Amphibian & Reptile Monitoring

2000-2014

on the Lester and Monique Anderson Lands

in Lincoln, Vermont

Prepared for the

Colby Hill
Ecological Project

Prepared by

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March 30, 2015

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, egg-mass counts and salamander cover-board surveys were scheduled to alternate annually to reduce costs. Data updates are now produced every other year as well. During the 2008 season, cover-boards were not checked, egg-mass surveys took place, and a report 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 and 2013 we monitored only the snake-covers to keep them on an alternating-year-schedule. In 2012 and 2014 we monitored egg-masses and salamander cover-boards. This report and the snake monitoring during the fall of 2015 will both be on the 2015 budget. The 2016 budget will fund amphibian monitoring (egg-masses and salamander cover-boards) only. 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 or two of maintenance is needed every year to replace rotten and broken covers, repaint marks, 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 number of 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 meaningful indices to those populations.

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, and worn when necessary. 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 at weekly intervals until egg-laying activity ends or the total number of egg-masses is declining.

In 2014, a late snow and cold nights delayed spring amphibian activity. Amphibian movement in the Champlain Valley did not start until the second week of April (compared to March 12 in 2013), and the first egg-masses were not seen in Lincoln until the April 16th visit, with six inches of snow still on the ground.

Cover-boards for salamanders

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 near the Lincoln/Bristol border and continues into Bristol as you head northwest toward Route 17. It appears that all of the cover-boards; however, are within the town of Bristol. 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 were 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 highly successful in attracting salamanders. The structures (salamander condos) are built 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 to them. In between the two layers of boards, along the outside edges, are two spacers (8 mm x 22 mm x 260 mm long), which are used to lift the outside edge of the upper two boards 8 mm 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 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 that 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 began measuring the mass of the salamanders as well.

We also keep records on where within the salamander condos the amphibians are found. It is of interest to us 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. Since the cover-boards have been very successful at attracting salamanders, we can obtain enough data and save time and money by only checking ½ of them during a given year. As described above, the covers are placed in pairs and both are labeled with the same numbers but different letters. During 2012 we checked only the B covers and left the A covers undisturbed. During 2014 we checked only the A covers and left the B covers undisturbed.

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 covers, though they are 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 (~18 mm x ~22 mm x ~260 m) placed approximately ¼ of the way in from the outside edge to create a small space of varying height between the slates. 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. Each year a few of these thicker covers are found to be broken and they are replaced, even if it is a year when monitoring does not occur. In addition, a few slates need to be remarked each year. We use white exterior latex paint for the numbers. Some of the new slates are 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 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.

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 underlying 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. Sometimes ants completely fill the spaces between the covers with their nests. When this occurs, the spaces between the covers are cleaned out but the nests under the covers are left in place.

Starting monitoring in late summer is ideal, 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 markings 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 expect to begin measuring the mass of the snakes again in 2015. We also keep records on where within the snake-cover the reptiles are found. Two locations are noted: between (between slate) and surface (between slate and ground).

We monitored the snake-covers during the fall of 2013, and will monitor them again in the fall of 2015. We continue to follow our schedule such that in years when we monitor the snake-covers, the amphibians are not monitored. These are good years (to keep budgets even) to write summaries of our findings. The way the pattern has developed, the reports are written in the late winter/early spring of the year prior to the monitoring of the snake-covers in the fall.

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 (lives underground). 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. As a result, 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 small openings within 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 Cabot Vermont in 2014, the snake measured 1002 mm (39.45 inches). They are the most common snake in the state (Andrews, 2015) 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 two records of gravid Common Gartersnake run over and found dead on the road. Ten babies (also run over) were found near the body of an adult female in 2005, and 15 young were found near the body of the second in 2014 (Andrews, 2015). In 2014, two gravid Common Gartersnakes were found, and 9 and 17 embryos were detected through palpation (Andrews 2015). 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 the second most frequently 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. Average length adults are generally longer than Common Gartersnakes. The largest Vermont Milksnake measured 1148 mm (45.2 inches). It was found in West Haven in 2014. 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

Egg-mass counts

In 2014 egg-mass counts were performed on six dates (April 9, April 16, April 23, April 30, May 7, and May 14) 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 1-5 and Figures 1-7. The 2013-2014 winter was the coldest in over 25 years. On average it was 4 degrees below average between November 1, 2013 and March 31, 2014, this is in stark contrast to the winter of 2011 – 2012 (last time we did egg-mass searches). That winter was the 4th warmest year on record, with March being considerably warmer than average and breaking numerous records around the northeast. In 2012, egg-masses were first found on April 3 (and were about a week old). In the spring of 2014 egg-masses were not seen until April 16. In 2012 amphibian movement was recorded in the Champlain lowlands on March 8. In 2014 it was close to a month later.

In 2014 the date for high counts of Wood Frog eggs were April 23 in all four ponds, and the earliest date any tadpoles were seen was April 30. In contrast, in 2012 the dates were the earliest dates we have ever recorded egg-masses and tadpoles (April 3 & 18th). For comparison, in 2010 the dates of high counts and first tadpoles for Wood Frogs were April 8 and April 23 respectively. 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.

Table 1. Spring 2014 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 9	0	0	Water open, but no masses found. Late snow and cold nights delayed spring movement. First movement in valley has just begun. Snow patches in woods.
April 16	0 Two clumps of spermatophores	211 Some pretty fresh, a few older with silt	Visibility ok, cloudy. Yesterday's heavy rain turned to snow, 6 inches on ground.
April 23	15	278 Some are pretty fresh, In some older masses, embryos in "U" shape	Visibility ok, glasses worn, can see out about 8 feet, can not see center or bottom.
April 30	125 Some look very fresh	232 Some floating across pond, many dead eggs >3500 tadpoles.	Visibility fair to good–
May 7	153 Some fairly fresh, some opaque, 2 partly non-viable	1 Only counted masses with non-hatched eggs >21,500 tadpoles	Visibility pretty good, glasses worn, cloudy and it was silty in middle.
May 14	152 Can see embryos moving in some masses	0 >2500 tadpoles	Visibility ok to good, glasses used, net is useful to have to point and move cattails around.

Figure 1. Egg-mass data from Lower Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont (2000-2014). In 2012, the Wood Frog egg-mass total was a combination of the high counts of both peaks (159).

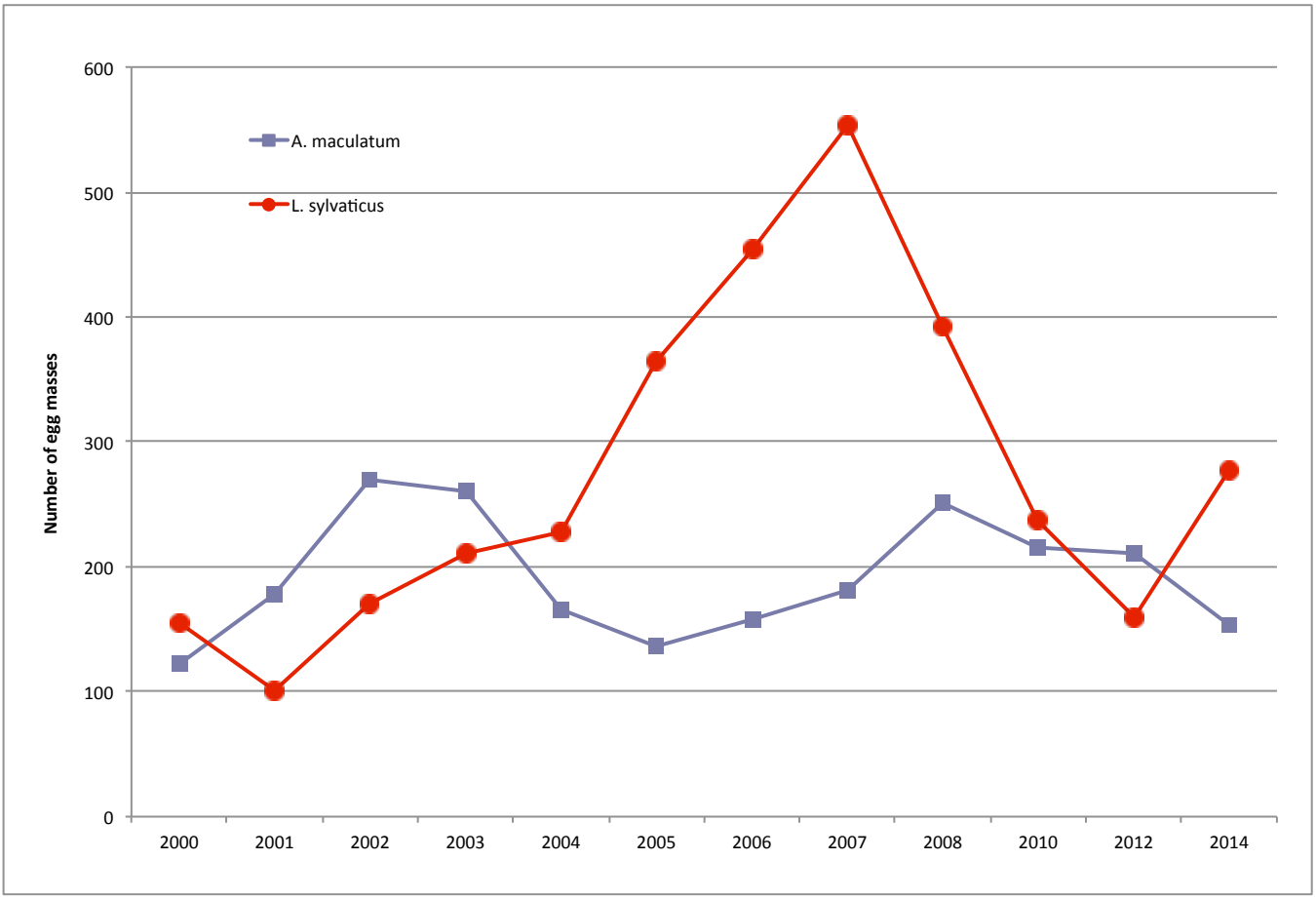


Table 2. Spring 2014 egg-mass data from Upper Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont.

Date	*Ambystoma maculatum* egg-masses	*Lithobates sylvaticus* egg-masses	Notes
April 9	0	0 .	Water open along the edge. Aspen fallen across pond, branches in water. Late snow and cold nights delayed spring movement. First movement in valley has just begun. Snow patches in woods.
April 16	0	88 Masses look a couple days old.	Visibility ok, This layer of ice on pond, we broke it up to look underneath, ice 0.5" in some places. Yesterday's heavy rain turned to snow, 6 inches on ground.
April 23	6 Six clumps of spermatophores	114 Eighteen were pretty fresh	Visibility ok, glasses used, cloudy..
April 30	44 Three clumps of spermatophores	98	Visibility ok, cloudy, windy.
May 7	75	31 Some hatched and masses spread out, only counted ones that still had some shape.	Visibility excellent, sunny no wind, glasses worn.
May 14	56	0 >200 tadpoles seen spread around pond	Visibility poor to ok, pollen on surface, glasses used.

