Amphibian & Reptile Monitoring

During the 2009 and 2010 Field Season

on the Lester and Monique Anderson Lands

in Lincoln, Vermont

Prepared for the

Colby Hill
Ecological Project

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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 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 this update was written. In 2011 we plan to monitor only the snake covers to keep them on an alternating-year-schedule. In 2012 we plan to monitor egg-masses and salamander cover-boards. There will be no report written for the 2011 or 2012 field years. The next report is anticipated after checking the snake covers again during the 2013 field season. This alternation between amphibian monitoring and snake monitoring with a report is expected to continue indefinitely as a cost-trimming measure; however, a day of maintenance will be needed every year to replace rotten and broken covers and trim vegetation. Less frequent reports could be another cost-cutting measure that would not require the loss of any data.

Methods

Egg-mass counts

Egg-mass counts take place at four ponds that I refer to using the name of the parcels on which they are found: 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 next egg-mass counts are planned for the spring of 2012.

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 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 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), substrate (between board and ground), crack (in the space between the boards) and adjacent (along side the cover-boards).

These counts are scheduled for every other year. Data from the salamander cover-boards were collected in 2010 and are currently scheduled to be collected again in 2012. In 2010 data were only collected from the ½ the condos (the A of each pair) to save time and money. Numbers will be doubled in order to make comparisons to other years. Our plan is to continue the pattern of monitoring only ½ the covers every-other year, monitoring alternating covers each year (A versus B).

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 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 distance from the stonewall has an impact on the use of individual artificial covers. Data from the new covers (41-45) are not be 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 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 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).

Our plan is to monitor snake covers during the 2011 field season and every-other year from then on. On 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. However, since we are writing this report during a year when both types of amphibian monitoring are taking place, we do not plan to summarize our findings in a report until after the 2013 season. This will bring the snake monitoring and report writing back into phase.

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 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 pregnant Gartersnake run over on August 8th. Ten babies (also run over) were counted around 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 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

Egg-mass counts

In 2010 egg-mass counts were performed on five dates (April 2, April 8, April 15, April 23, and April 30) at the four ponds that were selected for monitoring in 1999. All four ponds are man-made with well-defined shorelines and within easy migration distance of hardwoods. Since all of these ponds are permanent or semi-permanent they usually hold some water even through dry years.

The results of this year's counts are shown in Tables 1-4. The 2009-2010 winter was generally warmer than average and warmed up quickly. Spring came earlier with amphibian movement, first-egg-mass occurrence, and egg mass high counts all taking place earlier than previous years. Amphibian movement occurred in the Champlain lowlands in mid-March and there was some movement at higher elevations (Huntington, VT) on March 30th and 31st. Because of this early movement we checked the ponds on

April 2nd, a week or two prior to our 'normal' start date as compared to previous years. On April 2nd we saw and heard adult Wood Frogs. We saw no egg masses at the first pond (Guthrie) that we checked at 9:00 AM, one very fresh egg mass at the second pond (Wells) that we checked at 9:30 AM, and seven at the third pond (10:00 AM), also very fresh. We found 28 fresh masses at Lower Fred Pierce, checked at approximately 10:20 AM. It is likely had we gone back to Guthrie that same morning we would have found freshly laid masses. Wood Frog tadpoles were seen by April 23, with egg-masses at Wells appearing to having the slowest development time. High counts for Wood Frog-egg masses occurred on April 8th for all four ponds. After this early spring, a late-season snowstorm came through and dropped a foot of snow on the area on April 27th. Although our study doesn't document tadpole or salamander larvae numbers or survival, some may have been affected by the formation of ice on the ponds.

The 2010 dates of high counts and first tadpoles for Wood Frogs were considerably earlier than previous years. 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. High counts for Wood Frog egg masses first occurred on April 18 at Upper Fred Pierce, on April 23 at Lower Fred Pierce and Wells, and on April 30th at Guthrie. In 2006, high counts were spread out between April 14 and April 27 and in 2007 they all occurred on April 25th.

