# Amphibian & Reptile Monitoring

# 2000-2012

## on the Lester and Monique Anderson Lands

## in Lincoln, Vermont

**Prepared for the**

**Colby Hill**
**Ecological Project**

**Prepared by**

**Jim Andrews and Erin Talmage**
**Vermont Reptile and Amphibian Atlas Project**
**642 Smead Road**
**Salisbury, Vermont**
**05769**

**April 15, 2013**

## Introduction

In the spring of 1999 Lester Anderson expressed an interest in establishing herpetological monitoring at selected sites on his property. Three types of monitoring were discussed: egg-mass counts of spring breeding amphibians, cover-board monitoring of woodland salamanders, and snake monitoring using artificial cover (slate). All these methods provide indices of different segments of the local herpetofaunal population. During the 1999 field season four ponds were selected for egg-mass monitoring and counts began. During the 2000 field season both the cover-board transects for salamanders and the snake covers were put in place. Counts began along the cover-board transects in 2000. However, many of the snake covers broke over the late fall and winter and needed to be replaced with thicker slates during the early fall of 2001 before counts began. The thicker slates have held up well with only two or three needing replacement each year since.

Beginning with the 2008 field season, types of surveys were scheduled to alternate annually to reduce costs. Data updates are currently written every other year as well. During the 2008 season, cover-boards were not checked, egg-mass surveys took place, and the last update was written. Despite our plans, due to funding limitations, only the snake covers were checked during the 2009 field season and no report was written. In 2010 egg masses were surveyed, salamander cover-boards were checked, and an update was written. In 2011 we monitored only the snake covers to keep them on an alternating-year-schedule. In 2012 we monitored egg-masses and salamander cover-boards. We plan to check the snake covers during the fall of 2013 field season. This alternation between amphibian monitoring and snake monitoring with a report is an effort to help minimize costs and keep the budget fairly stable from year to year. A day of maintenance is needed every year to replace rotten and broken covers and trim vegetation. Our goal is to keep all artificial covers in use even on years when we are not checking them

## Methods

### Egg-mass counts

Egg-mass counts take place at four ponds: Upper Fred Pierce (UFP), Lower Fred Pierce (LFP), Wells (WP), and Guthrie (GP). Upper Fred Pierce Pond is immediately across Colby Hill Road (east) from the Anderson residence. Lower Fred Pierce is roughly 100 m south of the residence across Colby Hill Road. Both of these ponds are found on the Fred Pierce tract. Guthrie Pond is immediately inside the gate off Guthrie Road on the Guthrie-Bancroft tract. Wells Pond is in a field roughly 50 m northwest of the Wells homestead on the Wells tract. Exact locations for these ponds are shown in the 2001 & 2002 reports.

Egg-mass counts at this site are designed to monitor egg-masses of two spring breeding species with very large and easily identified egg-masses: *Lithobates sylvaticus* (Wood Frog) and *Ambystoma maculatum* (Spotted Salamander). The annual high count of egg-masses for each species is the index that over time can be used to show the relative size of the female breeding population at these sites (Corn and Livo, 1989). It is not intended to provide an estimate of the total population of either of these species only a convenient index of the breeding females. This is a variation of the breeding site survey recommended by Heyer et al. (1994). Adults and young of these and other species may be found during these counts and their presence and numbers are noted but these numbers are not intended to provide a meaningful index to those populations.

Over time the index that will be most useful is the highest count of egg-masses on any one day for each of the two species monitored. Since the egg-masses are visible for a few weeks after laying, the high count will be very close to the total count in most years. These counts are not cumulative nor do they have to be from the same day for different species. All surveys are performed under conditions that allow the viewer to see easily into the pond (limited wind, no rain, and adequate light from a high angle). Polarized glasses are sometimes helpful. The counts are designed to take place in habitats where Wood Frog and Spotted Salamander have been previously located and during or shortly after their breeding period. Egg-mass counts begin soon after the snow and ice melt and continue until egg-laying activity ends or the total number of egg-masses is declining.

The weather in 2012 was unusual in that there was very early warm weather that allowed amphibians to move. The early warm weather was followed by a cold dry spell and then another period of amphibian movement. We essentially had two separate springs far enough apart so that the first set of egg-masses had hatched by the time the second set were being laid. As a result, we combined the two high counts from the two separate springs. This is discussed in more detail in the results section.

<u>Cover-boards for salamanders</u>

Three sets of cover-boards were constructed and put in place along the old wood road connecting the Guthrie-Bancroft fields with Rte. 17. This road starts in Lincoln and crosses into Bristol. Consequently some of the cover-boards lie in each town. The first two sets each contain 15 pairs of cover-boards. Although it was our intention to have three sets of 15 pairs, it was discovered in 2001 that the third set of cover-boards actually contained 16 pairs rather than the 15 that was intended. The extra set was left in place and the data are included. Exact locations of the three sets with UTM coordinates are shown in the 2001 report. These cover-boards were spaced based on North American Amphibian Monitoring Program (NAAMP) protocols with Canadian design covers (Craig et al., 1999) that have been shown to be the most successful in attracting salamanders. The structures (salamander condos) each consist of four rough-cut white-oak boards that measure 305 mm x 152 mm (12" x 6") and two spacers. White oak was selected on the basis of its resistance to rot while in ground contact, however both boards and spacers have needed to be replaced at the rate of five or six per year as they gradually become saturated and rotten. Each condo consists of two boards side by side on the ground with a slight gap (~10 mm) left between them, so that they almost form a square 305 mm by 315 mm. The remaining two boards are placed on top of them and at right angles. In between the two layers of boards are 10-mm square spacers 280 mm long, which are used to hold up the outside edge of the upper two boards and create a small gap of varying height for the salamanders. The pairs of structures were placed a minimum distance of 0.5 m apart based on NAAMP recommendations and each pair of condos was located a minimum distance of 6 m from the nearest pair. The three 15-pair transects are separated by distances of between 100 and 200 m. All organic matter was removed from under the condos so that they rested on the mineral layer. Herbaceous growth was removed from between the pairs and for a distance of ~50 cm in all directions and is kept free from the area. Forest litter is removed from the top of the condos but left between and around them. All condos are numbered with latex exterior paint (white). These numbers fade over the course of a year and are remarked as needed. The first set of 15 pairs consists of condos marked 1A and 1B through 15A and 15B. The second set consists of condos 16 A & B through 30 A & B, and the last set consists of condos 31 A & B through 46 A & B.

Records are kept on the specific condo in which amphibians are found. In addition, all amphibians found under the cover-boards are measured to provide some information on age-class structure of the population using the boards. We measure both the snout to vent length (SVL) and the total body length (TBL) of the salamanders. However, the small salamander species, which are being monitored using this method, sometimes lose all or a portion of their tails to predatory birds and small mammals. Consequently, the most reliable measure of size is their snout to vent length (SVL). Starting in 2006, in addition to taking length measurements we massed the majority of the Eastern Red-backed Salamanders found.

We also keep records on where within the salamander condos the amphibians are found. It is of interest to me in order to more effectively design future condos. Four locations have been noted: board (between boards), ground (between board and ground), crack (in the space between the boards) and adjacent (along side the cover-boards).

These counts are currently scheduled for every other year. Data from the salamander cover-boards were collected in 2010 and 2012. In 2010, data were only collected from ½ of the condos (the A of each pair) to save time and money. In 2012 data were only collected from the B of each pair.

Snake-covers

The snake-covers were an experiment but they are working well. I am not aware of any other efforts to monitor snake populations using artificial cover, though artificial cover is often used as an inventory tool. I chose to use slate as a result of its ability to absorb the sun's rays and retain its heat as well as slate's longevity in ground contact. Through experience and informal communications with other herpetologists I have come to believe that the larger the piece of cover the better, but practical and aesthetic considerations led me to initially try old roofing slate. The largest used roofing slate that I could locate was 610 mm x 360 mm and 5 mm thick. With two of these slates I formed a sandwich with a small wooden spacer in between but off center to create a small space of varying height for the snakes. I placed forty of these snake sandwiches along the upper margins of the Guthrie-Bancroft fields at a distance of roughly 2 m from the trees (see earlier reports for photos). I chose the upper margins of the fields to maximize the exposure to southern and western sun. The snake covers were placed on the cut grass that already was in place. No additional cutting or clearing was done. During the late fall and winter of 2000-2001 most of the original snake-covers were broken. During the early fall of 2001, they were all replaced with thicker slate slabs that measured 560 x 360 mm and were 20-25 mm thick. Three of these were broken over the summer of 2002 and replaced in the early fall. A few slates are remarked each year with white exterior latex paint as needed. A few broken slates are replaced each year to keep the array in good condition. Some new slates were slightly longer (610 mm x 360 x 20-25 mm thick) but otherwise identical. Five new sets of covers were added to the transect during the summer of 2008. These covers continue the transect on the north side of the stonewall and hedge row into the adjacent field to the north. This is an effort to determine if the distance from the stonewall has an impact on the use of individual artificial covers. Data from the new covers (41-45) are not used for year-to-year monitoring comparisons. Each year a few covers are found to be broken and they are replaced, even if it is a year where monitoring does not occur.

Snake populations are often widely dispersed during their foraging season; consequently it was unknown whether forty pairs of artificial cover would attract enough snakes to provide useful data, however they seem to be working well. Conditions under the covers have changed from the first couple years as remaining vegetation dies, invertebrates colonize them, and small mammals begin to tunnel under them. In some places the woods began creeping into the field and/or branches reaching out and shading the covers. Initially the covers were approximately two meters from the woods. In 2007 we began an annual opening up of the cover array, including clearing brush that has moved into the field and cutting low branches that have shaded the covers.

Starting monitoring in late summer has some advantages, as it is after the young-of-the-year have been produced and snake numbers are at their annual maximum. In addition, the cooler air temperatures of late summer/early fall should make the relative warmth of the slate more attractive at this time of the year. The snake-covers are checked once a week until the snake's den for the winter.

When a snake is found, we measure the snout to vent distance as well as the total body length. We record any unusual physical findings or injuries, and when we find Milksnakes (*Lampropeltis triangulum*) we record their patterns to allow us to distinguish individual snakes. In 2006 and 2007, in addition to length measurements we massed the majority of the snakes we found. We also keep records on where within the snake cover the reptiles are found. Two locations have been noted: between (between slate) and surface (between slate and ground).

We monitored the snake covers during the 2009 and the 2011 field season and plan to monitor them in 2013. The current plan is in years when we monitor the snake covers, the amphibians will not be monitored. Consequently these will be good years (to keep budgets even) to write summaries of our findings.

**Basic species information**

Two of the spring-breeding amphibians that deposit large easily identified **egg-masses** are using the breeding ponds: *Ambystoma maculatum* (Spotted Salamander) and *Lithobates sylvaticus* (Wood Frog).

The Spotted Salamander is a large (190 mm) heavy-bodied salamander that is widespread in Vermont in areas where mature hardwoods or mixed hardwoods and suitable breeding ponds occur and migration is not obstructed. It is black with yellow spots and is largely fossorial. It emerges from its woodland over wintering sites during the first warm rains of spring to migrate to its breeding pond. Within a few short weeks it returns to its summer foraging territory. The egg-masses that it deposits are the most obvious evidence of its occurrence in an area.

The Wood Frog is a medium sized (60 mm) frog that is almost entirely terrestrial. It is easily recognized by its white upper lip and black mask on a solid brown background. It forages and over winters in the woodlands and only enters ponds in the spring to breed. It too is widespread in Vermont as long as healthy woodlands and breeding ponds can be found and travel between the two is largely unobstructed. It also deposits large and easily identified egg-masses in early spring. Within two weeks it has usually returned to nearby woodlands.

Only one species of salamander is found often enough under the **cover-boards** to be monitored: *Plethodon cinereus* (Eastern Red-backed Salamander). However, we have also found limited numbers of *Desmognathus fuscus* (Northern Dusky Salamander), *Ambystoma maculatum* (Spotted Salamander), *Eurycea bislineata*, Northern Two-lined Salamander, and *Notophthalmus viridescens* (Eastern Newts).

The Eastern Red-backed Salamander is a slender and small (40 mm) salamander that is our (Vermont's) only fully terrestrial species of amphibian. Its most common color morph has a dark reddish-brown back with black sides and a salt and pepper (gray and white speckled) belly. Occasionally it is missing the red stripe on its back and the entire salamander is a dark gray/brown color, this is considered a *lead phase*. Very occasionally the entire salamander is orange-red, this is considered *erythristic*. This species undergoes its larval stage and metamorphosis inside the egg. Eggs are laid in moist conditions inside a rotten log or in cavities in the soil as long as there is some solid object to suspend the egg-mass from. Consequently, it does not require open water at any life-stage and is dispersed widely in medium to mature hardwoods or mixed hardwoods regardless of the distance to the nearest water body. It is sensitive to soil pH, soil moisture, depth of leaf litter, and the structure and age of the woodlands in which it breeds. Consequently, it is a good species to monitor as an indicator of forest health.