Figure 2. Egg-mass data from Upper Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont (2000-2014).

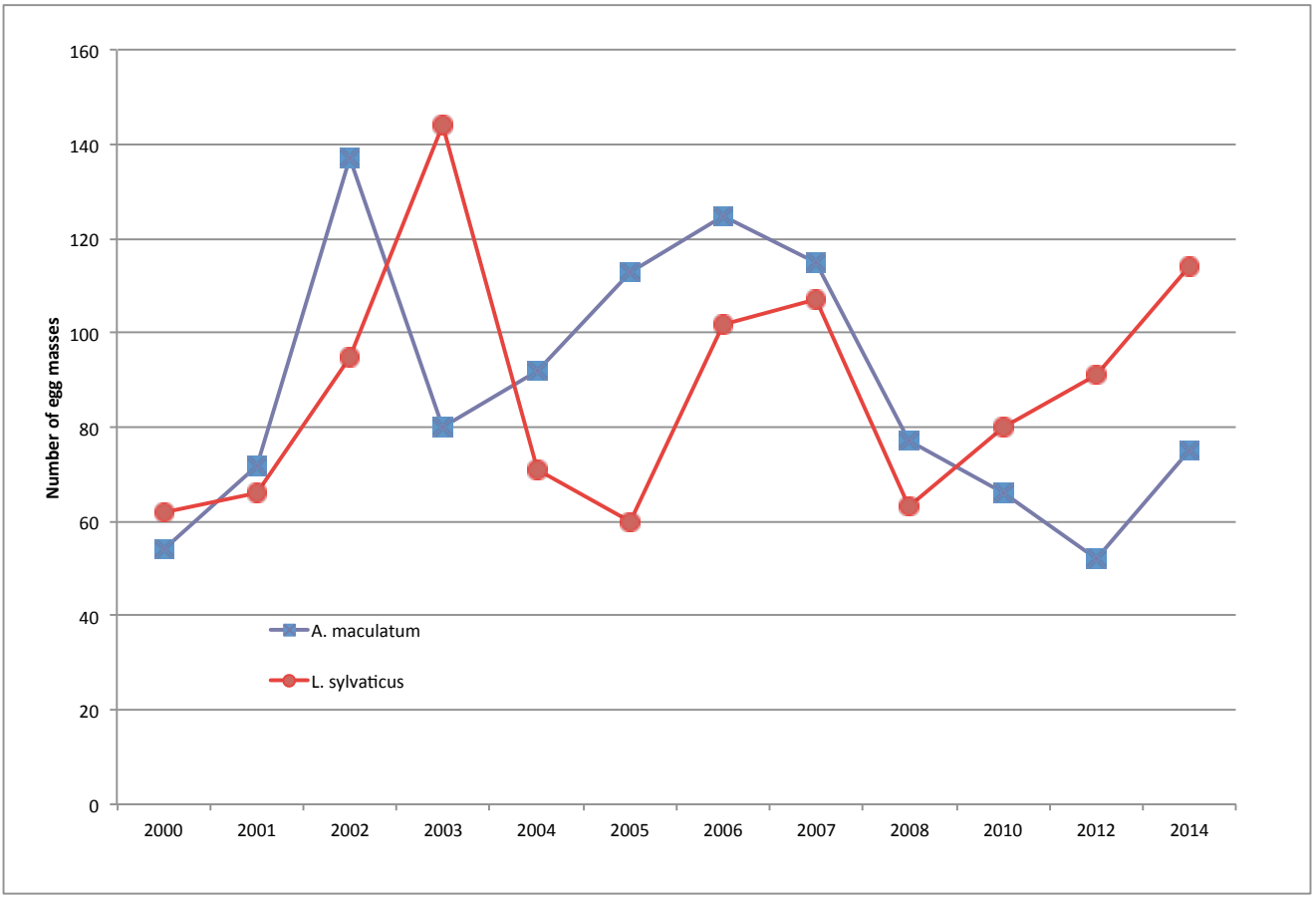


Table 3. Spring 2014 egg-mass data from Guthrie Pond on Lester Anderson lands in Lincoln, Vermont.

Date	*Ambystoma maculatum* egg-masses	*Lithobates sylvaticus* egg-masses	**Notes**
April 9	0	0	Almost entirely ice covered, some open water on northwest and east sides Late snow and cold nights delayed spring movement. First movement in valley has just begun. Snow patches in woods.
April 16	0 Six clumps.	380 Egg-masses very fresh. Four alive and four dead adults seen	Yesterday's heavy rain turned to snow, 6 inches on ground.
April 23	17 Some very fresh, five clumps of fresh spermatophore, making an almost continuous line.	625 One is very fresh	Visibility fair, cloudy, windy, water about 4 inches above big rock.
April 30	111 Some non-viable egg-masses, some spermatophores that may have been fresh.	18 Only counted new egg-masses, lots of non-viable masses and eggs, surface of water may have frozen >23,000 tadpoles	Visibility ok, slight breeze, but can still see into water, glasses worn.
May 7	220 Some pretty fresh, six non-viable.	1 Egg-masses all gone, can see about 60,000 tadpoles.	Visibility excellent, sunny, no wind, glasses worn
May 14	174 a few non-viable, many spread out but not hatched, can see embryos.	0 Tadpoles in big swarm, >2500.	Visibility excellent to good, glasses use, net is useful to have to point and move cattails around..

Figure 3. Egg-mass data from Guthrie Pond on Lester Anderson lands in Lincoln, Vermont (2000-2014). In 2012, the Wood Frog egg-mass total was a combination of the high counts of both peaks (262).

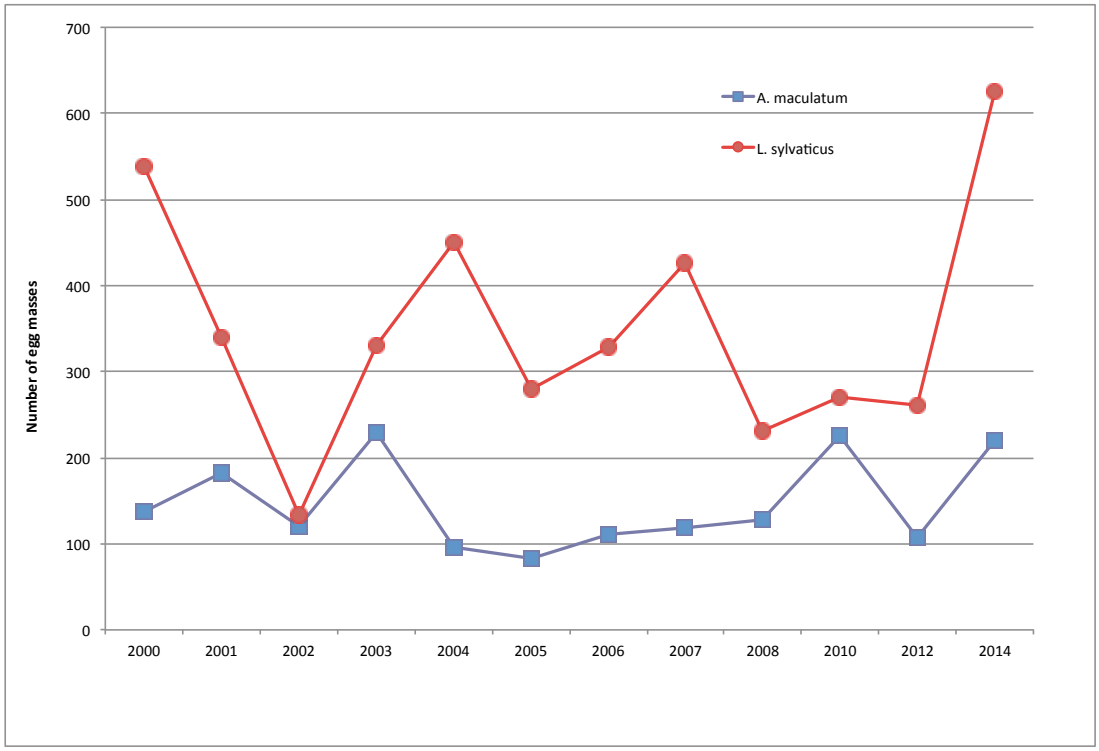
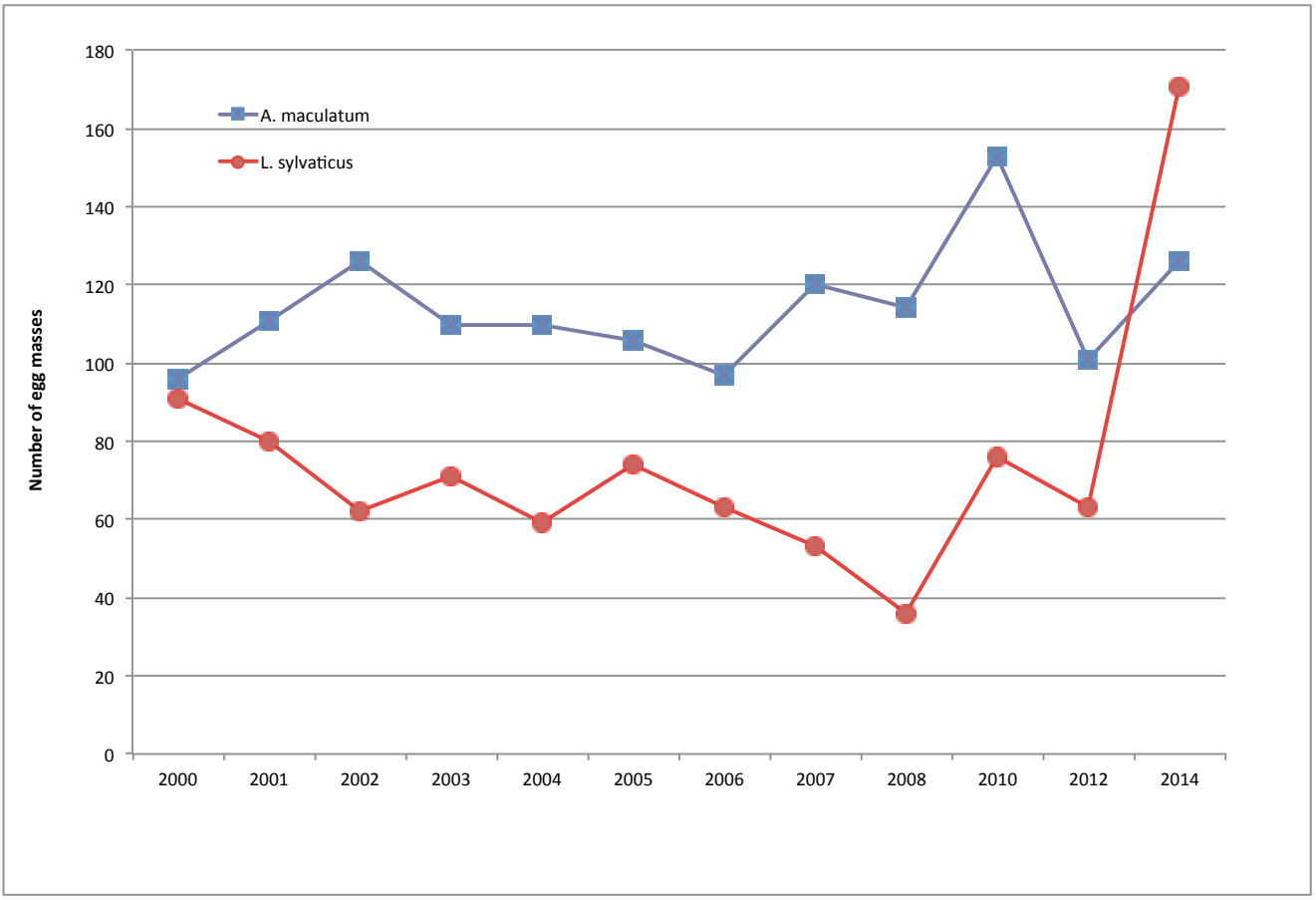


Table 4. Spring 2014 egg-mass data from Wells Pond on Lester Anderson lands in Lincoln, Vermont.