Spotted Salamander

In 2010 the first adults, and/or spermatophore and egg masses were seen on April 8th. Egg masses were seen at all ponds on that date (Tables 1-4). High counts occurred on April 23 for all ponds, except Wells whose high count was April 30 (Figure 3a). In 2008 the first adults and egg masses were seen on April 18th. High-count dates for egg masses at all ponds occurred in May 7. In 2007 high-count dates were spread from May 2 to May 30th.

At Guthrie the number of Spotted Salamander egg-masses continues to increase for the fifth count-year in a row, with 225 egg masses found in 2010, just 5 shy of the record number found in 2003. At Lower Fred Pierce the number of egg masses increased for four years and then dropped slightly from 251 (2008) to 216 in 2010. At Upper Fred Pierce the numbers of egg-masses declined from the previous count, as only 66 masses were seen. There were a record number of Spotted Salamander egg masses seen at Wells in 2010, where 153 masses were counted. All of these results are shown in Tables (5-8). The combined high count for all ponds was above average (Table 9).

Annual variation in these numbers is to be expected, and can be seen in Tables 5-8 and Figures 1a and 1b. Although there is year-to-year variation, it is not consistent from pond to pond (see Figure 1a). In Table 9 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, although no counts were done in 2009. Since the 2005 low was not as low as the 1999 starting point, the trend lines show a continuing increase. This is also the case with each pond plotted separately (Figure 1b). We will be interested in continuing to see how the numbers cycle on a regular multi-year pattern (Figure 2C).

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 presently. 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. 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 (Figure 3a).

Wood Frogs

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 was even lower with only 663 masses counted, 108 below average, (Table 9 and Figure 2a). The third-lowest total found in our ten years of Wood Frog data. At the same time, the numbers were up from 2008 in all three ponds and fell in one (Lower Fred Pierce). As we have seen in the past, numbers of breeding females could rebound in a matter of just a couple years. As was the case with the Spotted Salamanders, the greatest numbers of Wood Frog egg-masses this year were found in Guthrie (Figure 3b).

Trend lines for breeding female Wood Frogs show an upward trend for Lower Fred Pierce, a slightly declining trend for Guthrie, and virtually flat lines for Upper Fred Pierce and Wells (see Figure 2b).

Figure 2c shows the relative numbers of Wood Frogs and Spotted Salamanders at all three ponds combined over ten years of count data. This graph shows a very interesting negative correlation between Wood Frog and Spotted Salamander numbers at Colby Hill overall. What the mechanics of such a potential relationship are is 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; however, 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. Data from future years will show if this relationship holds true, and may reveal additional clues to the mechanisms that drive it.

Figure 4 shows the relative onset and peaks of egg-laying activity in both monitored species at all ponds combined since 2000. This figure clearly shows the peak of Wood Frog egg deposition is close to a full month prior to the peak in Spotted Salamanders. By the time Spotted Salamander egg masses reach their high numbers in mid-May, Wood Frog masses have all hatched and disintegrated. This is a useful figure for comparing breeding times and peaks for these two species at any location. This delay in the hatching of Spotted Salamander eggs may give the Wood Frog tadpoles time to reach a size that is too large for the salamander larvae to eat. In addition to species-specific differences, the timing of breeding also depends on elevation, aspect, spring temperatures, rainfall, and the amount of snow accumulated.

We now have eleven years of useful data from the ponds for Spotted Salamanders and ten years for Wood Frogs (counts during the first year started too late for Wood Frogs). This gives us a very solid baseline for future comparisons. Starting in 2009, we moved to an every-other year schedule of egg-mass monitoring.

Numerous birds were seen or heard in the vicinity of the ponds during the egg-mass counts including; American Crow, American Robin, Black-capped Chickadee, Blue Jay, Brown Creeper, Eastern Phoebe, Evening Grosbeak, Northern Cardinal, Red-winged Blackbird, Song Sparrow, Turkey Vulture, Yellow-bellied Sapsucker, and Yellow-rumped Warbler. Although we occasionally wrote down bird species we saw or heard, this in no way constitutes a complete list of the birds on the property.