When the **snake-covers** were placed, it was unknown which species of snake would be most attracted to them. During the fall of 2001 only *Storeria occipitomaculata* (Red-bellied Snake) used the snake covers. The Red-bellied Snake is a small, secretive, viviparous (giving live birth) snake of woodlands and woodland openings. Using data gathered in Vermont through 2006, an adult Red-bellied Snake has a median SVL of 195 mm and a median TBL of 240 mm (n=79). A neonate Red-bellied Snake in Vermont has a median SVL of 88 mm and a median TBL of 110.5 mm (n= 62) (Andrews, 2006). They are found throughout the state in forested areas (Andrews, 2007). They have a state rank of S5 and are the third most reported species in the state. They have a brown, gray, or black dorsum (back) and a bright red venter (belly). Three light spots can be seen on the neck: one in the middle and one on each side. They are harmless and quite docile. They feed primarily on slugs but will also eat other invertebrates (Mitchell, 1994). We have one record of a female Red-bellied Snake collected (legally) in Bridport, VT and brought into captivity. She then gave birth to 14 young on July 29. Determining the sexes of snakes can be difficult as there are no obvious external characteristics. Generally the males have a longer tail relative to their total body length although there is often some overlap. Male Red-bellied Snakes generally have a tail length of 21-25% of their TBL while females generally have a tail length of 17-22% of their TBL (Ernst and Barbour 1989). As we continue to collect more data and improve our techniques we may be able to draw some conclusions regarding the sexual make up of the snakes using the snake covers.

Since 2001 two additional species have been located under the snake-covers: *Lampropeltis triangulum* (Milksnake) and *Thamnophis sirtalis* (Common Gartersnake).

The Common Gartersnake is known to reach a total body length of up to 1000 mm (39 inches) in Vermont, though most adults are closer to 600 (~24 inches). The largest Common Gartersnake recorded in Vermont was found in Guilford Vermont in 2007, she measured 970 mm (38 inches). They are the most common snake in the state (Andrews, 2007) and are widespread at all elevations and in a wide variety of habitats but are most abundant near a combination of water, small open areas, and exposed rock. Their primary food item is amphibians but worms, insects, spiders, and other small invertebrates are also eaten. Male Common Gartersnakes mature in one to two years at an SVL of 360 mm – 390 mm, females usually mature in two to three years at an SVL of 420 mm to 550 mm. Litter sizes average 27 with a range from 1 to 101. Young Common Gartersnakes are born from mid-June to early November with most appearing in August and September. Neonates average 178 TBL (120mm – 278mm), and have a tendency to aggregate together (Ernst and Ernst, 2003). We have one record of a gravid Common Gartersnake run over on August 8$^{th}$. Ten babies (also run over) were counted near her body (Andrews, 2007). Based on our records through 2006 for adult and juvenile Common Gartersnakes found in Vermont the average SVL is 336 mm and TBL is 412 mm and the median SVL is 350 and the TBL is 438 (Andrews, 2006). Male Common Gartersnakes generally have a tail length that is 21-30% of their TBL and females have a tail length that is 17-22% of TBL (Ernst and Barbour, 1989).

The Milksnake is known to reach lengths of 1100 mm (43 inches) in Vermont and adults are generally larger than Common Gartersnakes. This snake is the second most reported snake in Vermont, though this may in part be the result of its large size and its tendency to live near overgrown human dwellings, foundations, and barns. Milksnakes are oviparous (egg laying), smooth scaled, and eat a wide variety of prey including small mammals, birds, other snakes, and invertebrates. They often will shake their tails when irritated and are frequently confused with Rattlesnakes as a result of this behavior. The sex of the Milksnake is not possible to determine based on tail length because there is too much overlap between males and females (Ernst and Barbour 1989).

**Results and Discussion**

<u>Egg-mass counts</u>

In 2012, egg-mass counts were performed on six dates (April 3, April 13, April 18, April 25, May 2, and May 16) at the four ponds that were selected for monitoring in 1999. All four ponds are man-made and fish-free with well-defined shorelines and within easy migration distance of hardwoods. Since all of these ponds are permanent or semi-permanent they almost always hold some water even through dry years.

The results of this year's counts are shown in Tables 1-4. The 2011-2012 winter was the 4$^{th}$ warmest year on record, with March being considerably warmer than average and breaking numerous records around the northeast. Spring came earlier with amphibian movement, first-egg-mass occurrence, and egg mass high counts all taking place earlier than previous years. Amphibian movement was recorded in the Champlain lowlands on March 8. Because of this early movement, we checked the ponds on April 3$^{rd}$, almost a week earlier than average. On April 3$^{rd,}$ we found Wood Frog egg masses, many that were estimated to be about one week old. In addition, a few Wood Frog egg masses were already seen hatching in Guthrie. Following this initial movement there was a period of cold and dry weather. After warmer weather returned we found new masses, although considerably fewer, on April 18$^{th}$. On that date, we also observed that most of the egg-masses that were visible on April 3 had already hatched and hence could not be included in that day's counts of egg-masses. Tadpoles were seen in every pond by April 18$^{th}$

at the same time as new egg-masses were appearing. Due to this unusual spring and the two amphibian movements, we combined our two "high counts" in order to be able to compare the 2012 data to the data from previous years when the peak count included almost all of the egg-masses.

The 2010 dates of high counts and first tadpoles for Wood Frogs had been considerably earlier than previous years (April 8 and April 23 respectively). In 2012 the dates were even earlier (April 3 & 18th), and were the earliest dates we have ever recorded egg masses and tadpoles. For comparison, in 2008 the first Wood Frog masses seen were on April 18th and Wood Frog tadpoles were first seen in all ponds on April 30. In 2007 tadpoles were first visible on May 2.

As we have now collected 11 years of data over a 13-year period, we are able to start looking at long-term trends for this site (Figures 1 and 2). Both figures show the dates of peak egg mass counts for both species are getting earlier in the year and the date of first egg masses for Spotted Salamander is also trending to an earlier date. Lower Fred Pierce was chosen as a representative pond for Figures 1 and 2 as it is often one of the most productive.

Figure 1: First egg-mass and peak egg mass counts (with trend lines) for *A. maculatum* at Lower Fred Pierce on Lester Anderson Lands, Lincoln, Vermont (2000-2012).

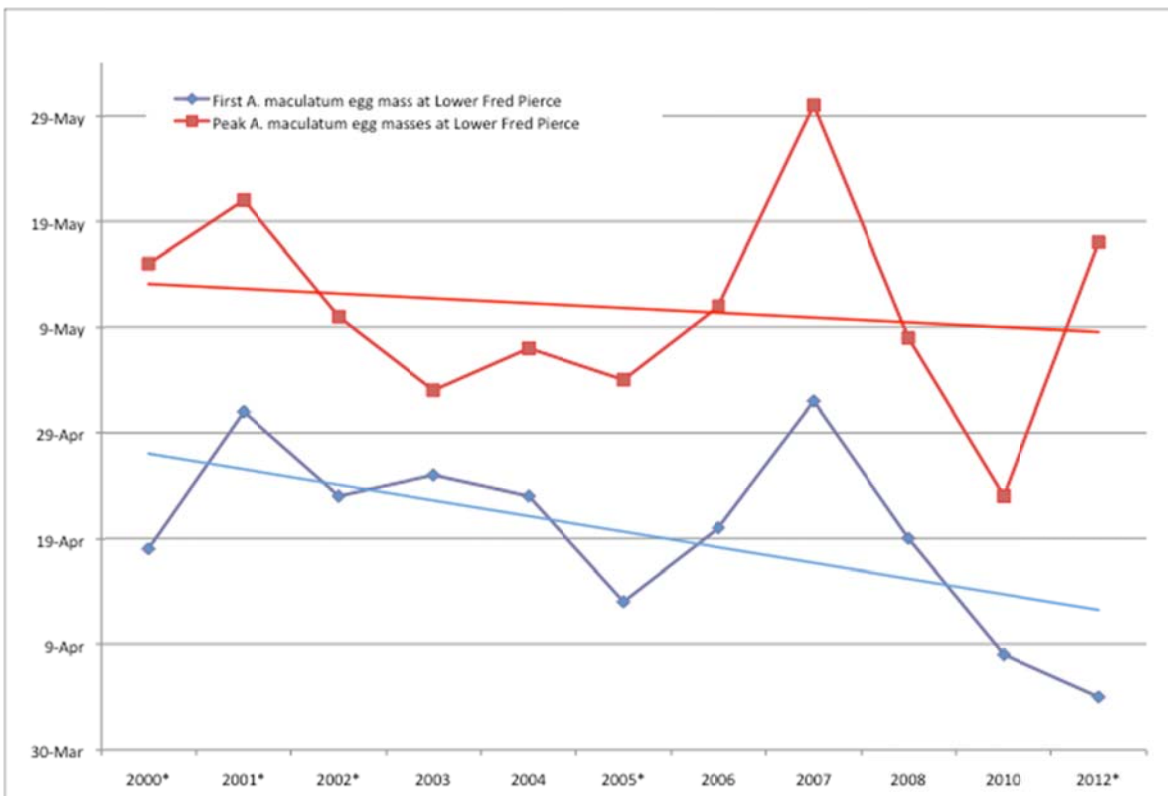
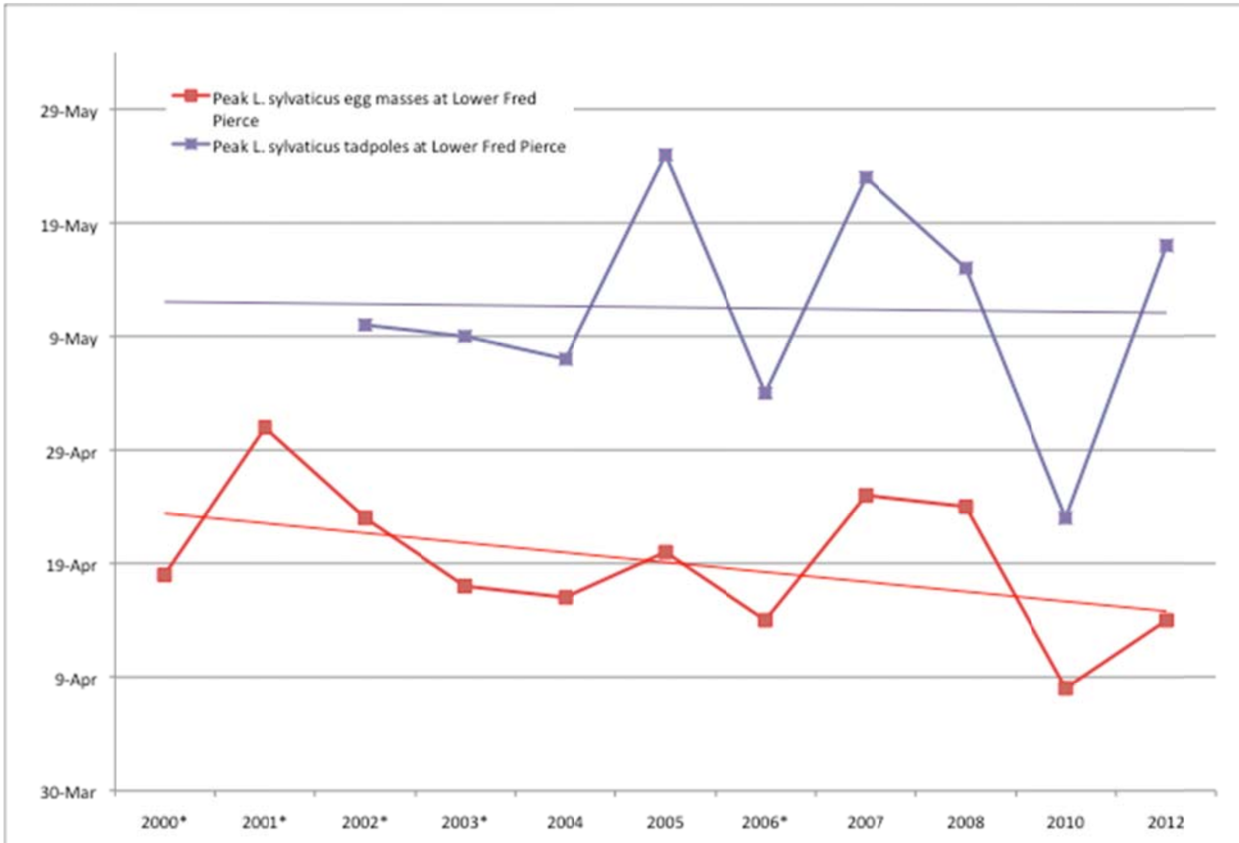



Figure 2: Peak egg mass and tadpole counts (with trend lines) for *L. sylvaticus* at Lower Fred Pierce on Lester Anderson Lands, Lincoln, Vermont (2000-2012).