Location/Date	*Ambystoma maculatum* egg-masses	*Lithobates sylvaticus* egg-masses	Notes
April 9	0	0	Water open. Visibility poor to fair, can not see middle, only out about 7 feet Late snow and cold nights delayed spring movement. First movement in valley has just begun. Snow patches in woods.
April 16	08	119 Seventy six look a little older, maybe laid Monday.	Visibility ok when no wind or clouds. Yesterday's heavy rain turned to snow, 6 inches on ground.
April 23	19 More than five clumps of spermatophore.	171	Visibility ok, better with glasses, which were used.
April 30	84	122 No tadpoles, many non-viable eggs, 20 look fresh.	Visibility ok, drizzle, cloudy, at times hard to see.
May 7	126	83 Some holding shape, other hatched, many non-viable.	Visibility excellent, sunny, no wind, glasses worn all day
May 14	93	0 A tadpole seen swimming around.	Visibility ok, lots of stuff on surface and breezy, glasses used

Figure 4. Egg-mass data from Wells Pond on Lester Anderson lands in Lincoln, Vermont (2000-2014). In 2012, the Wood Frog egg-mass total was a combination of the high counts of both peaks (63).



As we have now collected 12 years of data over a 15-year period we are able to start looking at long-term trends in timing for this site (Figure 5 and 6). Both figures show the dates of peak egg-mass counts for both species is getting earlier in the year and the date of first egg-masses for Spotted Salamander is also trending to an earlier date too. Lower Fred Pierce was chosen as a representative pond for Figures 5 and 6 as it is often one of the most productive.

Figure 5: Peak egg-mass and tadpole counts (with trend lines) for *A.maculatum* at Lower Fred Pierce on Lester Anderson Lands, Lincoln, Vermont (2000-2014).

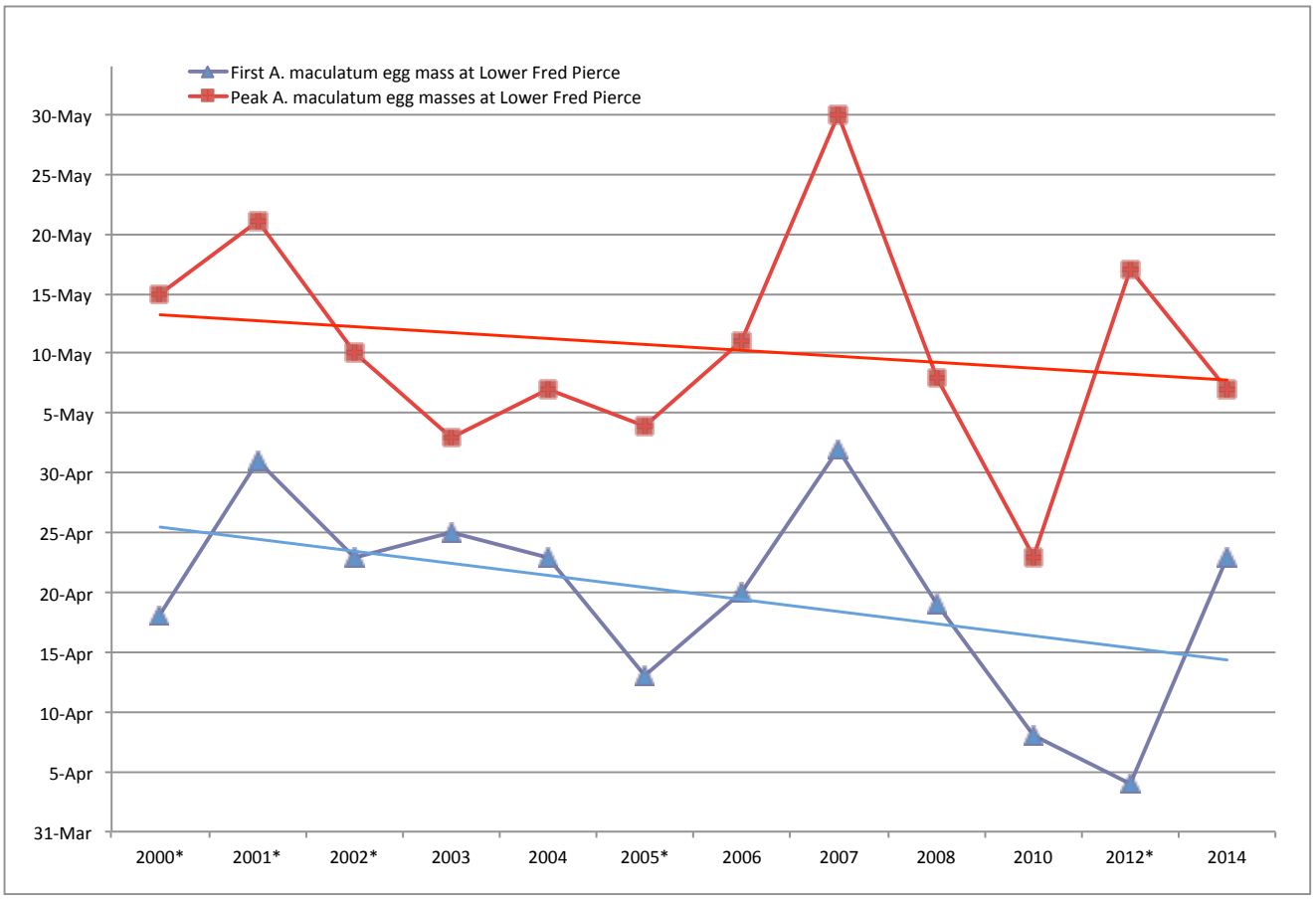


Figure 6: Peak egg-mass and tadpole counts (with trend lines) for *L. sylvaticus* at Lower Fred Pierce on Lester Anderson Lands, Lincoln, Vermont (2000-2014).

Spotted Salamander

During the 2014 season the first egg-masses were seen at Wells on April 16. At the other three ponds, the first egg-masses were seen on April 23 (Tables 1-4). The high counts for Spotted Salamander egg-masses were on May 7th for all four ponds. In 2012, Spotted salamander egg-masses were first seen on April 3, but the high counts occurred on May 12 at Upper Fred Pierce, and May 16th at the other three ponds.

At Guthrie we had been seeing an increase in egg-masses between 2005 and 2010. In 2012 we saw a decrease from 225 to 107 egg-masses, but the numbers increased in 2014 to 220 (Figure 3). At Lower Fred Pierce the number of egg-masses increased for four years and then has dropped each following year from 251 (2008) to 216 (2010) to 210 (2012) and finally to 153 (2014). At Upper Fred Pierce the numbers of egg-masses had been declining since 2006 to a low of 52 egg-masses found in 2012, but that decline reversed and the numbers increased to 75 in 2014. There had been a record number of Spotted Salamander egg-masses seen at Wells in 2010, when 153 masses were counted. In 2012, the total dropped to 101 masses and in 2014 it rose again to 126. All of these results are shown in Tables 1-4 and Figures 1-4. The combined high count for all ponds in 2014 was above average (Table 5).

Annual variation in these numbers is to be expected, and can be seen in Figures 1-7. Although there is year-to-year variation, it is not consistent from pond to pond. In Figure 7 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 and an increase again in 2014 (no counts took place in

2009 or 2011). Throughout the entire duration of the study the number of egg-masses fluctuates, but over all, the population appears to show a slight increase. We will be watching to see if the numbers cycle on a regular multi-year pattern. Except for 2010 and 2014, Lower Fred Pierce Pond continues to be the most productive breeding location and Upper Fred Pierce the least productive. In 2010 and 2014 Guthrie was more productive than Lower Fred Pierce.

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 5, this suggests that in 1999 approximately 104 female Spotted Salamanders laid eggs in these ponds. These numbers increased to 227 females in 2003, dropped, then rose to approximately 220 in 2010 and now 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 above, the 2013-2014 winter was the coldest in over 25 years as opposed to the winter of 2011-2012, which was the 4th warmest year on record.

The combined number of Wood Frog egg-masses from all ponds in 2007 was at a high of 1,141. After that, it dropped to a low of 573 in 2012. In 2014 the numbers rebounded and we ended up with our highest count number since monitoring began (1,188). As we have seen in the past, numbers of egg-masses/year fluctuate and therefore can potentially rebound or crash in a matter of just a couple years. The greatest numbers of Wood Frog egg-masses in 2014 were found in Guthrie with a record high of 625 masses detected (Table 3 and Figure 3). We also recorded 171 egg-masses at Wells, which was the highest number ever counted in that pond. Trend lines for breeding female Wood Frogs show a virtually flat line for combined totals for all four ponds (Figure 7).

In 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 and 2014, with the average count for Wood Frogs varying a great deal, the negative correlation between the two species did not hold true (R=-.22). 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 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.