Predaceous diving beetles (dytiscids) and large leeches (macrobdellans) were noted in Guthrie, and Water boatman were recorded at Upper Fred Pierce. We again noted that the marsh marigolds were beginning to bloom on April 30th at Upper Fred Pierce, but in 2010 we also remarked that they were covered with snow.

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.

An **American Bullfrog** (*Lithobates catesbeianus*) was seen at Wells on May 14, 2008. This large lowland predator had not been seen previously anywhere in Lincoln or in the nearby mountain towns of Fayston, Ripton, or Warren. It has been reported however, from Buel's Gore in 2004 and 2006 and may have originated from that direction. We did not see or hear any bullfrogs in 2010, but because of the early spring we were not surveying in May.

Snake-covers

In 2009 snake-covers were checked 9 times at weekly intervals starting on Sept. 2 with subsequent checks on Sept. 9, 16, 23, and 30, Oct. 7, 14, 21, and 28, (Tables 10 and 11). An additional check comparing afternoon results to morning results took place on Oct. 26 but those data are not included in the year-to year comparisons. 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. Therefore, the index that we are using in Table 12 is simply, for each species using the covers, the average number of snakes seen in the three highest counts. In 2009 Common Gartersnakes had an index of 10, the third highest since the study's inception. Using the above calculation, Red-bellied Snakes had an index of 5, the fourth highest since the study's inception. Anecdotally, we tend to see the high counts for Red-bellied Snakes later in the fall, late September and October. Milksnakes have not been captured under the snake covers for the last four count-years during the regular season. No new species were observed.

We check our snake-covers in the fall so that we will be able to include the young of the year in our data. It appears this was again a productive year for both Gartersnakes and Red-bellied Snakes (Table 13). Ninety-three percent of the Common Gartersnake captures were neonates. Twenty-three percent of the Red-bellied Snake captures were neonates. It appears that Milksnakes, both adults and young have declined steadily at Guthrie since 2001. The reasons for this remain unclear. The amount or quality of egg-laying substrate (hay, compost, exposed rock) may have 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. Checking covers annually during a late July maintenance visit might help us determine if they are still in the Guthrie area and if so, if they are successfully reproducing.

Eight Red-bellied snakes and 12 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. Milksnakes lay eggs. Those species that give live birth need to keep their body temperatures at optimal levels while carrying their young. As a result, the young will develop faster. 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. 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.

In 2007 we examined individual cover use for the first time. Certain snake-covers seemed to attract more snakes than others. For example, combined results for all years showed that numerous snakes have been measured at covers 20, 21, 22, and 25, while very few snakes had been seen under covers 19, 23 and 24 (Figure 7). At the same time, very few snakes have been found under covers 30-35 while covers 35-39 were often used and cover 40 is the second most-used snake-cover (Figure 7). Factors that may influence artificial cover usage could include relative distances to forested rocky areas (natural cover), distances to

birthing or prime feeding sites, the hedgerow and stonewall (natural cover), the road (potential mortality) or combinations of these features. Another possibility is that frequent usage is the result of higher temperatures at some covers. The steadily increasing number of snakes from cover 35 to the location of the hedge and stone wall at cover 40 (Figure 7) strongly suggests that proximity to the natural cover of the stone wall is a factor. We suspected that that might be the case and placed covers 41 through 45 in 2008 to check our hypothesis. It will take a few more years of data from the new covers to see if our hunch is correct.

Some of the snake covers have small mammal tunnels traveling under them. In addition, many invertebrates were found using the snake-covers. These were rarely identified to species and this is not a comprehensive list. However, in 2009 we noted ants, camel crickets, crickets, ground beetles, rove beetles, wolf spiders, millipedes, Isabella moth caterpillars (woolly bears), earthworms, and snails.

Cover-boards

The cover-boards were not monitored during the 2008 or 2009 field seasons, but were checked in 2010. Cover-boards were checked for maintenance purposes on September 2, 2009 and July 8, 2010 and renumbered 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 2010, 97 Eastern Red-backed Salamanders and 2 Dusky Salamanders were found. One Wood Frog was also located along the transects.