Spotted Salamander

In 2012 the first egg masses were seen on April 3, the first date the site was visited. Egg masses were seen at all ponds except Upper Fred Pierce on that date (Tables 3-6). Although egg masses were seen on this early date, the high counts were not seen until May 12 at Upper Fred Pierce, and May 16th at the other three ponds. In 2010 the first adults, and/or spermatophore and egg masses were seen on April 8th. In 2008 the first adults and egg masses were seen on April 18th.

At Guthrie we had been seeing an increase in egg masses between 2005 and 2010. In 2012 we saw a decrease to 107 egg masses. At Lower Fred Pierce the number of egg masses increased for four years and then dropped slightly from 251 (2008) to 216 (2010) to 210 (2012). At Upper Fred Pierce the numbers of egg-masses has been declining since 2006 with only 52 egg masses found in 2012. There had been a record number of Spotted Salamander egg masses seen at Wells in 2010, when 153 masses were counted. In 2012, 101 masses were counted. All of these results are shown in Tables 1-4 and Figures 3-6. The combined high count for all ponds was above average (Table 5).

Annual variation in these numbers is to be expected, and can be seen in Table 7 and Figures 1-5. Although there is year-to-year variation, it is not consistent from pond to pond. In Figure 5 egg-mass numbers at all ponds are combined and averaged. This reveals a steady five-year increase in numbers followed by a drop and a subsequent five count-year increase through 2010, with a drop in 2012 although no counts were done in 2009 and 2011. Throughout the entire duration of the study the number of egg masses fluctuate, but over all, the population does not show any long-term increases or decreases. We will be interested in seeing if the numbers cycle on a regular multi-year pattern. Except for 2010, Lower Fred Pierce Pond continues to be the most productive breeding location and Upper Fred Pierce the least productive. In 2010, Guthrie was more productive than Lower Fred Pierce with 225 and 216 egg masses found respectively.

According to Bishop (1941) breeding adult females lay from 2-4 egg-masses during their brief egg-laying period. Using an average of 3 masses per adult and the combined egg-mass numbers from Table 9, this suggests that in 1999 approximately 104 female Spotted Salamanders laid eggs in these ponds. These numbers increased to 227 females in 2003, dropped, and then have risen to approximately 220 in 201 and have dropped back to 156 females. It is possible that adult females do not lay eggs every year but rather build up energy reserves for a year or more between egg-laying events. Consequently the group of females laying in any given year may well be entirely different from those laying the previous year. The unusual weather of 2012 may have prevented some Spotted Salamanders from breeding. Whether they would defer their breeding for a year or perhaps more is not known.

Wood Frogs

As mentioned previously, the weather in 2012 was unusual with a record warm March followed by exceptionally early amphibian movement (for this site) in early April. After this first spring activity, we had a short cold and dry spell prior to a second amphibian movement in later April. For the first time we combined the two high counts from the first and second periods of Wood Frog movement to more accurately reflect the total number of breeding females.

The combined number of Wood Frog egg-masses from all ponds in 2007 was at an all-time high of 1,141. In 2008 the combined total dropped to 723, and in 2010 to 663 masses. In 2012 we counted our lowest number of 573 (Table 7). This was the second-lowest total found in our eleven years of Wood Frog data. The numbers decreased from the 2010 counts in all three ponds and increased in one (Upper Fred Pierce). As we have seen in the past, numbers of egg masses/year fluctuate and therefore can potentially rebound in a matter of just a couple years. The greatest numbers of Wood Frog egg-masses this year were found in Guthrie (Table 3 and Figure 5).

Trend lines for breeding female Wood Frogs show a virtually flat line for combined totals for all four ponds (Figure 7).

In our 2010 we reported how the relative numbers of Wood Frogs and Spotted Salamanders (Figure 7) at all four ponds combined over ten years of count data showed a very interesting negative correlation between Wood Frog and Spotted Salamander numbers at Colby Hill. We mentioned that the mechanics of such a potential relationship are unknown. It could be driven by conditions or relationships while in the pond, or perhaps weather. It seems unlikely that it could be the result of terrestrial interactions. Larval salamanders are carnivorous under all conditions and larval Wood Frogs are carnivorous under some conditions, so direct interactions in the breeding ponds are possible. In 2012, with the average count for Wood Frogs at such a low point, the negative correlation between the two species did not hold true. It will be interesting to see if in the future the pattern becomes visible once again or if the two species cycle independently of each other.

During egg-mass counts we also found Eastern Newts (*Notophthalmus viridescens*) and Green Frogs (*Lithobates clamitans*) at all of the breeding ponds. Both of these common species spend their adult lives in or near permanent still water. Eastern Newts lay individual eggs attached to vegetation and Green Frogs lay egg masses during the summer, consequently they are not suitable for spring egg-mass monitoring. The Eastern Newts are voracious predators on the Wood Frog eggs and even the Green Frog larvae scrape the algae off the Wood Frog eggs until the masses fall apart.

Numerous birds were seen or heard in the vicinity of the ponds during the 2012 egg-mass counts including; Black-capped chickadee, Black-throated green warbler, Brown-headed cowbird, Canada goose, Dark-eyed junco, Kestrel, Least flycatcher, Mallard, Ovenbird, Purple finch, Scarlet tanager, Turkey vulture, Yellow-rumped warbler, and Yellow-bellied sapsucker. Although we occasionally recorded bird species we saw or heard, this is not a complete list of the birds on the property.

Table 1. Spring 2012 egg-mass data from Lower Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont.

| **Date** | *Ambystoma maculatum* egg-masses | *Lithobates sylvaticus* egg-masses | Notes |
|---|---|---|---|
| April 3 | 9 | 152<br>Surface of egg masses damaged by freeze | Cool and sunny, rained on evening of April 1.<br>Visibility good, could not see bottom at center. |
| April 13 | 15 | 153<br>One new mass seen | Visibility 3 M from edge, algae fog, bottom not visible. |
| April 18 | 73<br>One had mostly white eggs, another mostly non-viable. | 6<br>Over 5270 tadpoles seen. | Sunny last two days, record high of 80 F on April 16, last night there was a low in the 30's. Visibility ok, lots of floating organic material on pond. |
| April 25 | 163<br>One had mostly non-viable eggs. | 4<br>>3300 tadpoles. | Two separate springs separated by a cold and dry spell.<br>Visibility fair – could not see bottom at the middle. |
| May 2 | 191<br>Four are non-viable, some are pretty fresh and not very developed. | 0<br>>3500 tadpoles | Visibility poor. Cloudy with slight wind, can not see bottom and can not see more than 6 feet out. |
| May 16 | 210<br>Can see embryos moving in some masses | >3900 tadpoles | Visibility excellent to good, most places could see the bottom, but shadows make some places hard to see. |

Figure 3. Egg-mass data from Lower Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont (2000-2012). In 2012, the Wood Frog egg mass total was a combination of the high counts of both peaks (159).

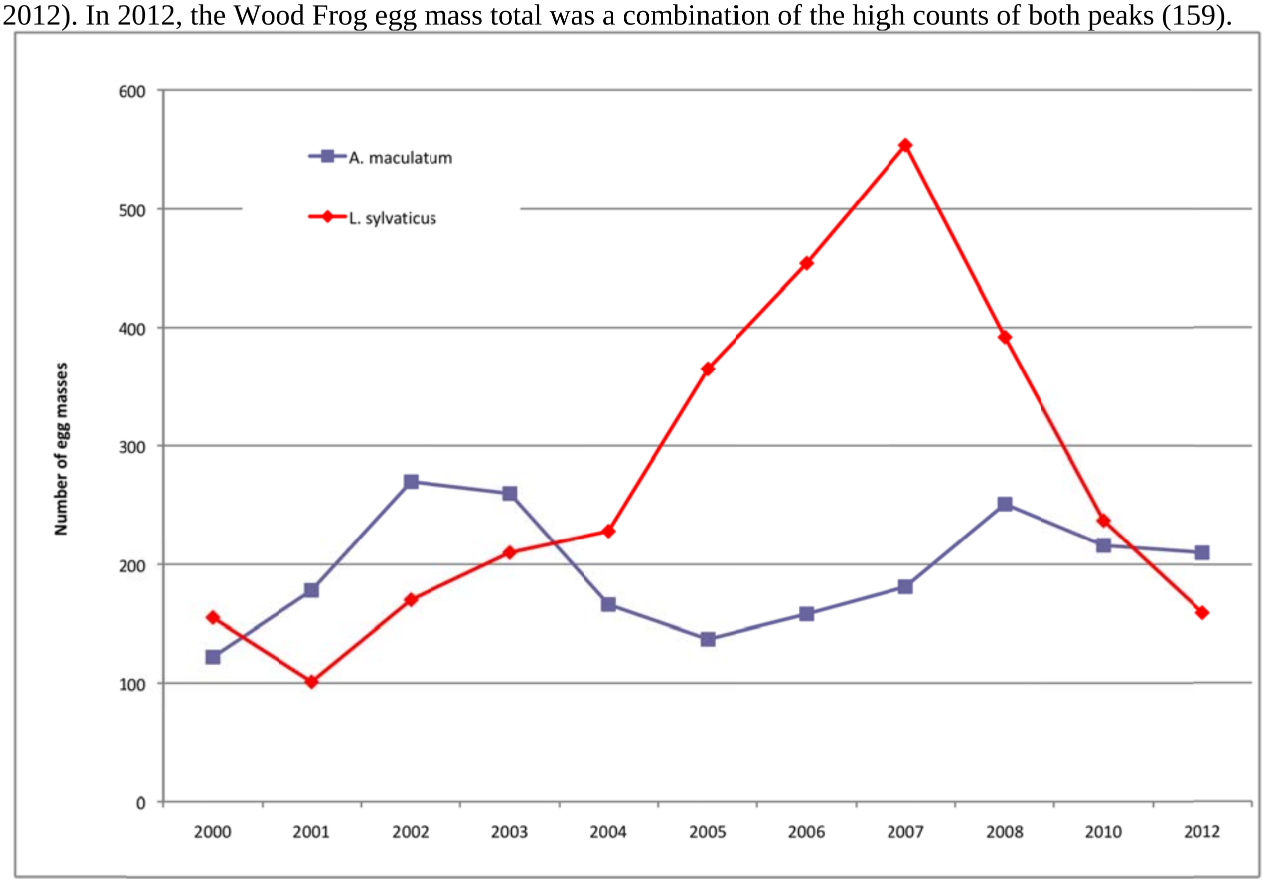


Table 2. Spring 2012 egg-mass data from Upper Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont.

| Date | *Ambystoma maculatum* egg-masses | *Lithobates sylvaticus* egg-masses | Notes |
|---|---|---|---|
| April 3 | 0 | 91<br>Estimated at one-week-old, freeze damage to surface layer. | Cool and sunny, rained on evening of April 1. Visibility good, could not see bottom of center. |
| April 13 | 0 | -<br>No new masses, eggs hatching, lots of *L. clamitans* tadpoles in egg masses. | Good visibility, can see to the bottom. |
| April 18 | 17 | -<br>No new masses. Only saw about 50 tadpoles | Sunny last two days, Record high of 80 F on April 16, last night there was a low in the 30's. Poor visibility. Appears that a human went around pond and removed branches coated with algae. Lots of plant growth remains in pond, floating island with scat on top. |
| April 25 | 33<br>Four groups of spermatophores seen. | 0 | Two separate springs separated by a cold and dry spell, visibility poor to fair. |
| May 2 | 52 | 0<br>About 4 tadpoles seen, probably more. | Visibility good to poor. Cloudy. Marsh Marigold in bloom. |
| May 16 | 45 | 0 | Visibility good, sunlight very helpful but lots of algae and silt covering masses on bottom. |

Figure 4. Egg-mass data from Upper Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont (2000-2012).