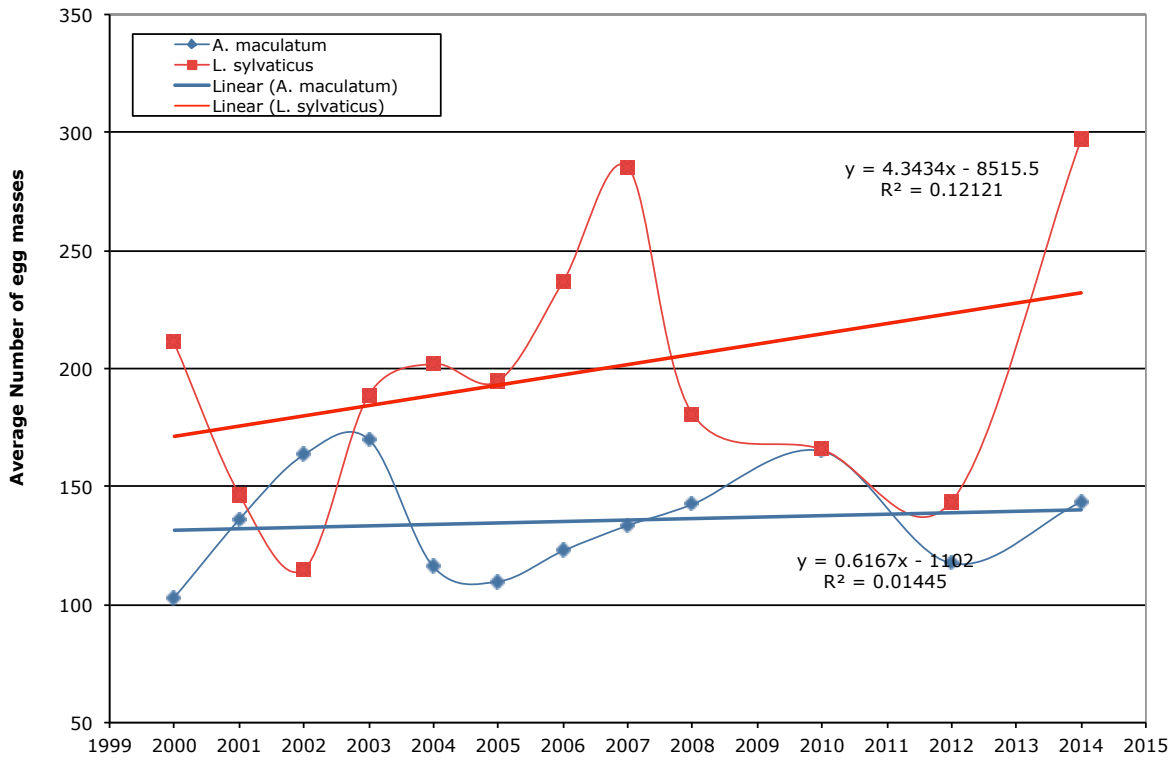
Numerous birds were seen or heard in the vicinity of the ponds during the 2014 egg-mass counts including; American Kestrel, American Redstart, American Robin, American Woodcock, Baltimore Oriole, Barred Owl, Black-capped Chickadee, Black-throated Blue warbler, Blue Jay, Bobolink, Broad-winged Hawk, Chipping Sparrow, Common Raven, Common Yellowthroat, Dark-eyed Junco, Eastern Phoebe, Least Flycatcher, Mourning Dove, Ovenbird, Pileated Woodpecker, Red-breasted Nuthatch, Red-winged Blackbird, Ruffed Grouse, Song Sparrow, White-breasted Nuthatch, White-throated Sparrow, Wilson's Snipe, Wood Thrush,

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 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
2014: 4/9,4/16, 4/23, 4/30, 5/7, 5/14	574	143.5	1188	297.0
Average for all years	**523.3**	**130.8**	**789.3**	**197.3**

Figure 7: Average High Counts and trend lines for *A. maculatum* and *L. sylvaticus* egg-masses on Lester Anderson Lands, Lincoln, Vermont (2000-2014).



Snake-covers

In 2013 snake-covers were checked nine times at weekly intervals starting on Sept. 4 with subsequent checks on Sept. 11, 18, and 25, Oct. 2, 9, 15, 23, and 30, (Tables 6, and 7). 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 and 9 is simply, for each species using the covers, the average number of snakes of that species seen on their three highest counts for that species. If there were multiple days with the same number of captures the earlier dates were used.

For Common Gartersnakes, this average climbed from 0 in 2001 to a peak of 19 in 2008 (Figure 8). Since then it has dropped precipitously to 2.67 in 2013. This is one of the most dramatic multi-year declines of all our monitoring at Colby Hill Ecological Project. We do not know why this would be occurring. Snake fungal disease has recently been documented in Vermont; however, we have not seen any evidence of this disease at these sites. Given the potential productivity of one large female gartersnake and our relatively low numbers of gartersnakes using the covers, this trend may well reverse itself in coming years. Still, we will need to be watching carefully for any evidence of potential driving mechanisms if this trend continues.

Red-bellied Snake numbers followed a similar pattern to gartersnakes but peaked (at 17) earlier (in 2006 versus 2008). After 2006, they then dropped to a low of 2.33 in 2011, but increased slightly to 3 in 2013 (Figure 9). Red-bellied Snakes have shown greater short-term variation in numbers than gartersnakes at this monitoring site and have been at these low numbers previously and then recovered. As we accumulate data over a longer period of time, we will better understand how significant or insignificant these sorts of changes really are. Anecdotally, we tend to see the high counts for Red-bellied Snakes later in the fall in late September and October. Perhaps

this is because some overwinter in the ant colonies established below the covers. It could also be the result of an increased need for the heat provided by the slate as the temperature cools.

One Milksnake was found in the old foundation, but no Milksnakes were found under the coverboards during the fall. No new species were seen.

We check our snake-covers in the fall so that we will be able to include the young-of-the-year in our data. Currently we are seeing that young-of-the-year numbers are the primary influence on our snake indices. Most of these young snakes will not survive their first year. Consequently, our population index would be expected to vary more than the population of adults. However, it is still a reflection of the number of adult breeding females.

Milksnakes continue to very rare at the transect site at Guthrie. One Milksnake was captured in 2011 under cover-boards. 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 be low or has changed. Predatory events may have increased, prey numbers may have declined, overwintering may have been unsuccessful, or it may be the result of other factors entirely. Large adult females might well prefer the breeding habitat provided by the old foundation rather than the slate covers that we use for monitoring.

During our annual maintenance of the snake-covers on July 8 of 2014 we found only three Red-bellied Snakes and a single Common Gartersnake. However, two of the Red-bellied Snakes were gravid with 13 and 9 embryos respectively. During the 2013 maintenance check, we located sixteen Red-bellied Snakes and six Common Gartersnakes during our maintenance visits on July 31, 2013 and August 7, 2013. Embryos were detected in twelve of thirteen Red-bellied Snakes found on July 31. Both Red-bellied Snakes and Common Gartersnakes give live birth and gravid females would be carrying young in July. We have seen this pattern in previous years as well. It may be that the snake-covers are good thermal refugia in which the female Red-bellied Snakes can raise their body temperatures to optimal levels for internal incubation. If so, the presence of the covers might have increased the population of Red-bellied Snakes for a period of years after their installation.

Some of the snake-covers have small mammal tunnels traveling under them and we found a mole, possibly star-nosed, under a cover-board, who briefly popped its head out. In addition, many invertebrates were found using the snake-covers. These are rarely identified to species and this is not a comprehensive list. However, in 2013 we noted ants, yellow jackets, crickets, ground beetles, cyanide millipede, spiders, Isabella moth caterpillars (woolly bears), and earthworms.

Table 6. Fall 2013 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. 4	*T. sirtalis*	320	432	#1 surface	
Sept. 4	*T. sirtalis*	180	225	#4 between	Young of Year (YOY)
Sept. 4	*T. sirtalis*	150	185	#4 surface	About to shed, YOY
Sept. 4	*T. sirtalis*	170	210	#3 surface	About to shed, YOY
Sept. 11	*T. sirtalis*	164	194	#14 just on edge	Young of Year (YOY)
Sept. 11	*T. sirtalis*	168	211	#38 between	Young of Year (YOY)
Sept. 18	*T. sirtalis*	173	216	#11 between	Young of Year (YOY)
Sept. 18	*T. sirtalis*	180	216	#39 ground	Young of Year (YOY)
Oct. 9	*T. sirtalis*	135	170	#26 between	Young of Year (YOY)

Figure 8. Average *T. sirtalis* total captures and average *T. sirtalis* adult captures per highest three counts under snake-covers 1- 40 over entire season (2002-2013).

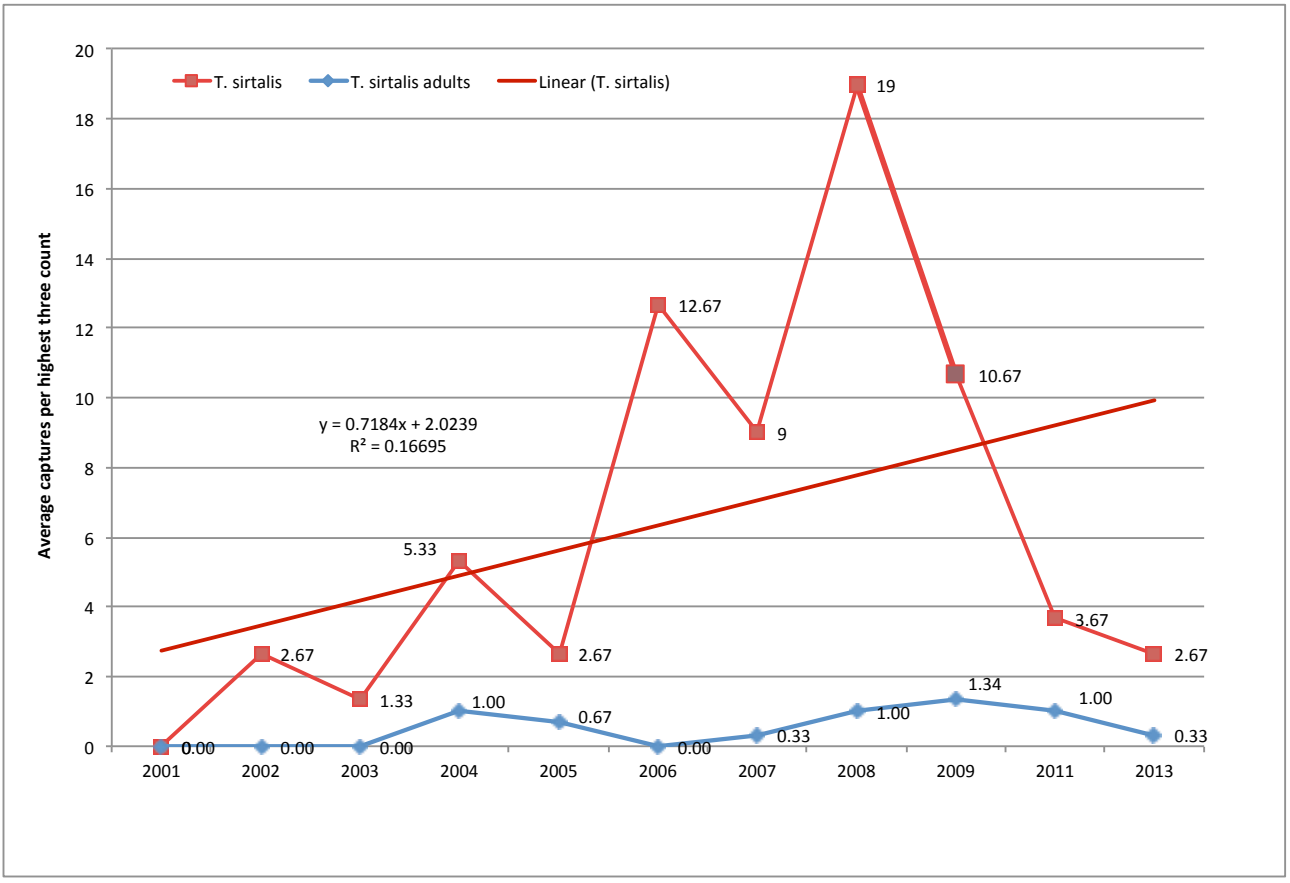


Table 7. Fall 2013 snake-cover results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for the Red-bellied Snake.