In 2010 the cover-boards were checked on seven dates: Sept. 3, 10, 17, and 24, Oct. 1, 8, and 15 (Table 15 and 16). This year we stopped the counts in the fall once we determined the number of salamanders seen each week was decreasing. Also, as a cost saving method we only counted salamanders under one of each pair of cover-boards (A cover-boards). Final numbers were then doubled for multi-year comparisons.

The species found under the cover-boards are almost exclusively the Eastern Red-backed Salamander. However, Eastern Newts in the Red Eft stage have been found in other years using the cover-boards. This year one Red Eft was found (9/17) as we walked along the trail. One Northern Two-lined Salamander (*Eurycea bislineata*) was found under a cover-board in 2010. At least one was also found in 2004, 2005, and 2006. This year we also found one Spotted Salamander under a cover-board. The Spotted Salamander was a juvenile; it was found Oct. 8 and measured 22 mm SVL and 45 mm TBL.

In 2010 the high count for numbers of Eastern Red-backed Salamanders on one day was 63 (Sept 10, Table 15). To compare with other years this number was doubled, as we only checked half of the cover-boards. In 2007 the high count was 164 on Sept. 5, in 2006 the high count of 123 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 Table 17 and Figure 5. The high counts are often the first three counts in September, but occasionally included a count taken in October.

With the exception of 2001, 2004, and 2010 the highest count has always been the first count in the fall. 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.

We have seen fall migrations of Red-backed Salamanders at other sites. It appears this movement reflects the leaving of wetter substrates for up slope over wintering locations that are better drained. This seasonal migration may have something to do with our annual fall declines under the cover boards. Another possible explanation for declining numbers through the fall may be the result of the fact that 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 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). In 2010 we did not find any juveniles.

The increasing numbers of Red-backed Salamanders found under the cover-boards over the last few count-years seem to reflect improving conditions for this species in the monitoring area. Whether this is due to local management, other local factors, or is part of a larger regional trend due to weather or other conditions is not known. Eastern Red-backed numbers at our Mt. Mansfield monitoring site 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 they quickly reverse themselves.

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 5 and 6, and Tables 16 and 18). 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). As we are still seeing annual variation, and the overall trend is positive we not have yet 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 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. 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.

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

Summary

We now have eleven years of **egg-mass** data (ten for Wood Frogs); consequently we are able to look at longer-term trends. Numbers of breeding female **Spotted Salamanders** are stable or increasing at all ponds. This year's combined total of 660 was the second highest number of egg masses seen since the study's inception. **Wood Frog** egg-mass numbers dropped from 2008 at all four ponds.

The apparent negative correlation between Spotted Salamander egg-mass numbers and Wood Frog egg-mass numbers was new to us when we first reported this in our 2008 report, it was new to science, and unexplained at this time, yet seems to be continuing. We will be watching it in the future, to see if it holds true and to look for clues to the mechanics behind it.

The beautiful relationship clearly shown between the breeding periods of Wood Frogs and Spotted Salamanders was expected but is rewarding to still see it in Figure 4. The relative numbers of egg-masses, the timing of peak egg laying, and the relative persistence of the egg-masses can all be seen in this figure.

Cover-boards for Red-backed Salamanders show a continued healthy population. Although the high count was lower in 2010 than in 2007, it was still the second highest since the study's inception.

We now have nine solid years of data from the **snake-covers** and we have examined population trends for the first time in Table 12. Milksnakes have virtually disappeared from the transect site at Guthrie. 2009 was the fourth year in a row that we did not capture any Milksnakes during the regular cover checks. In addition, we have not seen any young of the year during our regular checks since 2003.

Regarding preferences in cover-board usage some of the covers not used previously have now been used. However, the possible influence of the stonewall and hedgerow (increasing usage) seems clearer than ever. In 2008 we placed five pairs of additional covers on the opposite side of the hedgerow (north) to help us examine this influence. We hope to put some more thought into why this might be and measure some variables between productive and non-productive covers.

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.

Future Study

In our 2008 report we proposed doing egg mass counts, and checking the snake-covers and salamanders covers every other year. We also proposed preparing a complete written report every other year on the year when we monitored snakes only. This would serve to even out the annual effort and resulting cost. We deviated from this plan but are working toward returning to it.