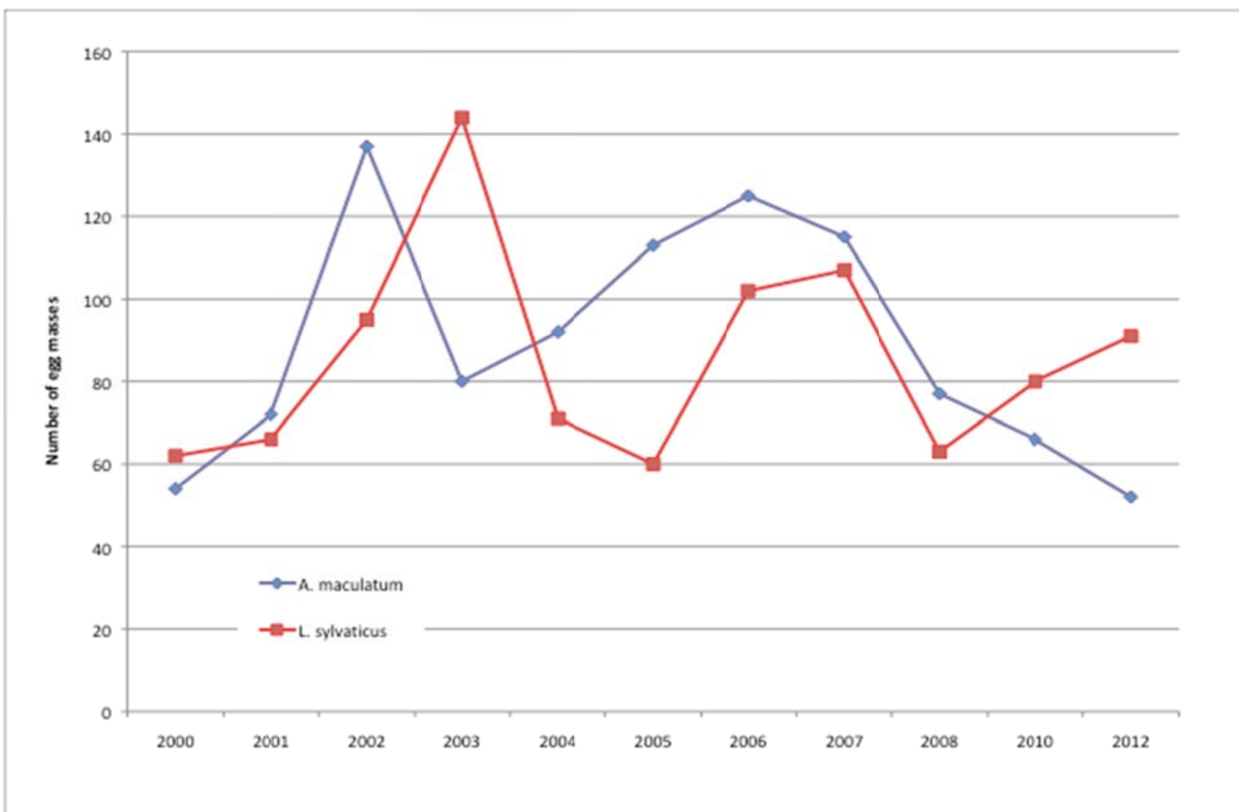


Table 3. Spring 2012 egg-mass data from Guthrie Pond on Lester Anderson lands in Lincoln, Vermont.

| Date | *Ambystoma maculatum* egg-masses | *Lithobates sylvaticus* egg-masses | **Notes** |
|---|---|---|---|
| April 3 | 6 | 250 Seven egg masses have hatched. | Cool and sunny, rained on evening of April 1. Visibility excellent could see bottom, light wind. |
| April 13 | 12 Two masses had non-viable eggs. | 252 Two new masses seen. | |
| April 18 | 32 Two masses had non-viable eggs. Twelve groups of fresh spermatophores. | 10 New masses (referred to as group #2). Two have non-viable eggs. About 8000 tadpoles have hatched from Group #1 masses. | Sunny last two days, Record high of 80 F on April 16, last night there was a low in the 30's (F). |
| April 25 | 59 A few clumps seen. | 4 Fewer tadpoles than last week. Saw one egg mass on ground, probably predator ate live frog. | Two separate springs separated by a cold and dry spell. Visibility poor, windy, water higher. |
| May 2 | 60 A few close to hatching and a few pretty fresh. | 0 Egg masses all gone, can see about 50 tadpoles scattered throughout pond. | Visibility fair, water 1-2 inches higher than last week. |
| May 16 | 107 Some have a few non- viable eggs. | 0 Can see tadpoles in clusters away from edge >2500. | Visibility excellent. |

Figure 5. Egg mass data from Guthrie Pond on Lester Anderson lands in Lincoln, Vermont (2000-2012). In 2012, the Wood Frog egg mass total was a combination of the high counts of both peaks (262).

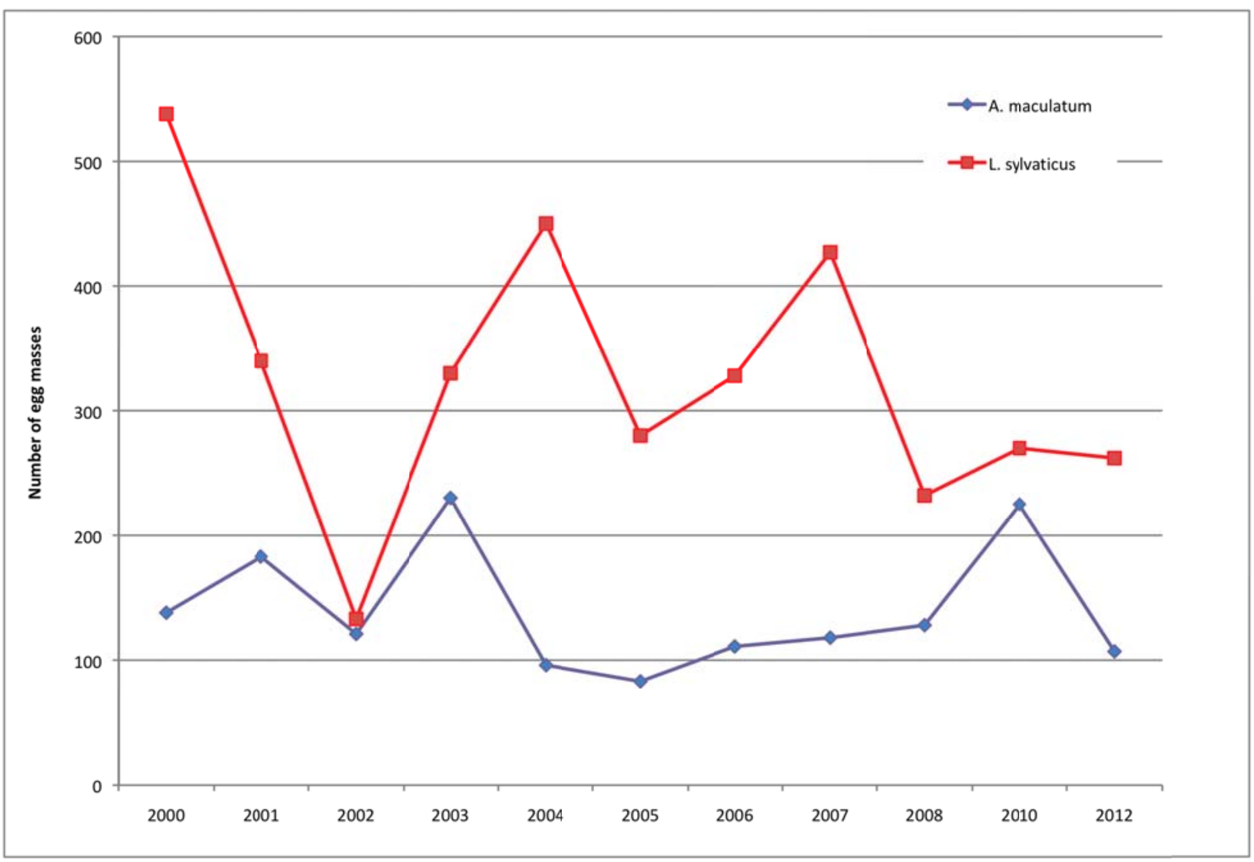



Table 4. Spring 2012 egg-mass data from Wells Pond on Lester Anderson lands in Lincoln, Vermont.

| Location/Date | *Ambystoma maculatum* egg-masses | *Lithobates sylvaticus* egg-masses | Notes |
|---|---|---|---|
| April 3 | 7 | 53 | Cool and sunny, rained on evening of April 1. Visibility good, could see bottom but high wind. |
| April 13 | 8 | - No new masses, old egg masses on bottom. They had been supported by a branch but branch was removed. | Visibility excellent. |
| April 18 | 40 Three clumps of spermatophores. | 8 Six were pretty fresh; all masses in first group are green and at the bottom, saw more that 250 tadpoles. | Sunny last two days, Record high of 80 F on April 16, last night there was a low in the 30's. Visibility excellent. |
| April 25 | 66 | 10 Some of the "new" masses hatching, tadpoles on bottom from first group of masses. | Two separate springs separated by a cold and dry spell, visibility poor to good. |
| May 2 | 90 A few attached to green and growing cattails, one has risen completely above water surface. Two masses are pretty fresh. | 0 Egg masses mostly disintegrated with tadpoles swimming around | Visibility fair. |
| May 16 | 101 | 0 No tadpoles seen. | Visibility excellent |

Figure 6. Egg mass data from Wells Pond on Lester Anderson lands in Lincoln, Vermont (2000-2012). In 2012, the Wood Frog egg mass total was a combination of the high counts of both peaks (63).