Date	Species	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Mass and Physical Info
Sept. 4	*S. occipitomaculata*	210	270	#13 between	male
Sept. 4	*S. occipitomaculata*	135	175	#45 surface	male ?
Sept. 25	*S. occipitomaculata*	80	95	#5 between	Young of Year
Oct. 2	*S. occipitomaculata*	78	101	#7 between	Young of Year
Oct. 2	*S. occipitomaculata*	80	100	#21 between	Young of Year
Oct. 15	*S. occipitomaculata*	85	110	#39 between	Young of Year
Oct. 15	*S. occipitomaculata*	170	210	#40 surface	Young of Year
Oct. 15	*S. occipitomaculata*	85	105	#40 surface	Young of Year
Oct. 15	*S. occipitomaculata*	77	103	#40 surface	Young of Year
Oct. 15	*S. occipitomaculata*	88	103	#40 surface	Young of Year
Oct. 23	*S. occipitomaculata*	85	105	#39 between	Young of Year
Oct. 23	*S. occipitomaculata*	65	85	#39 between	Young of Year

Figure 9. Average *S. occipitomaculata* total captures and average *S. occipitomaculata* adult captures per highest three counts under snake-covers 1- 40 over entire season (2001-2013).

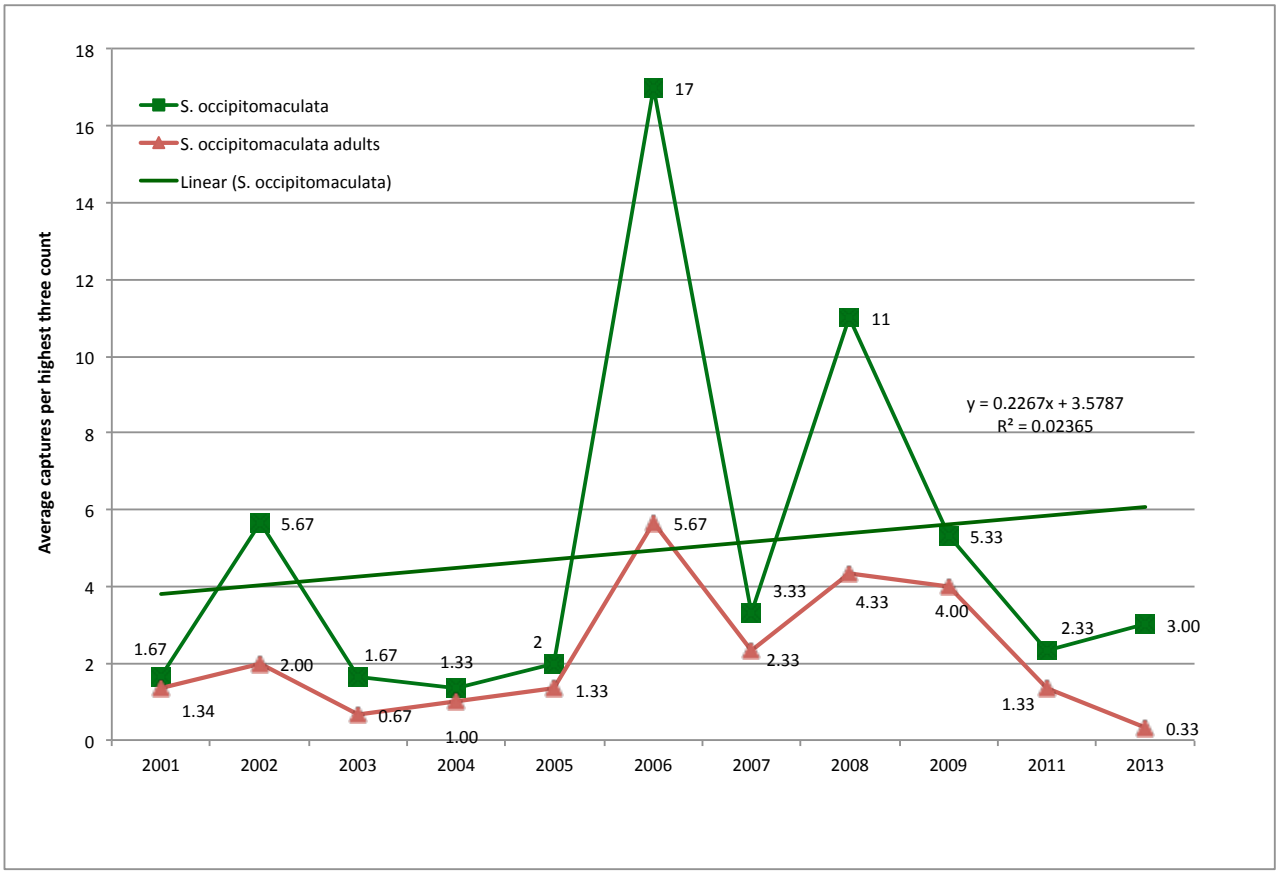


Table 8. Accidental and unidentified snakes captured during the 2013 summer and fall in and around the snake-cover from the Lester Anderson lands on the Bristol/Lincoln border in Vermont.

Date	Species	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Mass and Physical Info
July 31	*L. triangulum*	960	1095	Foundation	White Y completely enclosed, first blotch Y right, 6 Y left, 10 Y right, 15 Y left, 18 Y left, 36 Y right, 37 vent 44 Total, tip of the tail is missing
Aug. 7	*L. triangulum*			Foundation	Two snakes seen, no measurements taken
Oct. 2	*L. triangulum*	715	805	Foundation	Fiesty
July 31	*S. occipitomaculata*	230	280	#7 between	Brown, 9 embryos
July 31	*S. occipitomaculata*	230	285	#7 between	Brown, 17 embryos
July 31	*S. occipitomaculata*	210	260	#7 between	Brown, 8 embryos
July 31	*S. occipitomaculata*	230	280	#7 between	Brown, 11 embryos
July 31	*S. occipitomaculata*	245	300	#7 between	Brown, 13 embryos
July 31	*S. occipitomaculata*	190	235	#14 between	Brown, 12 embryos
July 31	*S. occipitomaculata*	253	298	#14 between	Brown, 11 embryos
July 31	*S. occipitomaculata*	200	245	#14 between	Brown, 9 embryos
July 31	*S. occipitomaculata*	140	180	#21 between	Brown, possibly 2 embryos
July 31	*S. occipitomaculata*	172	209	#21 between	Brown, 7 embryos
July 31	*S. occipitomaculata*	220	280	#21 between	Dark gray brown, about to shed
July 31	*S. occipitomaculata*	236	276	#27 between	Brown, 10 embryos
July 31	*S. occipitomaculata*	210	260	#36 between	Brown, 12 embryos
Aug. 7	*S. occipitomaculata*			#18 - 45 between specifics not noted	Red/brown
Aug. 7	*S. occipitomaculata*			#18 - 45 between specifics not noted	Brown
Aug. 7	*S. occipitomaculata*			#18 - 45 between specifics not noted	Dark grey
Sept. 4	*Unidentified*			#7 between	Shed skin

Table 8.5. Accidental and unidentified snakes captured during the 2014 summer and fall in and around the snake-cover from the Lester Anderson lands on the Bristol/Lincoln border in Vermont.

Date	Species	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Mass and Physical Info
July 8	*S. occipitomaculata*	225	275	#7 between	13 embryos
July 8	*S. occipitomaculata*	223	277	#7 between	Female, 0 embryos
July 8	*S. occipitomaculata*	250	396	#14 between	9 embryos
July 8	*T. sirtalis*	338	433	#34	Brown, 11 embryos

Cover-boards (Salamander)

The cover-boards were not monitored during the 2011 and 2013 field seasons, but were checked in 2012 and 2014. Cover-boards are checked annually for maintenance purposes. At those times, the boards are renumbered and/or replaced as needed. In addition, brush and downed trees are cleared from around the cover-boards and along the access trail. During the maintenance of the cover-boards on July 10, 2014, 158 Eastern Red-backed Salamanders and 2 Eastern Newts were found. Also on that day one Northern Dusky Salamander (*Desmognathus fuscus*) was seen under cover-board 10A. One Wood Frog an additional Eastern Newt, and an American Toad were also located in the area. During maintenance in the summer of 2013 (over 2 days) 121 Eastern Red-backed Salamanders were seen.

In 2014 the cover-boards were checked on seven dates: Sept. 3, 8, 15, 22, and 29, Oct. 6, and 13 (Table 9). This year we again 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 (the A cover-boards in 2014). This is the method we intend to stick with in the future since it produces plenty of salamanders for our purposes and saves both time and money.

The species found under the cover-boards are almost exclusively the Eastern Red-backed Salamander. However, one Eastern Newt in the red eft stage was found using the cover-boards in 2014 (#8A). A Northern Dusky Salamander was found on September 3 (#12A), and on September 15 (#11A). Northern Dusky Salamanders have been found under the cover-boards six times during the regular monitoring, and have been found four times while performing maintenance. They were found on cover-board #10 (5 times), cover-board #11 (2 times), cover-board #12 (2 times), and cover-board #16 (one time). This section of cover-boards is in a particularly wet area and that is the habitat preferred by this species. Of course, individual Northern Dusky Salamanders may have been seen and counted on repeated visits.

In 2014 the high count for numbers of Eastern Red-backed Salamanders on one day was 50 (Sept. 3) (Table 9). In 2012 the high count for numbers of Eastern Red-backed Salamanders on one day was 60 (Sept. 12), and in 2010 the high count was 63. To adjust for day-to-day variation caused by weather and seasonal differences 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 mentioned that although temperatures clearly drop as the fall progresses and these ectotherms need to descend to greater soil depths (or move to other locations) to keep from freezing, the decline in numbers under the boards begins before the decline in temperatures. Their original movement must be triggered by day length or some other factor other than temperature.

We have seen fall migrations of Eastern Red-backed Salamanders at other sites and this phenomenon was recently reported by Woolbright and Martin (2014). 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 related to salamanders moving for mating purposes 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, and in 2014 totals were higher than our high count (even when doubled) in the fall. It also would be interesting to do a count in mid-August when eggs, if in the vicinity, may have hatched. We did find four recently hatched young with an adult on September 3, 2014.