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 missing Milksnakes. Data on gravid females are otherwise not available during fall checks. In 2011 we plan to monitor only the snake covers. In 2012 we plan to monitor the egg-masses in spring and one-half the cover-boards (the Bs) in the fall. In 2013 we plan to monitor the snake covers again as well as write a report. After 2013, we might want to consider putting written reports on an every-fourth-year (during a snake-cover year) schedule rather than every other year as an additional cost saving measure, we would continue to compile the data for Tables 1-9, 12, 13, 17, and 18 and Figure 2c and Figure 5 every-other year.

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Table 1. Spring 2010 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 2	0	28 Eggs very fresh – just a few hours old. Forty five adults also seen	Early spring thaw, movement in Valley in mid-March (early by two weeks. Small amount of movement in Huntington, VT March 30th and 31st. Visibility excellent.
April 8	3 Lots of spermatophores seen.	237 Some on the top of the big clump may have been frozen	Sunny and warm (70's F) yesterday morning followed by rain, and clouds in late afternoon, with a warm rainy night. Visibility good to excellent, sun has come out.
April 15	188	237 No new masses	Last few days have been sunny with cold dry nights. Good visibility.
April 23	216 Two masses were opaque,	0 Almost all eggs have hatched, just remnant eggs see ~5,000 tadpoles.	Visibility excellent. ET wore polarizing glasses.
April 30	203 Three egg-masses were opaque, twelve had white eggs.	0 All egg-masses have hatched, only white eggs in remnants remain. Only about 1000 tadpoles seen.	Snowstorm with more than a foot of snow came through on Tuesday and Wednesday (4/27 and 4/28), yesterday was in 40's F, today warmer. Visibility excellent.

Table 2. Spring 2010 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 2	0	7 All very fresh, 1-2 hours, at least 12 adults seen.	Early spring thaw, movement in Valley in mid-March (early by two weeks. Small amount of movement in Huntington, VT March 30th and 31st. Visibility good to excellent. Pond is silty.
April 8	3 One adult seen and 7 clumps of spermatophores	80	Sunny and warm (70's F) yesterday morning followed by rain, and clouds in late afternoon, with a warm rainy night. Visibility poor – very silty. ET wore polarizing glasses.
April 15	62 No Spermatophores seen.	80 No new masses.	Last few days have been sunny with cold dry nights. Good visibility
April 23	66 Some very fresh.	0 Remnants, about 500 tadpoles seen.	Visibility excellent. ET wore polarizing glasses.
April 30	60 One had white eggs.	0 About 10 tadpoles seen.	Snowstorm with more than a foot of snow came through on Tues and Wednesday (4/27 and 4/28), yesterday was in 40's F, today warmer. Visibility excellent. Marsh Marigold in bloom and partially covered with snow.

Table 3. Spring 2010 egg-mass data from Guthrie Pond on Lester Anderson lands in Lincoln, Vermont.

Date	*Ambystoma maculatum* egg-masses	*Lithobates sylvaticus* egg-masses	**Notes**
April 2	0	0 Heard an adult calling as we approached, saw more than 15 adults.	Early spring thaw, movement in Valley in mid-March (early by two weeks. Small amount of movement in Huntington, VT March 30th and 31st. Visibility excellent, 3-5 inches of water over big rock, water relatively high.
April 8	2 Six adults seen. Lots of scattered clumps seen scattered and continuous along edge. There were more spermatophores seen than we can remember from previous visits.	270 Eight were slightly older, but most seem like they were laid last night, older ones look like they didn't turn, they might be dead.	Sunny and warm (70's F) yesterday morning followed by rain, and clouds in late afternoon, with a warm rainy night. Visibility good no rain or wind, ET wore polarizing glasses.
April 15	138 No spermatophores seen.	270 No new masses.	Last few days have been sunny with cold dry nights. Visibility excellent.
April 23	225 Four masses were very fresh. Thirty-three masses had a high percentage of white eggs.	0 Just remnants seen, about 21,000 tadpoles seen.	Visibility excellent. ET wore polarizing glasses.
April 30	146 Twenty masses had a high percentage of white eggs.	0 Can see some tadpoles in shallow water, not as clustered or as active as last week, ~5,000.	Snowstorm with more than a foot of snow came through on Tues and Wednesday (4/27 and 4/28), yesterday was in 40's F, today warmer. Visibility good, some high clouds, high rock completely covered. About 4 inches of snow around pond.