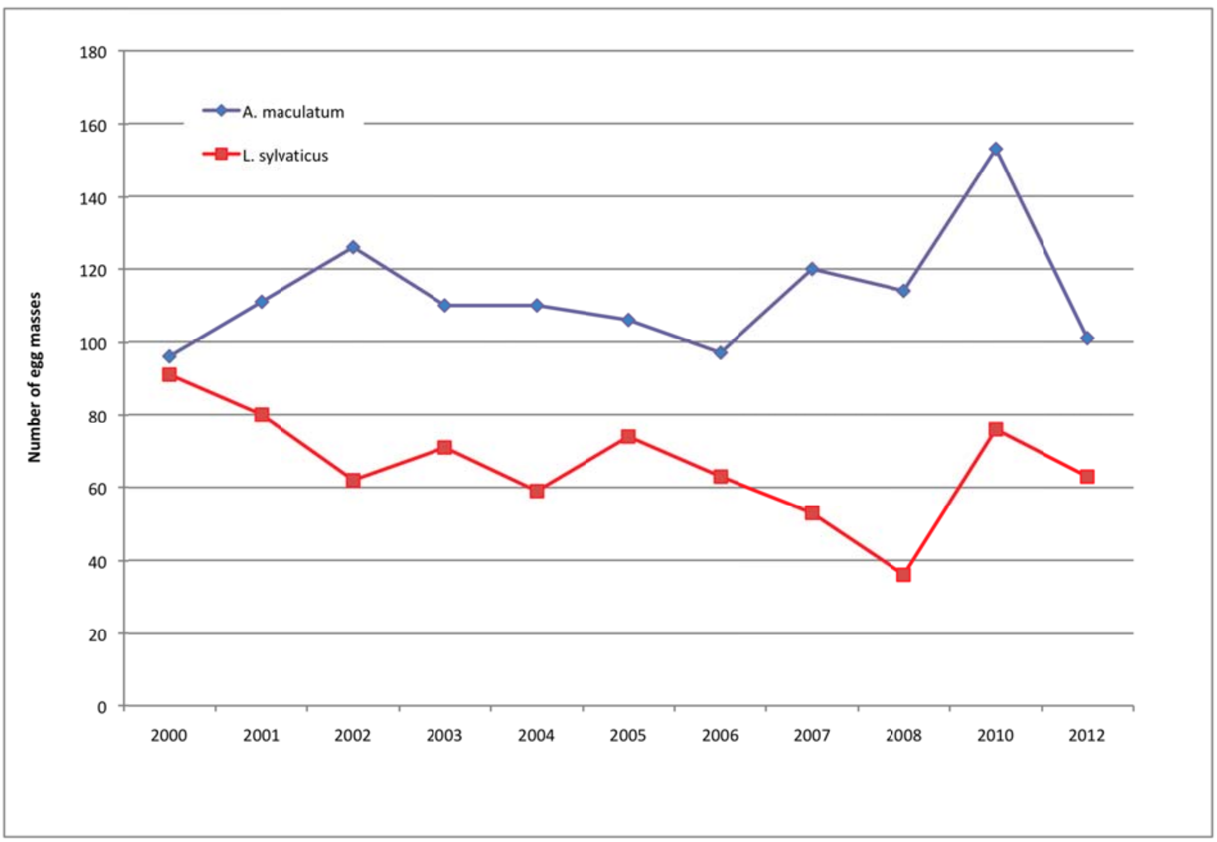
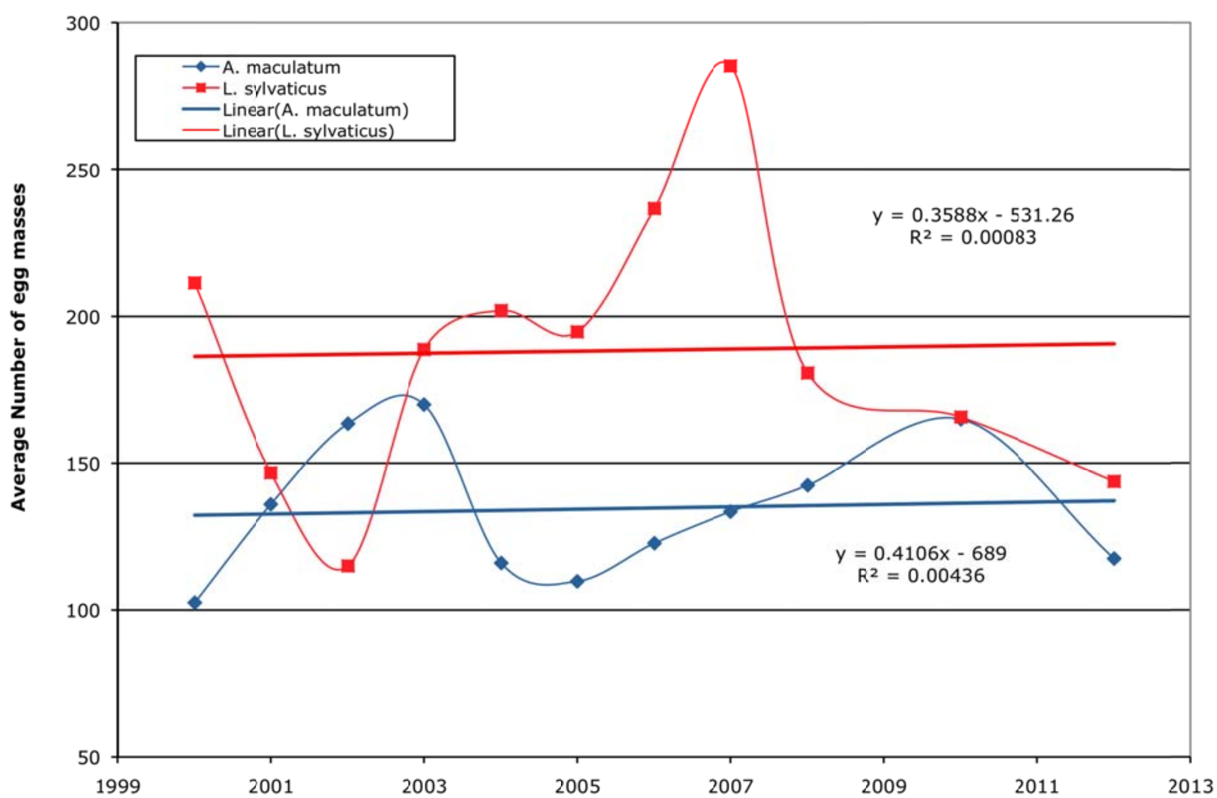


Table 5: Combined high counts of *Ambystoma maculatum* and *Lithobates sylvaticus* egg-masses for all ponds monitored on Lester Anderson lands in Lincoln, Vermont.

| Lester Anderson Lands year and count dates | *Ambystoma maculatum* (combined) | *Ambystoma maculatum* (average) | *Lithobates sylvaticus* (combined) | *Lithobates sylvaticus* (average) |
|---|---|---|---|---|
| 1999: 5/5, 5/18 | 313 | 78.3 | Early masses missed | Early masses missed |
| 2000: 4/17, 4/29, 5/14 | 410 | 102.5 | 846 | 211.5 |
| 2001: 5/1, 5/7, 5/14, 5/21 | 544 | 136.0 | 587 | 146.8 |
| 2002: 4/23, 5/1, 5/10, 5/20 | 654 | 163.5 | 460 | 115.0 |
| 2003: 4/17, 4/25, 5/3, 5/9, 5/20 | 680 | 170.0 | 755 | 188.8 |
| 2004: 4/9, 4/15, 4/22, 4/29, 5/6, 5/12 | 464 | 116.0 | 808 | 202.0 |
| 2005: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25 | 439 | 109.8 | 779 | 194.8 |
| 2006: 4/14, 4/20, 4/25, 5/4, 5/11, 5/25 | 491 | 122.8 | 947 | 236.8 |
| 2007: 4/4, 4/18, 4/25, 5/2, 5/17, 5/23, 5/30 | 534 | 133.5 | 1141 | 285.3 |
| 2008: 4/9, 4/18, 4/23, 4/30, 5/7, 5/14, 5/21 | 570 | 142.5 | 723 | 180.8 |
| 2010: 4/2, 4/8, 4/15, 4/23, 4/30 | 660 | 165 | 663 | 165.8 |
| 2012: 4/3, 4/13, 4/18, 4/25, 5/2, 5/16 | 470 | 117.5 | 575 | 143.8 |
| **Average for all years** | **519** | **129.8** | **753** | **188.3** |

Figure 7: Average High Counts and trend lines for *A. maculatum* and *L. sylvaticus* egg masses on Lester Anderson Lands, Lincoln, Vermont (2000-2012).



Snake-covers

In 2011 snake-covers were checked nine times at weekly intervals starting on Sept. 2 with subsequent checks on Sept. 6, 13, 20, and 27, Oct. 3, 11, 18, and 28, (Tables 6, 7, and 8). Ten Red-bellied Snakes (*S. occipitomaculata*), 15 Common Gartersnakes (*T. sirtalis*), and 1 Milksnake (*L. triangulum*) were captured.

We have started making year-to year comparisons of snake populations based on our monitoring. It is safe to assume that we have multiple captures of the same snakes over the course of the monitoring period. The index of population size that we are using in Figures 8, 9, and 10 is simply, for each species using the covers, the average number of snakes of each species seen on their three highest counts. If there were multiple days with the same number of captures the earlier dates were used. In 2009 this average for Common Gartersnakes was 10.67. This was the third highest since the study's inception. In 2012 the average of the high counts was 3.67. There is a great deal of fluctuation from year to year, and although our index dropped it is not the lowest seen over the duration of the study. Using the above index, Red-bellied Snakes had an average of 5.33 in 2010, the fourth highest since the study's inception and 2.33 in 2012. A considerable drop is noticeable on the graph, which may be part of a multi-year cycle, as they have recovered from previous lows in the past. Anecdotally, we tend to see the high counts for Red-bellied Snakes later in the fall, late September and October. This may be because some overwinter in the ant colonies established below the covers and/or an increased need for the heat provided by the slate as the temperature cools. One Milksnake was captured under the snake covers in 2011. No new species were seen.

Relatively few snakes were captured in 2011 when compared to previous years. Both Red-bellied Snakes and Common Gartersnakes have been declining since 2008 at our study site at Guthrie. Prior to 2008 Common Gartersnakes were increasing steadily in population where Red-bellied Snakes showed large annual variation. However, neither of these two species shows a clear long-term population trend.

We check our snake-covers in the fall so that we will be able to include the young of the year in our data. However, we have discovered that our snake indices are primarily influenced by young-of-the-year numbers. Most of these young snakes will not survive their first year. Consequently, we show young-of-the-year numbers separate from total numbers in our figures. In the future, we will periodically show year-to-year comparisons of snake indices without including that year's young.

Milksnakes continue to very rare at the transect site at Guthrie. One Milksnake was captured in 2011. This was the first since 2008. Milksnake adults and young have declined steadily at Guthrie since 2001, although the numbers have always been too low to draw any statistically meaningful conclusions. It is possible that the amount or quality of egg-laying substrate (hay, compost, exposed rock) may have declined. Predatory events may have increased, prey numbers may have declined, overwintering may have been unsuccessful, or it may be the result of other factors (disease?) entirely. Large adult females might well prefer the breeding habitat provided by the old stone foundation located nearby, rather than the slate covers that we use for monitoring.

Nine Red-bellied Snakes and twelve Common Gartersnakes were found using the covers during our maintenance visit on July 8, 2010, despite the fact that bears had disturbed some of the covers. All snakes were measured and palpated on that visit. Both Red-bellied Snakes and Common Gartersnakes give live birth and gravid females would be carrying young in July. When we did our snake-cover maintenance on July 30, 2008, we found nine adult Red-bellied Snakes using the covers. All of them were gravid. Palpating revealed from 7 to 11 young in each adult. During our maintenance of covers in 2010, 7 of the 8 Red-bellied Snakes found were gravid and we could feel from 5 to 11 embryos in each one. In 2012 we did our annual maintenance on June 15 and 28. During the maintenance we found one Milksnake and two Red-bellied Snakes. Both Red-bellied Snakes were gravid with 10 and 6 eggs respectively. It may be that the snake covers are good thermal refuges in which the females can raise their body temperatures to optimal levels for internal incubation.  If so, the presence of the covers may increase the population of Red-bellied Snakes for a number of years.  We will schedule our maintenance day in 2013 for July, so that we may look for gravid females.

Some of the snake covers have small mammal tunnels traveling under them and twice we have found a *Peromyscus* species between the slates.  In addition, many invertebrates are found using the snake-covers. These are rarely identified to species and this is not a comprehensive list.  However, in 2011 we noted ants, box elder beetles, crickets, ground beetles, hickory tussock moth cocoons, Isabella moth caterpillars (woolly bears), and earthworms.

Table 6. Fall 2011 snake-cover results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for the Common Gartersnake (*T. sirtalis*) and unidentified snakes. This is the eleventh year of results. In 2011, 10 Red-bellied Snakes (*S. occipitomaculata*), 15 Common Gartersnakes (*T. sirtalis*), and 1 Milksnake (*L. triangulum*) were captured.

| Date | *Species* | S-V length in mm | Total length in mm | Location Cover # - Cover Area | Physical Info |
|---|---|---|---|---|---|
| Sept. 6 | *T. sirtalis* | 155 | 200 | #25 surface | Young of year |
| Sept. 13 | *T. sirtalis* | 155 | 200 | #3 between | |
| Sept. 13 | *T. sirtalis* | 145 | 195 | #25 surface | |
| Sept. 13 | *T. sirtalis* | | | #25 between | 1/2 of a snake, top half still here may have been crushed or perhaps flattened as a result of drying |
| Sept. 20 | *T. sirtalis* | 150 | 195 | #25 surface | |
| Sept. 27 | *T. sirtalis* | 185 | 235 | #11 surface | |
| Sept. 27 | *T. sirtalis* | 170 | 220 | #25 surface | |
| Oct. 3 | *T. sirtalis* | 180 | 232 | #3 between | |
| Oct. 3 | *T. sirtalis* | 160 | 212 | #45 | |
| Oct. 11 | *T. sirtalis* | 180 | 235 | #14 between | |
| Oct. 11 | *T. sirtalis* | 175 | 225 | #14 surface | |
| Oct. 11 | *T. sirtalis* | 430 | 440 | #26 surface | Missing tail |
| Oct. 11 | *T. sirtalis* | 385 | 405 | #26 surface | |
| Oct. 11 | *T. sirtalis* | 135 | 182 | #36 between | |
| Oct. 11 | *T. sirtalis* | 160 | 210 | #36 between | |

Figure 8. Average *T. sirtalis* total and young-of-year captures per highest three counts under snake-covers 1-40 over entire season (2002-2012).

