortality of all the species monitored.

Nontarget 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. During field seasons 2002, 2003, and 2005 we experimented with installing dowels and sponges 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 using traps with dowels. As a result, we removed the dowels from all the traps. In order to compare these years' data to years when we did not use dowels, we excluded data from all traps with dowels, doubled captures from traps without dowels, and added the snake trap data.

There was a dramatic jump in jumping mice populations during 2019. Consequently, there was a large increase in their mortality at the fences. This stimulated efforts to once again alter the pitfall traps in a way that would lower small-mammal mortality while at the same time not allowing amphibians to escape. For the 2020 season, we hung nylon parachute cord in the center of one of each pair of pitfall traps, keeping the end of the cord off the bottom of the pitfall traps. Making these changes to only ½ of the traps allows us to measure the success of the method and generate correction factors to compare data to other years. Our data show 155 small mammals died in traps without cords and 95 in traps with cords. Mortality was 39% lower in traps with cords. The percentages differed between species. Jumping mice mortality dropped by 64% in traps with cords. Only 16 jumping mice died in traps. Shrew mortality (106 totals, not including Short-tailed Shrews) declined by 57%. *Peromyscus* sp. mortality dropped by 62%. Mortality of Short-tailed Shrews (77) and voles (16) did not decline in traps with cords.

Overall small mammal mortality at the fences in 2020 year totaled 251: 36 *Peromyscus* species mice, 16 jumping mice, 16 voles, 77 Short-tailed Shrews, and 106 other shrews. These were all transferred to Dr. C. William Kilpatrick of UVM. This year's combined total mortality is the lowest in the last decade. It compares to 373 in 2019, 411 in 2018, 268 in 2017, 425 in 2016, 426 in 2015, 328 in 2013, 439 in 2012, and 338 in 2011. Although we see annual variation in species numbers, we have not seen any long-term declines in the numbers of any of the mammal species caught in our fences.

So far, this method does not appear to be facilitating the escape of either Red-backed Salamanders or Spring Peepers. In fact, the number of amphibians captured appeared to be relatively consistent between the standard trap versus the string trap for most species with the exception of Spotted Salamanders 21(14), Northern Two-lined 3(1), and Eastern Newt 7 (4).

These numbers are currently too small to generate a reliable correction factor that would allow us to compare indices generated from traps with and without cords. We plan to continue to use strings in ½ of the pitfall traps for two more years. If we are seeing a consistent decrease in small mammal mortality and are able to generate reliable correction factors for decreased captures of amphibians, we will put cords in all the pitfall traps. If not, we will revise the 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 2020. Once again, we are experimenting with methods to reduce small mammal mortality in the pitfall traps. This time we are using braided-nylon parachute cords suspended near the center of half of the traps. We plan to continue this experiment for two more years and then, depending on the results, either suspend cords in all the pitfall traps or revise the design.

The overall number of suitable nights to open the drift fences was low in 2020 due to drought; and the total number of amphibians captured was lower than 2019, but still above our long-term average.

- Populations of **Spring Peeper** have declined over the long-term duration of this study; they entirely disappeared and then rebounded in 2016 and 2017. Their numbers fell again over the last three years.

- Populations of the **Eastern Red-backed Salamander** have increased over the length of the study, but the number detected in 2020 was lower than the previous eleven years.

- Populations of **Spotted Salamander** remain fairly stable; although there may be a larger population than indicated in this year's data since some animals appear to be escaping the traps using the strings.

- Populations of **Eastern Newt** have decreased but show large annual variations. Relatively few were seen in 2019 and 2020 and it is possible that a few animals escaped using the strings.

- Populations of the **Northern Two-lined Salamander** have increased, although we continue to catch relatively few, and is possible a few animals escaped using the strings.

- 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 an increase over the long term and were stable in 2019 and 2020.

- 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 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 2020 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 and Matt Gorton entered all the data. Kate Kelly calculated the small mammal mortality 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 2020. 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, and in 2020 only one trapping was used in June. **Data from 13 of 14 trap-efforts were used: April 14 and April 27; May 16 and May 30; June 30, July 12 and 23; September 14, 30, and Oct 8; October 14, 21, and 27.** Abnormality, maximum size, and first metamorph data were taken from all **14** 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*	36	16	44%	Sept. 14	183	2.8	27%	11%	0/36
N. Dusky Salamander	*Desmognathus fuscus*	7	0	0%	N/A	92	0.5	5%	2%	0/7
N. Two-lined Salamander	*Eurycea bislineata*	4	1	25%	June 30	81	0.3	3%	1%	0/4
Spring Salamander	*Gyrinophilus porphyriticus*	0	0	N/A	N/A	N/A	0.0	0%	0%	0/0
Eastern Newt	*Notophthalmus viridescens*	11	5	45%	Sept. 14	78	0.8	8%	3%	0/11
E. Red-backed Salamander	*Plethodon cinereus*	73	0	0%	N/A	96	5.6	56%	22%	0/73
Group totals	Group totals	131	22	17%	N/A	N/A	10.1	100%	40%	0/131
Anurans (Frogs)										
American Toad	*Anaxyrus americanus*	14	0	0%	N/A	78	1.1	7%	4%	0/14
Green Frog	*Lithobates clamitans*	24	3	13%	Sept. 14	69	1.8	12%	7%	0/24
Pickerel Frog	*Lithobates palustris*	2	1	50%	Sept. 14	40	0.2	1%	1%	0/2
Wood Frog	*Lithobates sylvaticus*	148	13	9%	Sept. 14	60	11.4	75%	45%	0/148
Spring Peeper	*Pseudacris crucifer*	10	0	0%	N/A	32	0.8	5%	3%	0/10
Group totals	Group totals	198	17	9%	N/A	N/A	15.2	100%	60%	0/198
Amphibian totals	Amphibian totals	329	39	12%	N/A	N/A	25.3	100%	100%	0/329

[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 2020 (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 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]	17	18	19	20
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	2.8
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	0.5
N. Two-lined Salamander	0.5	0.1	0.2	0.1	0.2	0.2	0.2	0.4	0.1	0.3	0.3	1.1	0.2	0.4	0.9	1.1	0.9	0.5	0.8	0.4	0.8	0.7	0.5	0.5	0.3
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	0.0
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	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	7.7	14.5	7.5	11.1	5.6
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	10.1
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	1.1
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	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	1.8
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	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	11.3	8.8	11.3	11.4
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	0.8
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	15.2
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	25.3

[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[4], 18 in 2017, 18 in 2018, 15 in 2019, and 13 in 2020. 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] April and May data were gathered in the spring of 2017.

Table 3. A comparison of young-of-the-year salamanders from drift-fence data from 1995 through 2020 (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	20
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%)	16/36 (44%)
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%)	0/5 (0%)	0/12 (0%)	0/11 (0%)	0/14 (0%)	0/7 (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%)	3/12 (25%)	0/13 (0%)	3/8 (38%)	2/8 (25%)	1/4 (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%)	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%)	5/11 (45%)
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%)	2/97 (2%)	3/261 (1%)	1/127 (1%)	1/167 (1%)	0/73 (0%)
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%)	22/131 (17%)
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%)	39/329 (12%)

[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, 15 in 2019, and 13 in 2020. 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 2020 (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	20
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%)	0/14 (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%)	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%)	0/10 (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%)	2/6 (33%)	7/10 (70%)	22/34 (65%)	13/47 (28%)	3/24 (13%)
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%)	1/2 (50%)
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%)	13/148 (9%)
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%)	17/198 (9%)
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%)	39/329 (12%)

[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, 15 in 2019, and 13 in 2020. 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.