As shown in Figure 11, our index shows an increasing population of Eastern Red-backed Salamanders along the cover-board transect, although fewer were detected in 2014. 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 analysis of Eastern Red-backed Salamander numbers at our Mt. Mansfield monitoring site show that they have also been increasing 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 salamanders caught 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 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 adults using the cover-boards may exclude same-sex adults (Corey, 2002). Although we see annual variation, the average for the top three counts has shown variation since it peaked in 2006 (Figure 11), perhaps we have reached this upper limit. Corey's results also suggest that there is possible predation upon younger juveniles; therefore, the age-class data generated by the cover-boards may not be representative of those in the larger populations. 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 this portion of the Anderson Lands and also the Eastern Red-backed Salamander's general natural history, including but not limited to, size and mass information (Figure 13 and 14), and other natural history information.

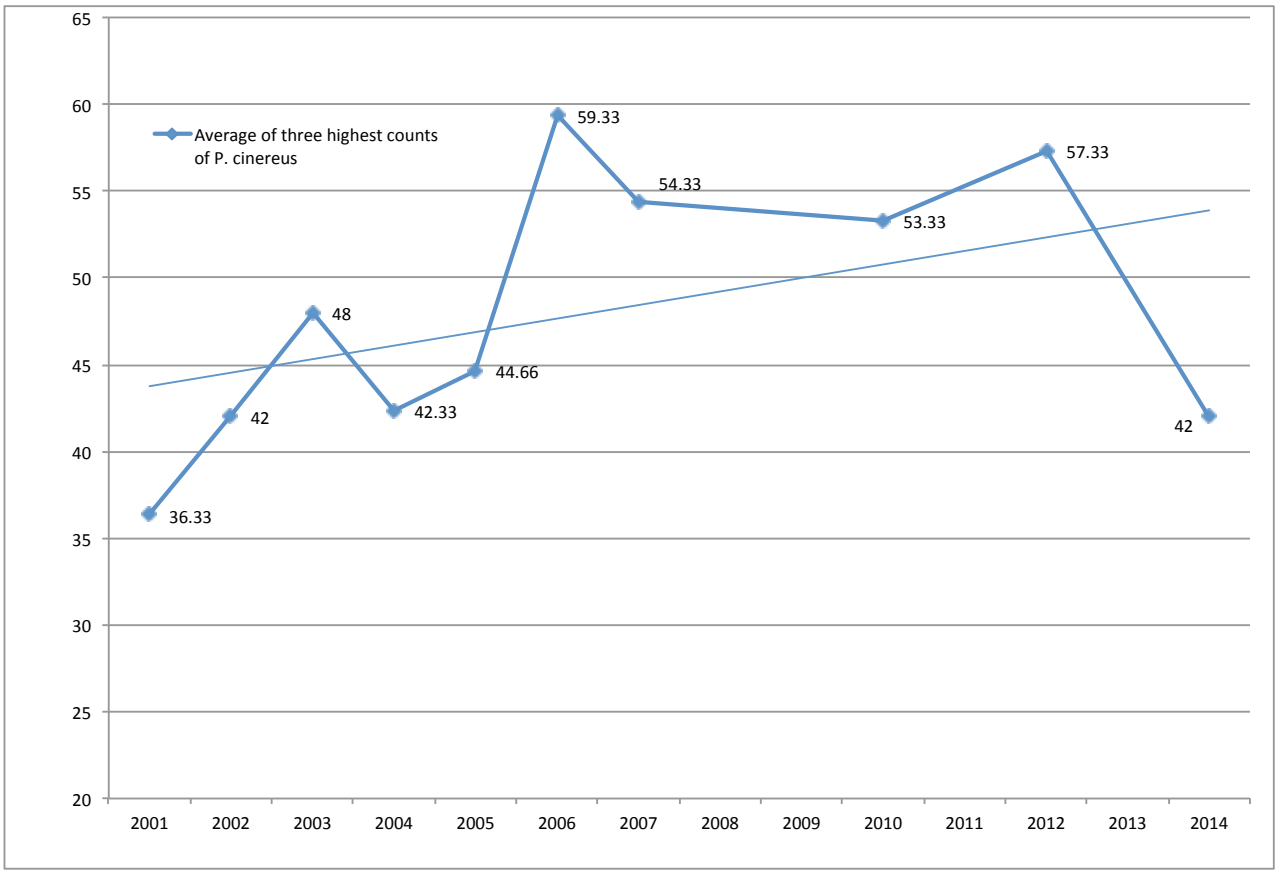
Many invertebrates were found using the cover-boards. In 2014 we noted slug and slug eggs, and heard a Barred Owl, Black-throated Blue Warbler, Blue Jay, Common Raven, Eastern Wood-Pewee, and Pileated Woodpecker.

Table 9. Fall 2014 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 A cover-boards of each pair 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. 3	6	5	21	18	0	0	50
Sept. 8	0	3	25	15	0	0	43
Sept. 15	0	8	21	11	2	0	42
Sept. 22	0	7	17	10	0	0	34
Sept. 29	0	11	15	8	0	0	34
Oct. 6	0	4	10	3	0	1	18
Oct. 13	0	9	9	2	0	0	20
Total	**6**[2]	**47**[2]	**118**[2]	**67**[2]	**2**[2]	**1**[2]	**241**[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 (2001-2014).



[1]Half of cover-boards checked (or data used), for each year. Cover-boards A in 2001, 2003, 2006, 2010, 2014. 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 (2001-2014).

	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
2014	6	16	67	44	2	0
Average/Year	**2.4**	**24.3**	**83.6**	**32.3**	**0.3**	**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, 2014. 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 (2001-2014).

	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%
2014	3.55%	49.11%	27.22%
Average/Year	**1.48%**	**74.51%**	**21.77%**

[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 (2001-2014).

Figure 13: SV lengths for all *P. cinereus* found during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2001-2014) n = 4048 captures.

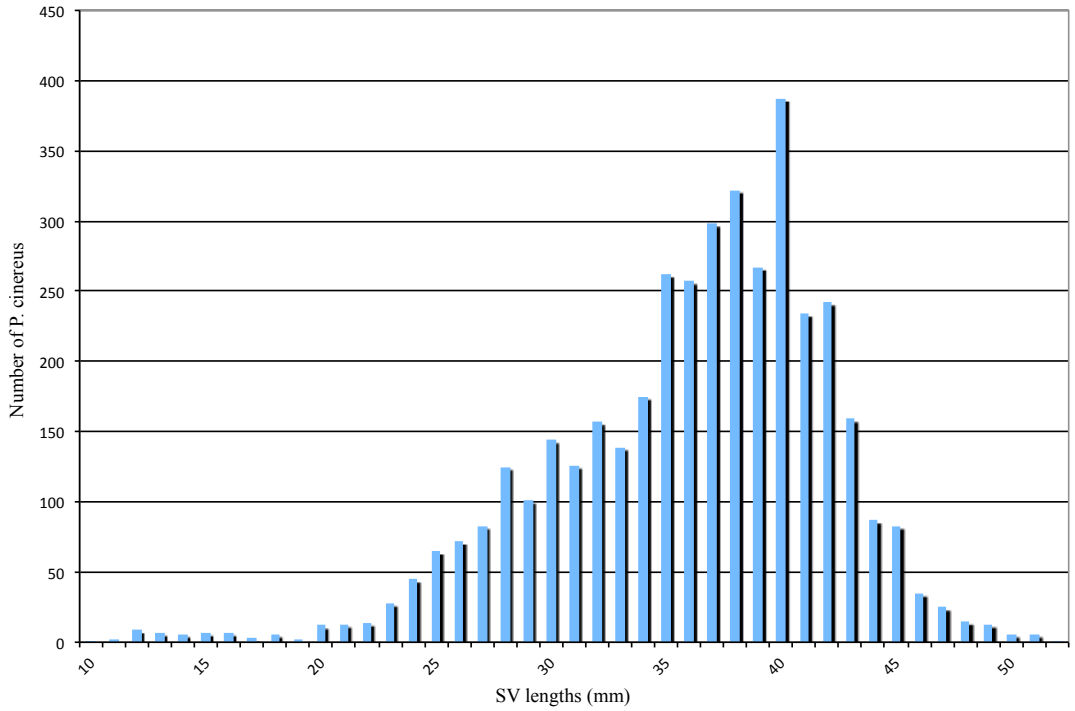
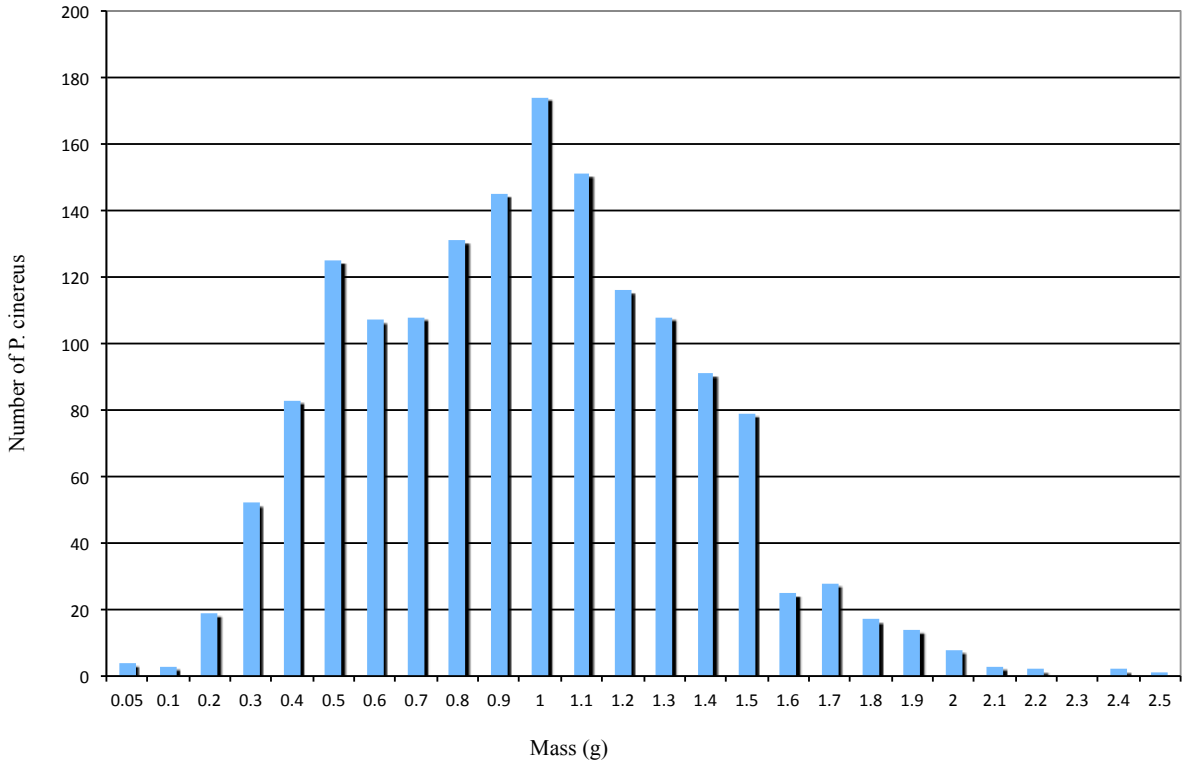


Figure 14: Mass in grams for all *P. cinereus* (for which mass was measured) found during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2006-2014) n = 1596 captures



Summary-Egg-masses

We now have thirteen years of egg-mass data (twelve for Wood Frogs); 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 reached an all-time-high this year. The longer-term population trend for this species at all monitoring ponds combined also appears to be stable or increasing

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 did not continue in 2012 or 2014. This may be due to the unusual weather circumstances. We plan to continue to track these numbers and explore the mechanics behind it.