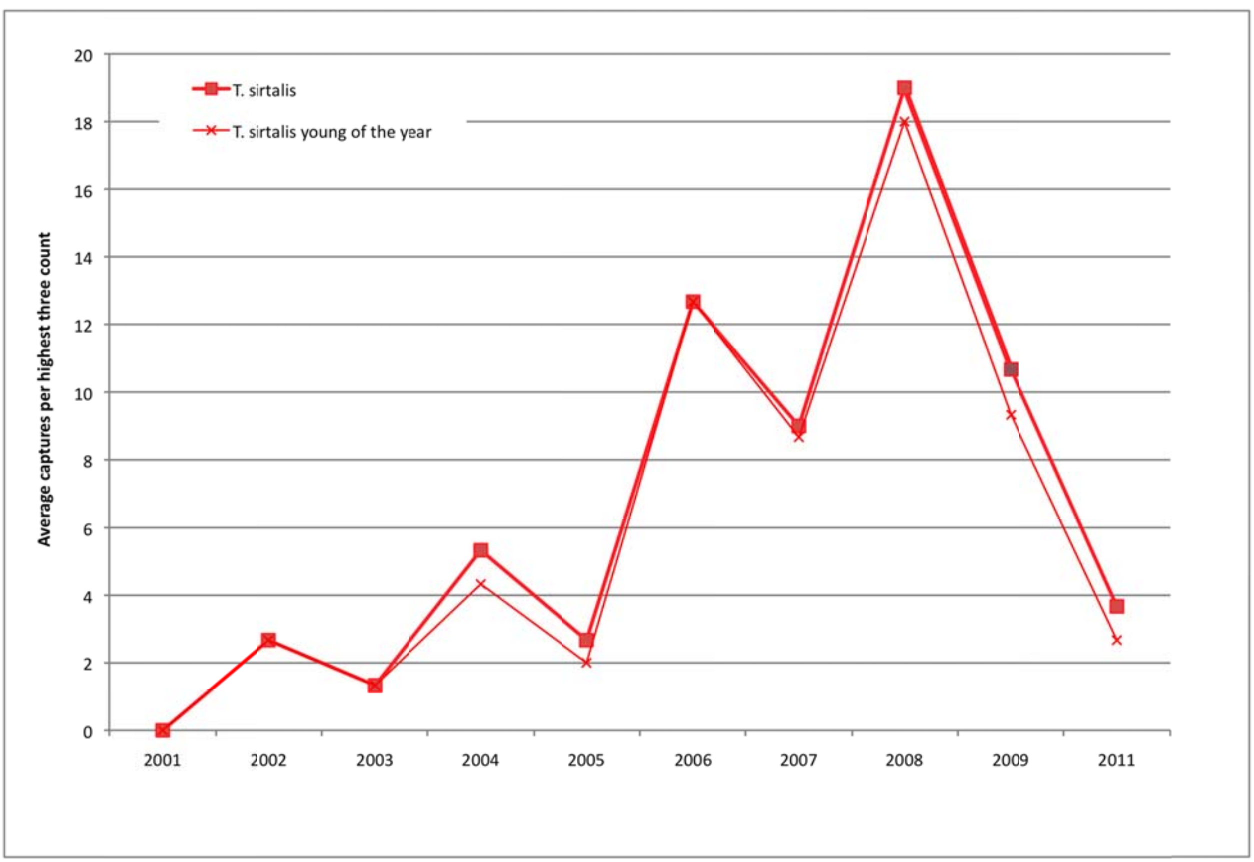


Table 7. Fall 2011 snake-cover results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for the Red-bellied Snake.

| Date | Species | S-V length in mm | Total length in mm | Location Cover # - Cover Area | Mass and Physical Info |
|---|---|---|---|---|---|
| Sept. 2 | *S. occipitomaculata* | | | #8 | Shed skin |
| Sept. 2 | *S. occipitomaculata* | 135 | 180 | #15 | |
| Sept. 13 | *S. occipitomaculata* | 87 | 107 | #15 between | |
| Sept. 20 | *S. occipitomaculata* | 65 | 83 | #8 between | |
| Oct. 3 | *S. occipitomaculata* | 180 | 235 | #21 between | |
| Oct. 11 | *S. occipitomaculata* | 75 | 92 | #7 between | 3 mm wide |
| Oct. 11 | *S. occipitomaculata* | 85 | 105 | Covers #8 between | |
| Oct. 11 | *S. occipitomaculata* | 220 | 270 | #8 between | Very pretty, gray background with brown stripes in middle, stripes on side are darker brown injured scales on dorsal side of tail, 3 spots on neck are tan. |
| Oct. 11 | *S. occipitomaculata* | 130 | 160 | #33 surface | |
| Oct. 11 | *S. occipitomaculata* | 133 | 168 | #40 surface | |
| Oct. 28 | *S. occipitomaculata* | 210 | 255 | # 21 surface | |

Figure 9. Average *S. occipitomaculata* total and young-of- year captures per highest three counts under snake-covers 1-40 over entire season (2001-2012).

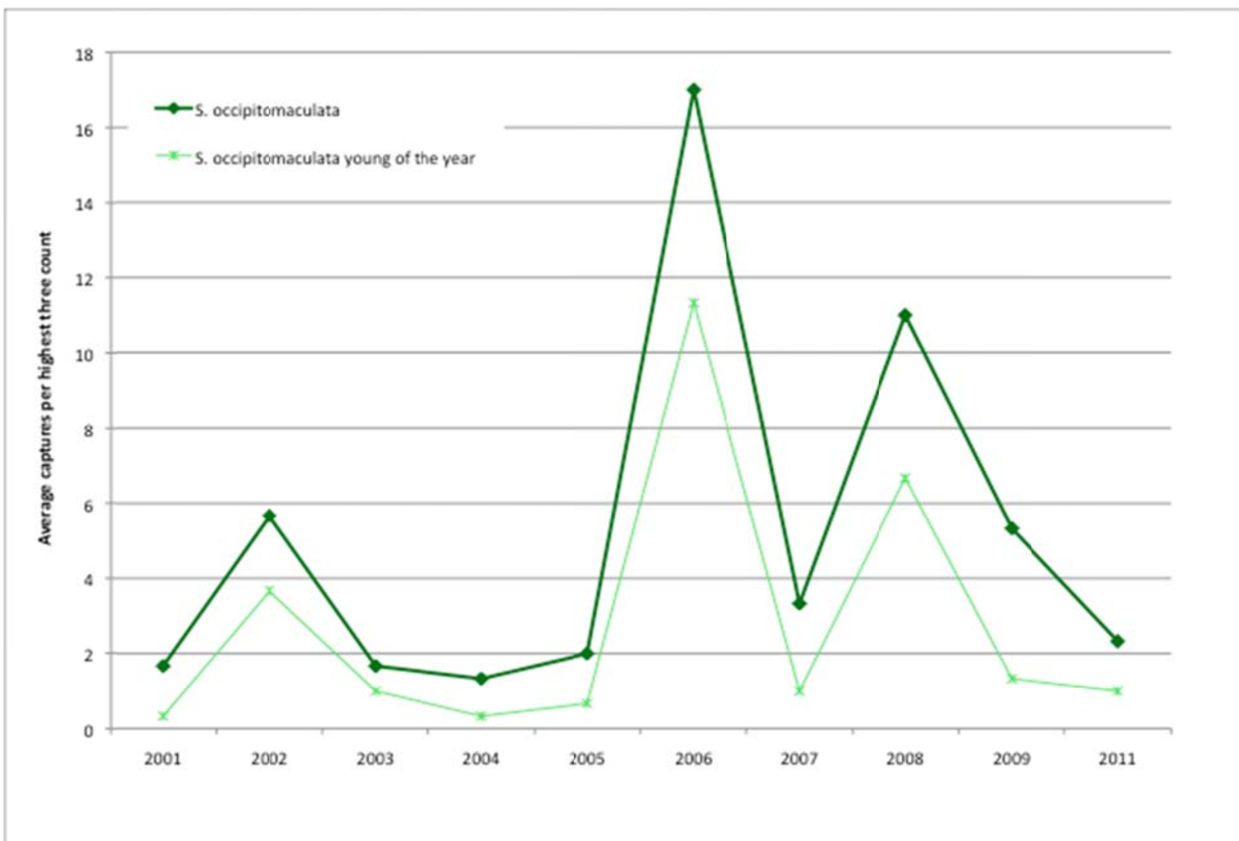
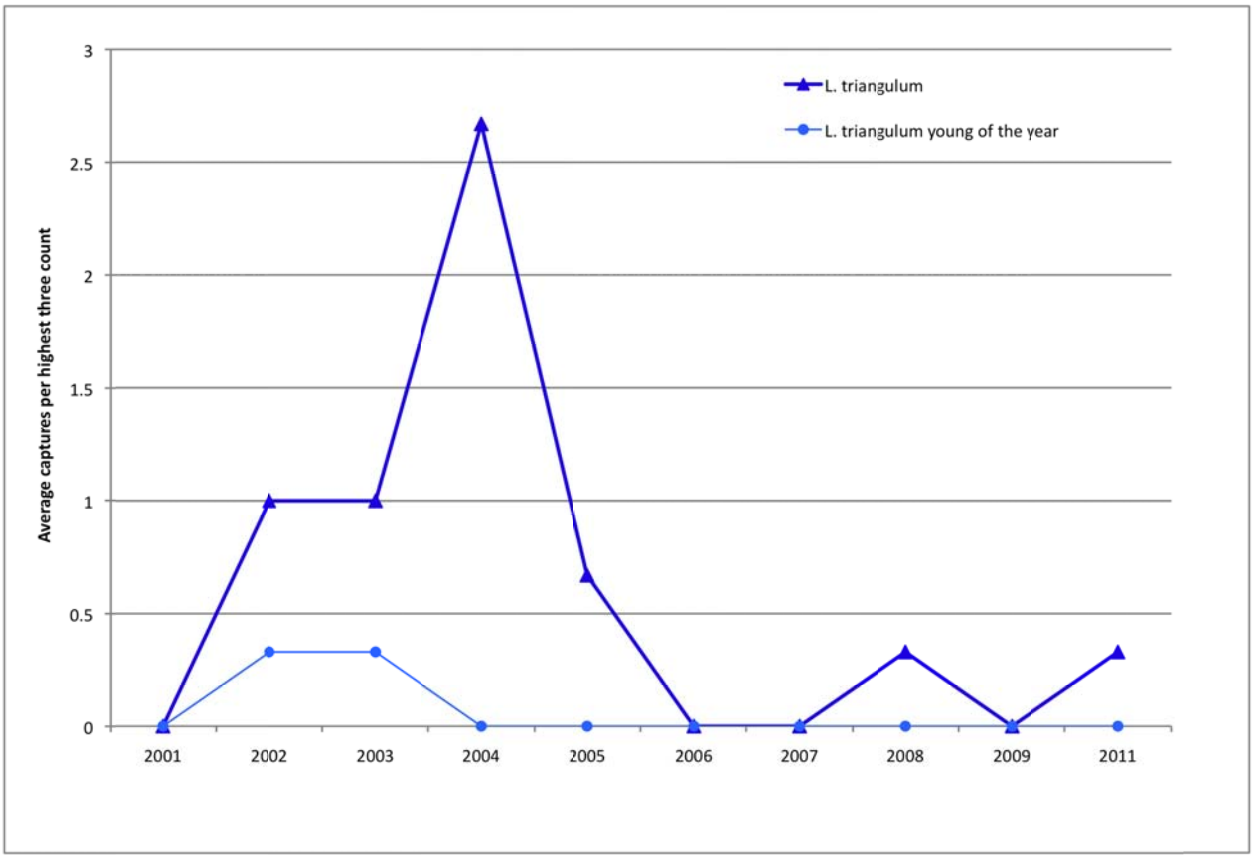


Table 8. Fall 2011 snake-cover results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for the Milksnake (*L. triangulum*) and unidentified snakes.

| Date | Species | S-V length in mm | Total length in mm | Location Cover # - Cover Area | Mass and Physical Info |
|---|---|---|---|---|---|
| Sept. 6 | *L. triangulum* | 220 | 260 | #25 surface | |
| Sept. 2 | *Unidentified* | | | #7 | Shed skin |
| Sept. 2 | *Unidentified* | | | #36 | Shed skin |
| Sept. 2 | *Unidentified* | | | #21 | Skeleton |
| Sept. 13 | *Unidentified* | | | #21 between | Shed skin |

Figure 10. Average *L. triangulum* total and young-of- year captures per highest three counts under snake-covers 1-40 over entire season (2002-2012).



Cover-boards (Salamander)

The cover-boards were not monitored during the 2011 field seasons, but were checked in 2012. Cover-boards were checked for maintenance purposes on September 28 and October 21, 2011 and June 28 and June 29, 2012. The boards were renumbered and/or replaced as needed. In addition, brush and downed trees were cleared from around the cover-boards and along the access trail. During the maintenance of the cover-boards in 2011, about 70 Eastern Red-backed Salamanders and 1 Eastern Newt were found. During maintenance in the summer of 2012 (over 2 days) 113 Eastern Red-backed Salamanders were seen. Under cover board 8B, along with 3 adults, a clutch of 12 eggs was found. This was the first record of eggs being found under the cover board at this location. Also on that day, one Northern Dusky Salamander (*Desmognathus fuscus*) was seen under cover board 10A.

In 2012 the cover-boards were checked on seven dates: Sept. 5, 12, 19, and 26, Oct. 2, 10, and 17 (Table 9). This year we stopped the counts in the fall once we determined the number of salamanders seen each week was decreasing. As we have done previously, we only counted salamanders under one of each pair of cover-boards (B cover-boards). This is the method we intend to stick with in the future since it produces plenty of salamanders for our purposes.

The species found under the cover-boards are almost exclusively the Eastern Red-backed Salamander. However, two Eastern Newts in the red eft stage were found using the cover-boards in 2012. Both were found on September 12. A Northern Dusky Salamander was found and photographed under the same cover board (10B) on three different dates (September 12, 19, and 26). A Northern Dusky Salamander was also found during the annual maintenance on June 28, 2012 under cover board 10A

In 2012 the high count for numbers of Eastern Red-backed Salamanders on one day was 60 (Sept 12) (Table 9). To compare with other years we selected half of the cover boards each year (or half of the data collected) to have an equivalent comparison. In 2010 the high count was 63 on September 10, in 2007 the high count was 70 on Sept. 5, and in 2006 the high count of 74 was also on Sept 5. To adjust for day-to-day variation we have developed an index to compare high counts from year to year. We have taken the highest three counts and averaged them. Results are shown in Figure 11. The high counts are often the first three counts in September, but occasionally include a count taken in October.

The highest count has been the first count in the fall on over 50% of the survey years. We had previously thought that since there is no obvious weather change of significance that corresponds with the drop in numbers after the first check, the quick decline was possibly a result of disturbance. To check this, in 2003 and 2004 we checked all cover-boards on the first check, but only one half of the cover-boards on the following check, and every other subsequent check. Interestingly, the rate of decline was almost identical for those covers checked every two weeks and those checked every week. Apparently, checking at one or two week intervals did not have any impact on board use as a result of disturbance (Andrews and Talmage 2005). This is in accordance with the results published by Marsh and Goicochea (2003). They also found no difference between covers checked every week and covers checked every three weeks. It should be added that although temperatures clearly drop as the fall progresses and these ectotherms need to descend to greater soil depths to keep from freezing, the decline in numbers under the boards begins before the decline in temperatures. Their movement could be triggered by day length or some other factor as well.

We have seen fall migrations of Eastern Red-backed Salamanders at other sites. It appears this movement is from wetter substrates to upslope over wintering locations that are better drained. The better-drained locations probably allow the salamanders to descend below the depth of freeze without hitting the water table. This seasonal migration to more appropriate wintering locations may be part of the reason we see fewer salamanders as the fall progresses. Some of this movement may be almost entirely vertical as well if the location already is sufficiently drained. Another possible explanation for declining numbers through the fall may be the result of the fact that Eastern Red-backed Salamanders start mating in the autumn and continue through the spring. One study found a population in NY started mating in the second week in October. Females have the ability to keep sperm in their cloacae through late April (Petranka 1998). Perhaps the high early fall numbers are due to salamanders moving to mating areas before disappearing underground for over wintering.

Based on Vermont data, juvenile Eastern Red-backed Salamanders are most often found from late July through November (Andrews 2007). This suggested to us, that the peak population size under the cover-boards should also be in the fall as opposed to the summer. In 2005 we tested this by doing additional counts in the summer. Counts were made on June 28 and August 3. As we had hypothesized, the high counts were in the early fall (Andrews and Talmage 2006). This may be something to look at again in the future as the numbers do appear to be consistently high when the cleaning is being done in the summer. It also would be interesting to do a count in mid-August when eggs may have recently hatched.

As shown in Figure 11, our index shows an increasing population of Eastern Red-backed Salamanders along the cover-board transect. Conditions appear to be improving for this species in the immediate monitoring area. Whether this is due to local forest management, other local factors, or is part of a larger regional trend due to weather or other conditions is not known. We would expect conditions to improve as hardwood forests age and produce increasing amounts of coarse woody debris. This debris provides moisture refugia, cover from predators, and egg-laying sites. The presence of the cover-boards themselves might bring about a temporary increase in population, but this would have to level off once the boards had been colonized. Our most recent population analysis of Eastern Red-backed Salamanders at our Mt. Mansfield monitoring site has also shown increasing numbers over the past few years. Monitoring at multiple sites allows us to make these comparisons. Long-term monitoring allows us to see if these changes are sustained or if multi-year cycles exist.

It is important to note that individuals are not marked, and the total number of individual salamanders caught throughout the monitoring season is not known. The same individuals may well have been counted on more than one date. However, for purposes of comparison from year to year we do not need to know the total number of individuals. We can compare averages, high counts, and size-class information from the high-count days (Figures 11 and 12, and Tables 9, 10, and 11). As mentioned in earlier reports, Caitlin Corey's results suggest that there is an upper limit to the number of adults that we can theoretically find under the boards, since the cover-boards may exclude same sex adults (Corey, 2002). Although we see annual variation, the average for the top three counts has shown little variation since it peaked in 2006 (Figure 11). Perhaps we have reached this upper limit. Corey's results also suggest that there is an apparent active exclusion of same sex adults and possible predation upon younger juveniles; therefore, the age-class data generated by the cover-boards may not be representative of those in the larger population. It is still important data to collect. In theory, once we reach the upper limit, the age class data under the cover-boards would remain relatively stable. We are now able to begin to look at this question (Table 10 and 11 and Figure 12). It does not appear that the age class structure is stable at the present time, but it may approach stability in future years (Figure 12). At the same time there may be other factors we have yet to discover that influence the age classes of the salamanders found under the cover-boards. As this study continues it will be interesting to see if Corey's hypotheses are correct.

As we continue to gather data, we are able to learn more about the population on Anderson Lands and also the Eastern Red-backed Salamander's natural history, including basic size and mass information (Figure 13 and 14).

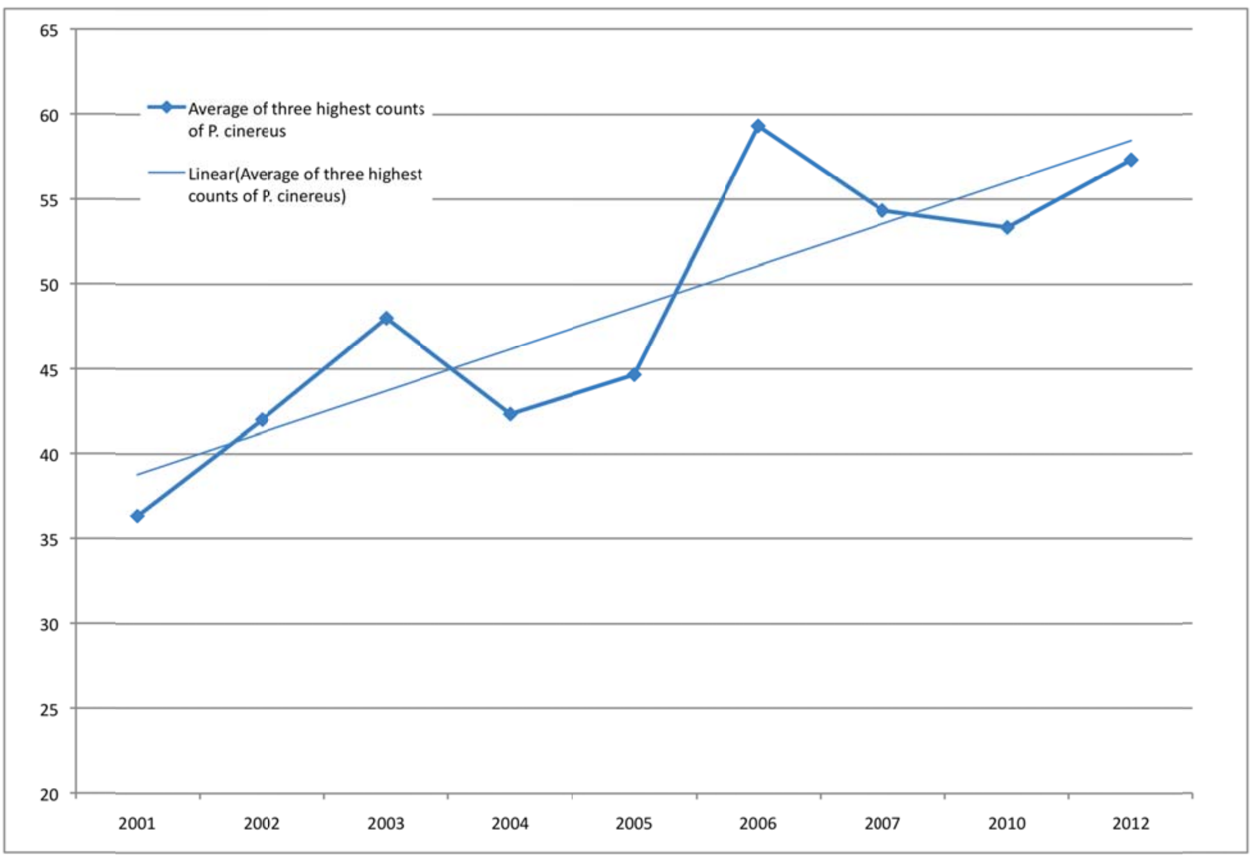
Many invertebrates were found using the cover-boards. In 2012 we noted slugs, camel crickets, ground beetles, and ants; however, this list is not complete.

Table 9. Fall 2012 cover-board results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont. The species being monitored is Eastern Red-backed Salamander (*Plethodon cinereus*). Only the B cover boards were checked.

| | **Snout to Vent Length** | | | | | | |
|---|---|---|---|---|---|---|---|
| Date | 1-20 mm | 21-30 mm | 31-40 mm | 41-50 mm | 51-60 mm | Unk.[1] | Total |
| Sept. 5 | 0 | 0 | 38 | 17 | 0 | 0 | 55 |
| Sept. 12 | 0 | 3 | 32 | 24 | 0 | 1 | 60 |
| Sept. 19 | 0 | 7 | 27 | 22 | 0 | 0 | 56 |
| Sept. 26 | 0 | 8 | 34 | 14 | 0 | 0 | 56 |
| Oct. 2 | 0 | 6 | 21 | 13 | 0 | 1 | 41 |
| Oct. 10 | 0 | 7 | 14 | 11 | 0 | 0 | 32 |
| Oct. 17 | 0 | 7 | 8 | 8 | 0 | 0 | 23 |
| **Total** | **0**[2] | **38**[2] | **174**[2] | **109**[2] | **0**[2] | **2**[2] | **323**[2] |

[1] Salamanders escaped before measurements were taken.
[2] Salamanders may have been caught on more than one occasion throughout the field season.

Figure 11. Average number of Eastern Red-backed Salamanders (*Plethodon cinereus*) captured during the three highest counts[1] for during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2001-2012).




[1]Half of cover-boards checked (or data used), for each year. Cover boards A in 2001, 2003, 2006, 2010. Cover boards B in 2002, 2005, 2007, 2012, and odd numbered cover-boards in 2004.

Table 10. Totals[2] for each cohort of Eastern Red-backed Salamanders (*Plethodon cinereus*) found on the three highest count days during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2001-2012).

| Snout to Vent Length | | | | | | |
|---|---|---|---|---|---|---|
| Date | 1-20 mm | 21-30 mm | 31-40 mm | 41-50 mm | 51-60 mm | Unk.[1] |
| 2001 | 0 | 5 | 71 | 22 | 1 | 0 |
| 2002 | 0 | 7 | 91 | 25 | 0 | 0 |
| 2003 | 2 | 24 | 94 | 23 | 0 | 0 |
| 2004 | 2 | 40 | 64 | 19 | 0 | 0 |
| 2005 | 1 | 35 | 78 | 18 | 0 | 1 |
| 2006 | 10 | 40 | 93 | 34 | 0 | 0 |
| 2007 | 3 | 43 | 87 | 32 | 0 | 1 |
| 2010 | 0 | 15 | 98 | 46 | 0 | 1 |
| 2012 | 0 | 18 | 93 | 60 | 0 | 1 |
| **Average/Year** | **1.8** | **22.7** | **76.9** | **27.9** | **0.1** | **0.4** |

[1]Salamanders escaped before measurements were taken.
[2]Half of cover-boards checked (or data used), for each year. Cover boards A in 2001, 2003, 2006, 2010. Cover boards B in 2002, 2005, 2007, 2012, and odd numbered cover-boards in 2004.