The dates of peak egg-mass counts, first egg laying, and peak tadpoles over the course of this study (Figures 5 & 6) are occurring up to ~10 days earlier in the spring. This may well be the result of global warming but will need to be watched over the coming years.

Summary-Cover-boards

We now have enough data to be looking at any meaningful long-term trends. Long-term data indices from our cover-boards for Eastern Red-backed Salamanders suggest an increasing population; although the numbers detected in 2014 were lower than the previous four years we surveyed.

Summary-Snake-covers

We also have eleven solid years of data 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 precipitously since 2008 at our study site at Guthrie. Prior to 2008, Common Gartersnakes were increasing steadily in population while Red-bellied Snakes showed large annual variation. Neither of these two species shows a clear long-term population trend but these recent declines are dramatic. Milksnakes continue to be very rare at the transect site at Guthrie. Our snake indices are primarily influenced by young-of-the-year numbers and those numbers would be expected to vary more than the populations of breeding adults.

Future Study

We plan to continue doing egg-mass counts and checking the salamanders covers on even years and writing reports and checking snake covers on odd years. In 2015 we wrote this report during the late winter/early spring and plan to monitor the snake-covers in the fall. In 2016 we plan to monitor the egg-masses in spring and one-half the cover-boards (the Bs) in the fall. In 2017 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. However, it would also allow for more in depth reporting on each type of monitoring.

We will continue to schedule our annual maintenance day/s in late July each year and take advantage of them to check snake-covers. 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.

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

Ned Bohman, Shawn Bruso, Mandy Dow, Cindy Harwood, Adrienne Fortune, Megan Kane, Zach Maisch, Cindy Sprague, Elizabeth Mitchell Spinney, and Erin Talmage helped gather data and provide maintenance during 2013 and 2014. Erin Talmage helped prepare this report.

Appendix for:
Amphibian & Reptile Monitoring

2000-2014

on the Lester and Monique Anderson Lands

in Lincoln, Vermont

Prepared for the

Colby Hill
Ecological Project

Prepared by

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March 30, 2015

Table 1. Maximum counts of egg-masses in the Lower Fred Pierce Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2014.

Lower Fred Pierce Pond	*Ambystoma maculatum*	*Lithobates sylvaticus*	Notes
1999 count dates: 5/5, 5/18	134	1	Early masses missed.
2000 count dates: 4/17, 4/29, 5/14	122	155	Timed well, early eggs of *L. sylvaticus* nonviable.
2001 count dates: 5/1, 5/7, 5/14, 5/21	178	101	Timed well, very dry spring.
2002 count dates: 4/23, 5/1, 5/10, 5/20	270	170	Timed well, irregular spring with late snow.
2003 count dates: 4/17, 4/25, 5/3, 5/9, 5/20	260	210	Timed well, cool spring, April drier than normal.
2004 count dates: 4/9, 4/15, 4/22, 4/29, 5/6, 5/12	166	228	Timed well.
2005 count dates: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	137	365	Timed well, went slightly later than normal.
2006 count dates: 4/14, 4/20, 4/27, 5/4, 5/11, 5/25	158	454	Timed well, went slightly later than normal.
2007 count dates: 4/4, 4/18, 4/25, 5/2, 5/17, 5/23, 5/30	181	554	Timed well – spring started late but went quickly.
2008 count dates: 4/9, 4/18, 4/23, 4/30, 5/7, 5/14, 5/21	251	392	Timed well.
2010 count date: 4/2, 4/8, 4/15, 4/23, 4/30	216	237	Timed well – spring started early
2012 count date: 4/3,4/13, 4/18, 4/25, 5/2, 5/16	210	159	Two separate springs separated by a cold and dry spell.
2014 count date: 4/9, 4/16, 4/23, 4/30, 5/7, 5/14	153	278	Timed well.

Table 2. Maximum counts of egg-masses in the Upper Fred Pierce Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2014.

Upper Fred Pierce Pond	*Ambystoma maculatum*	*Lithobates sylvaticus*	Notes
1999 count dates: 5/5, 5/18	63	20	Early masses missed.
2000 count dates: 4/17, 4/29, 5/14	54	62	Timed well, early eggs of *L. sylvaticus* nonviable.
2001 count dates: 5/1, 5/7, 5/14, 5/21	72	66	Timed well, very dry spring.
2002 count dates: 4/23, 5/1, 5/10, 5/20	137	95	Timed well, cool spring, April drier than normal.
2003 count dates: 4/17, 4/25, 5/3, 5/9, 5/20	80	144	Timed well, cool spring, April drier than normal.
2004 count dates: 4/9, 4/15, 4/22, 4/29, 5/6, 5/12	92	71	Timed well.
2005 count dates: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	113	60	Timed well, went slightly later than normal.
2006 count dates: 4/14, 4/20, 4/27, 5/4, 5/11, 5/25	125	102	Timed well, went slightly later than normal.
2007 count dates: 4/4, 4/18, 4/25, 5/2, 5/17, 5/23, 5/30	115	107	Timed well – spring started late but went quickly.
2008 count dates: 4/9, 4/18, 4/23, 4/30, 5/7, 5/14, 5/21	77	63	Timed well.
2010 count date: 4/2, 4/8, 4/15, 4/23, 4/30	66	80	Timed well – spring started early
2012 count date: 4/2, 4/8, 4/15, 4/23, 4/30	52	91	Two separate springs separated by a cold and dry spell
2014 count date: 4/9, 4/16, 4/23, 4/30, 5/7, 5/14	75	114	Timed well.

Table 3. Maximum counts of egg-masses at Guthrie Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2014.

Guthrie Pond	*Ambystoma maculatum*	*Lithobates sylvaticus*	Notes
1999 count dates: 5/5, 5/18	50	5	Early masses missed.
2000 count dates: 4/17, 4/29, 5/14	138	538	Timed well, early eggs of *L. sylvaticus* nonviable.
2001 count dates: 5/1, 5/7, 5/14, 5/21	183	340	Timed well, very dry spring.
2002 count dates: 4/23, 5/1, 5/10, 5/20	121	133	Timed ok, may have missed high count for *L. sylvaticus* irregular spring late snow.
2003 count dates: 4/17, 4/25, 5/3, 5/9, 5/20	230	330	Timed well, cool spring, April drier than normal.
2004 count dates: 4/9, 4/15, 4/22, 4/29, 5/6, 5/12	96	450	Timed well.
2005 count dates: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	83	280	Timed well, went slightly later than normal.
2006 count dates: 4/14, 4/20, 4/27, 5/4, 5/11, 5/25	111	328	Timed well, went slightly later than normal.
2007 count dates: 4/4, 4/18, 4/25, 5/2, 5/17, 5/23, 5/30	118	427	Timed well – spring started late but went quickly.
2008 count dates: 4/9, 4/18, 4/23, 4/30, 5/7, 5/14, 5/21	128	221	Timed well.
2010 count date: 4/2, 4/8, 4/15, 4/23, 4/30	225	270	Timed well – spring started early
2012 count date: 4/2, 4/13, 4/18, 4/25, 5/2, 5/16	107	262	Two separate springs separated by a cold and dry spell
2014 count date: 4/9,4/16, 4/23, 4/30, 5/7, 5/14	220	625	Timed well, productive year.

Table 4. Maximum counts of egg-masses in the Wells Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2014.

Wells Pond	*Ambystoma maculatum*	*Lithobates sylvaticus*	Notes
1999 count dates: 5/5, 5/18	66	50	Early masses missed.
2000 count dates: 4/17, 4/29, 5/14	96	91	Timed well, early eggs of *L. sylvaticus* nonviable.
2001 count dates: 5/1, 5/7, 5/14, 5/21	111	80	Timed well, very dry spring.
2002 count dates: 4/23, 5/1, 5/10, 5/20	126	62	Timed well, irregular spring with late snow.
2003 count dates: 4/17, 4/25, 5/3, 5/9, 5/20	110	71	Timed well, cool spring, April drier than normal.
2004 count dates: 4/9, 4/15, 4/22, 4/29, 5/6, 5/12	110	59	Timed well.
2005 count dates: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	106	74	Timed well, went slightly later than normal.
2006 count dates: 4/14, 4/20, 4/27, 5/4, 5/11, 5/25	97	63	Timed well, went slightly later than normal.
2007 count dates: 4/4, 4/18, 4/25, 5/2, 5/17, 5/23, 5/30	120	53	Timed well – spring started late but went quickly.
2008 count dates: 4/9, 4/18, 4/23, 4/30, 5/7, 5/14, 5/21	114	36	Timed well.
2010 count date: 4/2, 4/8, 4/15, 4/23, 4/30	153	76	Timed well – spring started early.
2012 count date: 4/3, 4/13, 4/18, 4/25, 5/2, 5/16	101	61	Two separate springs separated by a cold and dry spell
2014 count date: 4/9, 4/16, 4/23, 4/30, 5/7, 5/14	126	171	Timed well. Productive year.

Table 5. Fall 2014 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 A 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
9/3/14	6	5	21	18	0	0	50
9/8/14	0	3	25	15	0	0	43
9/15/14	0	8	21	11	2	0	42
9/22/14	0	7	17	10	0	0	34
9/29/14	0	11	15	8	0	0	34
10/6/14	0	4	10	3	0	1	18
10/13/14	0	9	9	2	0	0	20
Total	**6**[2]	**47**[2]	**118**[2]	**67**[2]	**2**[2]	**1**[2]	**241**[2]

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

Table 6. Percentage of totals for each cohort of Eastern Red-backed Salamanders (*Plethodon cinereus*) found during fall 2014 cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont.

Snout to Vent Length							
Date	1-20 mm	21-30 mm	31-40 mm	41-50 mm	51-60 mm	Unk.[1]	Total[2]
9/3/14	12%	10%	42.00%	36.00%	0%	0%	100.00%
9/8/14	0%	7%	58.14%	34.88%	0%	0%	100.00%
9/15/14	0%	19%	50.00%	26.19%	5%	0%	100.00%
9/22/14	0%	21%	50.00%	29.41%	0%	0%	100.00%
9/29/14	0%	32%	44.12%	23.53%	0%	0%	100.00%
10/6/14	0%	22%	55.56%	16.67%	0%	6%	100.00%
10/13/14	0%	45%	45.00%	10.00%	0%	0%	100.00%
	0.00%	**11.76%**	**53.87%**	**33.75%**	**0%**	**0.62%**	**100.00%**

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

Table 7. Dates and Averages of the three highest counts[1] for Eastern Red-backed Salamanders (*Plethodon cinereus*) during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2001-2014).