Table 11. Percentage of totals for each cohort of Eastern Red-backed Salamanders (*Plethodon cinereus*) found on the three highest count days during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2001-2012).

| Snout to Vent Length | | | |
|---|---|---|---|
| Date | 1-20 mm | 21-40 mm | 41-60 mm |
| 2001 | 0.00% | 76.77% | 23.23% |
| 2002 | 0.00% | 79.67% | 20.33% |
| 2003 | 1.40% | 82.51% | 16.08% |
| 2004 | 1.60% | 83.20% | 15.20% |
| 2005 | 0.75% | 85.17% | 13.53% |
| 2006 | 5.65% | 75.14% | 19.21% |
| 2007 | 1.81% | 78.31% | 19.28% |
| 2010 | 0.00% | 70.63% | 28.75% |
| 2012 | 0.00% | 64.54% | 34.88% |
| **Average/Year** | **1.39%** | **76.73%** | **22.37%** |

[1]Salamanders escaped before measurements were taken.

Figure 12: Percentage of totals for each cohort of Eastern Red-backed Salamanders (*Plethodon cinereus*) found on the three highest count days during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2001-2012).

Figure 13: SV lengths for all *P. cinereus* found on the three highest count days during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2001-2012) N=3808.

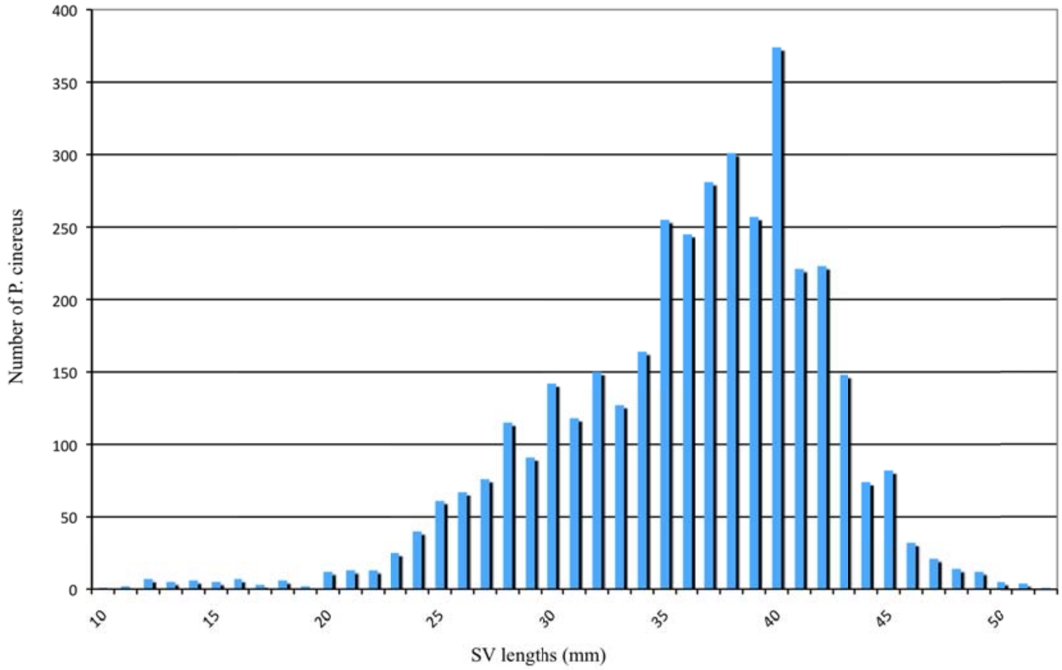



Figure 14: Mass in grams for all *P. cinereus* (for which mass was measured) found on the three highest count days during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2006-2012) N=1358.

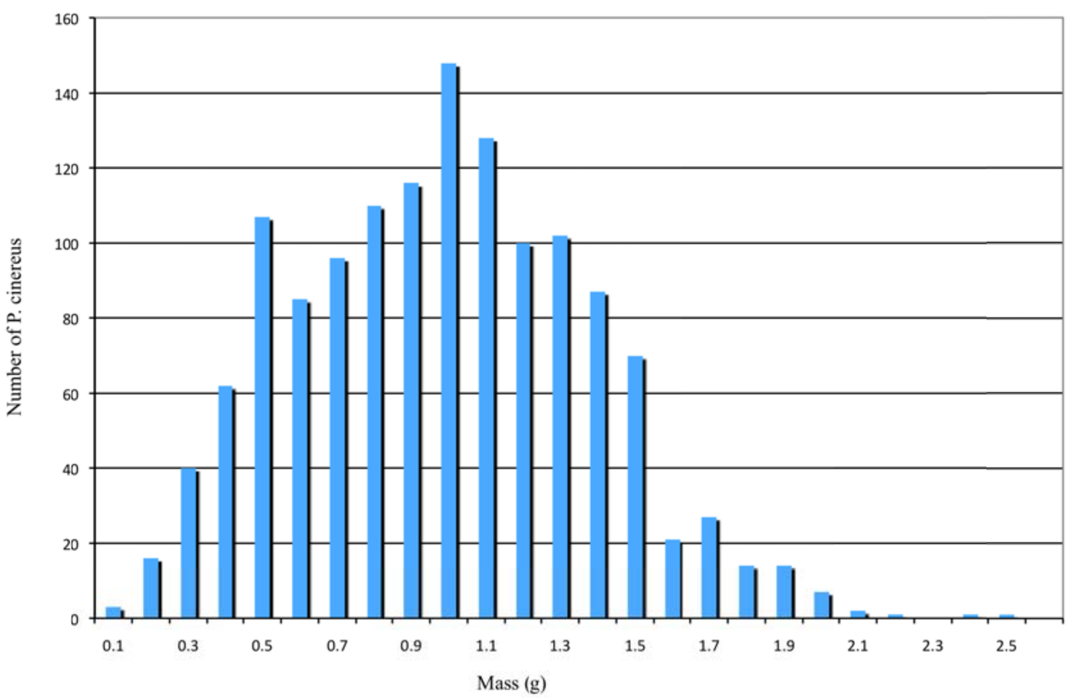
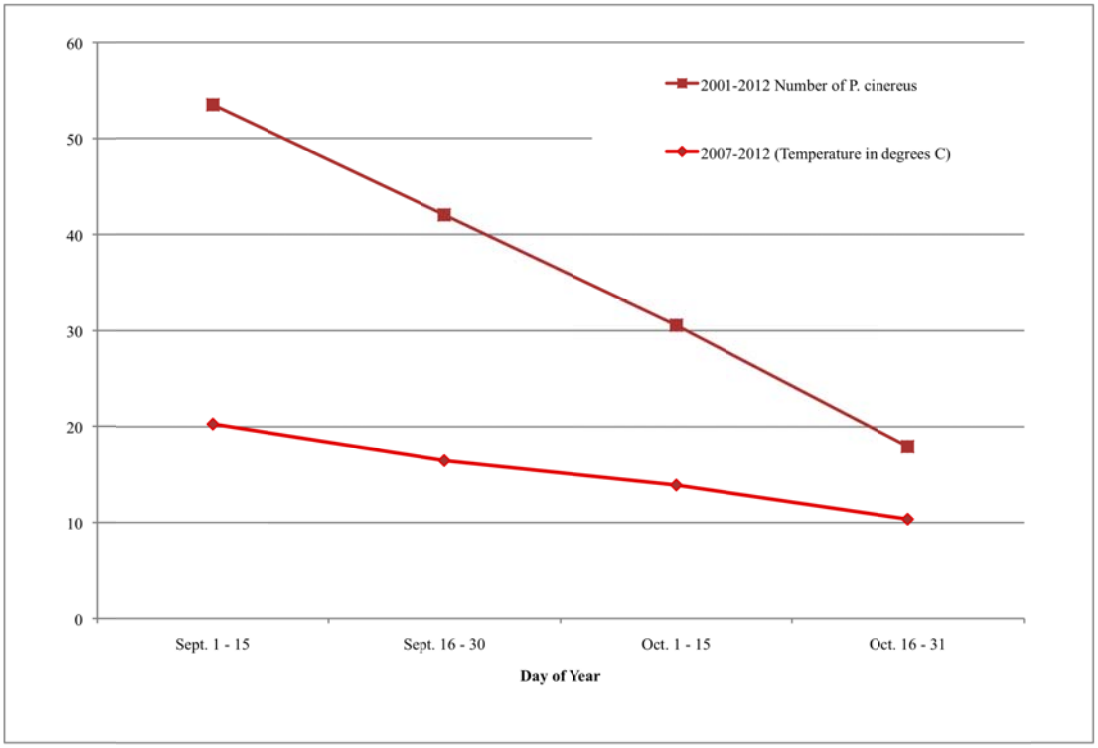


Figure 15: Average number of *P. cinereus* found during cover-board monitoring, and average temperature measured on site at the start of each count on the Lester Anderson lands on the Bristol/Lincoln border in Vermont throughout the fall (2001-2012).




**Egg-mass Summary**

We now have eleven sets of egg-mass data (gathered over 13 years); consequently we are able to look at longer-term trends. Numbers of breeding female **Spotted Salamanders have** fluctuated from year to year, but their populations over the long term appear to be remaining stable. **Wood Frog** egg-mass numbers were considerably lower this year, but that may have been in part due to the unusual spring weather that produced two separate springs in March and April of 2012. The longer-term population trend for this species at all monitoring ponds combined also appears to be stable.

The apparent negative correlation between Spotted Salamander egg-mass numbers and Wood Frog egg-mass numbers was new to us when we first reported it in our 2008 report, it was new to science, and unexplained at that time. It did not hold true in 2012, but again this may be due to the unusual weather circumstances and we plan to continue to track these numbers and explore the mechanics behind it.

One reason these long-term studies are important is that populations are affected by both local and global factors. We know single weather events or a single errant season may affect a local population in the short-term, but we as scientists are just beginning to understand how long-term changes in the climate may affect populations over the long-term. As these climate changes occur, the data from these long-term monitoring studies becomes more and more valuable. For this study we are just now starting to have enough data to be able to compare the population with multi-year weather trends and temperatures.

The figures showing the changing timing of peak egg mass counts, first egg laying, and peak tadpoles over the course of this study was interesting and potentially reflective of the changing weather patterns we are experiencing.

**Cover-board Summary**

We now have been monitoring Eastern Red-backed Salamander populations for 12 years (nine data sets). Our long-term data indices strongly suggest an increasing population. Our population index this year was second highest since the study's inception.

**Snake-cover Summary**

We have ten years of data (over an 11-year period) from the snake-covers and we can begin to look at population trends for all three species. Both Red-bellied Snakes and Common Gartersnakes have been declining since 2008 at our study site at Guthrie. Prior to 2008 Common Gartersnakes were increasing steadily in population where Red-bellied Snakes showed large annual variation. However, neither of these two species shows a clear long-term population trend. Milksnakes continue to very rare at the transect site at Guthrie. Our snake indices are primarily influenced by young-of-the-year numbers. Most of these young snakes will not survive their first year.

**Future Study**

In our 2008 report, we proposed doing egg-mass counts, checking the snake-covers, and checking the salamander covers every-other year. We also proposed preparing the written reports every other year during the year when we monitored snakes only. This evens out the annual effort and resulting cost.

To reiterate our future schedule, we will schedule our annual maintenance day in late July each year and take advantage of this day to check snake covers as we did during 2010. This provides data on gravid females and might turn up the rare (at this site) Milksnakes. Data on gravid females are otherwise not available during fall checks. In 2013 we wrote this report during the late winter/early spring and plan to monitor the snake covers in the fall. In 2014 we plan to monitor the egg-masses in spring and one-half the cover-boards (the As) in the fall. In 2015 we plan to monitor the snake covers again as well as write a report. We might want to consider focusing on only one type of monitoring in each report. For example, one year it would be on snakes, two years later it would cover egg-mass counts, and two years later it would cover salamanders. This would leave a gap of six years (three data sets) between reports on any one monitoring protocol. Since we essentially gather only one data point per year, this makes sense. In addition, it would allow for more in-depth reporting on each type of monitoring.

Thanks

Opportunities for long-term monitoring are both exceptionally rare and very valuable. Most funding for this type of project is short-term. This greatly limits the type of data that can be gathered and the reliability of the data. We continue to appreciate the opportunity that has been created for us through the Colby Hill Ecological Project. These data are not being gathered anywhere else that I am aware of.

**Acknowledgments**

Amy Alfieri, Kiley Briggs, April Hillman, Mike Iacchetta, Kelly Hunt, and Erin Talmage, helped gather data and provide maintenance during 2011 and 2012. Erin Talmage helped prepare this report.