Eastern Red-backed Salamander		
Year	Dates	Average of top three counts[1]
2001	Sept. 16. Sept. 22, Oct. 6	36.33
2002	Sept. 12, Sept. 20, Sept. 27	42.00
2003	Sept. 19, Sept. 25, Oct. 2	48.00
2004	Sept. 15, Sept. 22, Sept. 29	42.33
2005	Sept. 7, Sept. 14, Sept. 28	44.66
2006	Sept. 5, Sept. 12, Sept. 26	59.33
2007	Sept. 5, Sept. 12, Sept. 19	54.33
2010	Sept. 3, Sept. 10, Sept. 17	53.33
2012	Sept. 12, Sept 19, Sept. 26	57.33
2014	Sept. 3, Sept 8, Sept. 15	42

[1]Half of cover-boards checked (or data used), for each year. Cover boards A in 2001, 2003, 2006, 2010, 2014. Cover boards B in 2002, 2005, 2007, 2012, and odd numbered cover-boards in 2004.

Figure 1: Percentage of totals for each cohort of Eastern Red-backed Salamanders (*Plethodon cinereus*) found during three highest count days during cover-board monitoring on the Lester Anderson lands on Bristol/Lincoln border in VT (2001-2014).

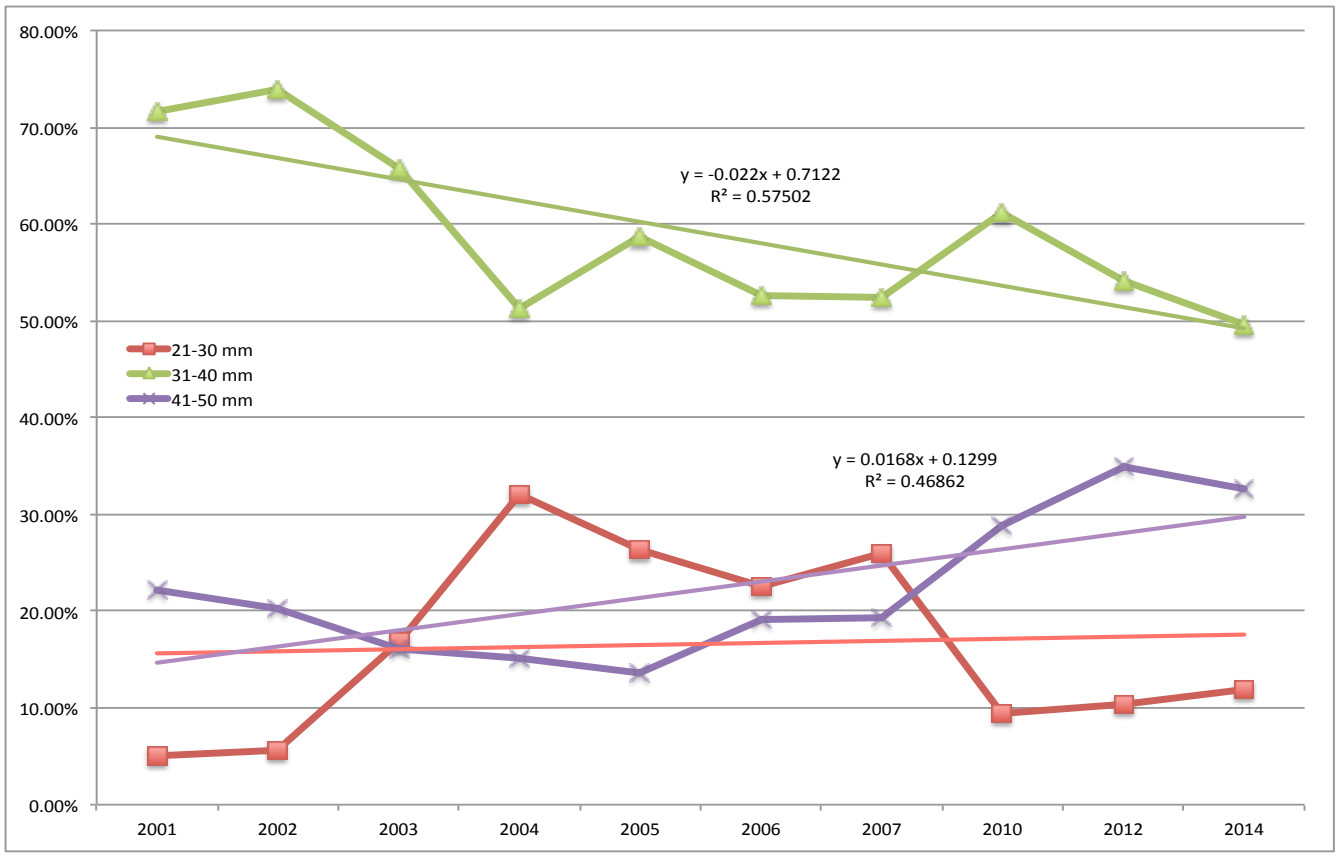

Figure 2: Raw numbers for each cohort of Eastern Red-backed Salamanders (*Plethodon cinereus*) found during top three count days during cover-board monitoring on the Lester Anderson lands on Bristol/Lincoln border in VT (2001-2014).

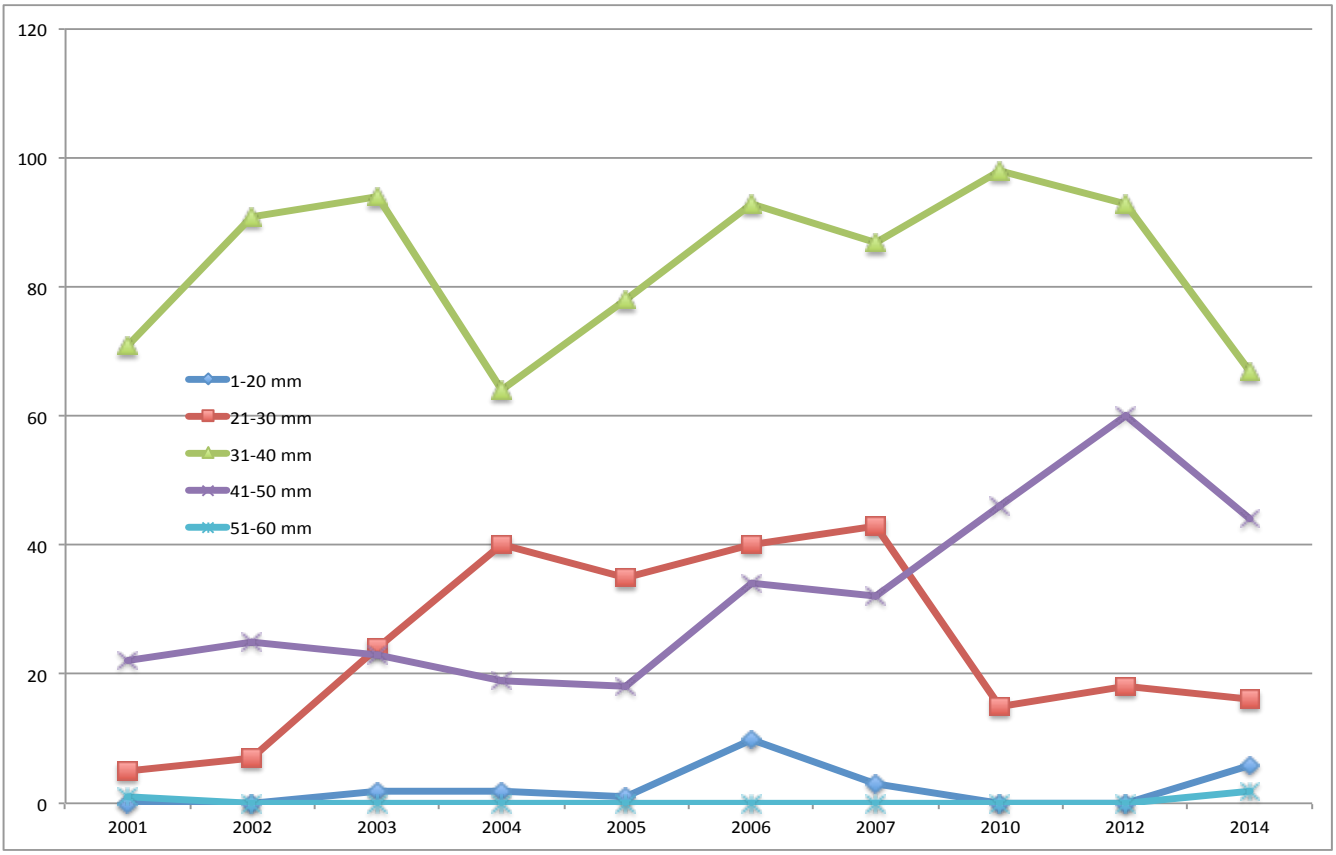

Figure 8: Average number of snakes per capture during top 3 most productive snake-cover days from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for all Common Gartersnakes (*T. sirtalis*), Red-bellied Snakes (*S. occipitomaculata*), and Milksnakes (*L. triangulum*) (2001-2014). Some snakes may have been caught on more than one occasion.

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2011	2013
S. occipitomaculata	1.67	5.67	1.67	1.33	2	17	3.33	11	5.33	2.33	3.00
T. sirtalis	0	2.67	1.33	5.33	2.67	12.67	9	19	10.67	3.67	2.67
L. triangulum	0	1	1	2.67	0.67	0	0	0.33	0	0.33	0.00

Figure 9: Average number of Young of Year snakes per capture of during top 3 most productive snake-cover days from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for all Common Gartersnakes (*T. sirtalis*), Red-bellied Snakes (*S. occipitomaculata*), and Milksnakes (*L. triangulum*) (2001-2014). Maximum snout-to-vent lengths for snakes to be considered young-of-the-year were: *T. sirtalis* (215 mm), *S. occipitomaculata* (120 mm), and *L. triangulum* (190 mm). Some snakes may have been caught on more than one occasion.

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2011	2013
S. occipitomaculata Young of Year	0.33	3.67	1	0.33	0.67	11.33	1	6.67	1.33	1	2.67
T. sirtalis Young of Year	0	2.67	1.33	4.33	2	12.67	8.67	18	9.33	2.67	2.33
L. triangulum Young of Year	0	0.33	0.33	0	0	0	0	0	0	0	0

Figure 10: Average number of adult snakes per capture of during top 3 most productive snake-cover days from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for all Common Gartersnakes (*T. sirtalis*), Red-bellied Snakes (*S. occipitomaculata*), and Milksnakes (*L. triangulum*) (2001-2014). Some snakes may have been caught on more than one occasion.

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2011	2013
S. occipitomaculata adults	1.34	2.00	0.67	1.00	1.33	5.67	2.33	4.33	4.00	1.33	0.33
T. sirtalis adults	0.00	0.00	0.00	1.00	0.67	0.00	0.33	1.00	1.34	1.00	0.33
L. triangulum adults	0.00	0.67	0.67	2.67	0.67	0.00	0.00	0.33	0.00	0.33	0.00