Table 4. Spring 2010 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 2	0	1 Very fresh, four adults seen in amplexus, more than 10 adults seen.	Early spring thaw, movement in Valley in mid-March (early by two weeks. Small amount of movement in Huntington, VT March 30th and 31st. Visibility excellent.
April 8	1 Two clumps of spermatophore seen.	76 Snail seen on one egg mass, three are older and one is very fresh (laid this morning?). Adults seen.	Sunny and warm (70's F) yesterday morning followed by rain, and clouds in late afternoon, with a warm rainy night. Visibility good to excellent; can see to bottom. ET wore polarizing glasses.
April 15	95 On egg-mass was nonviable and two were opaque.	76 No new masses.	Last few days have been sunny with cold dry nights. Visibility excellent.
April 23	119	0 Most egg masses have hatched (a little behind Guthrie, tadpoles still on or in the masses and the masses more clumped. About 3,000 tadpoles.	Visibility ok, breezy, sun behind clouds. ET wore polarizing glasses.
April 30	153 Thirteen egg-masses very fresh, two opaque, one had nonviable eggs.	0 Some still on the remnant egg masses and on grass under water, about 1,700 tadpoles.	Snowstorm with more than a foot of snow came through on Tues and Wednesday (4/27 and 4/28), yesterday was in 40's F, today warmer. Visibility good to excellent. Sunny yet slightly breezy, 2-3 inches of snow around pond.

Table 5. Maximum counts of egg-masses in the Lower Fred Pierce Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2010.

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

Table 6. Maximum counts of egg-masses in the Upper Fred Pierce Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2010.

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

Table 7. Maximum counts of egg-masses at Guthrie Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2008.

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

Table 8. Maximum counts of egg-masses in the Wells Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2010.

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.

Table 9: 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 (total egg masses)	*Ambystoma maculatum* (combined)	*Ambystoma maculatum* (average)	*Lithobates sylvaticus* (combined)	*Lithobates sylvaticus* (average)
1999 count dates: 5/5, 5/18	313	78.3	Early masses missed	Early masses missed
2000 count dates: 4/17, 4/29, 5/14	410	102.5	846	211.5
2001 count dates: 5/1, 5/7, 5/14, 5/21	544	136.0	587	146.8
2002 count dates: 4/23, 5/1, 5/10, 5/20	654	163.5	460	115.0
2003 count dates: 4/17, 4/25, 5/3, 5/9, 5/20	680	170.0	755	188.8
2004 count dates: 4/9, 4/15, 4/22, 4/29, 5/6, 5/12	464	116.0	808	202.0
2005 count dates: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	439	109.8	779	194.8
2006 count dates: 4/14, 4/20, 4/25, 5/4, 5/11, 5/25	491	122.8	947	236.8
2007 count dates: 4/4, 4/18, 4/25, 5/2, 5/17, 5/23, 5/30	534	133.5	1141	285.3
2008 count dates: 4/9, 4/18, 4/23, 4/30, 5/7, 5/14, 5/21	570	142.5	723	180.8
2010 count date: 4/2, 4/8, 4/15, 4/23, 4/30	660	165	663	165.8
Average for all years	524	130.9	771	192.7

Table 10. Fall 2009 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 ninth year of results. In 2009, 21 Red-bellied Snakes and 39 Common Gartersnakes (*T. sirtalis*) were captured.

Date	*Species*	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Physical Info
Sept. 2	*T. sirtalis*			#37 between	Shed skin - scraped off
Sept. 2	*T. sirtalis*	120	153	#38 between	Shed skin - scraped off
Sept. 2	*T. sirtalis*	145	187	#11 between	Could see "belly button"
Sept. 2	*T. sirtalis*	150	197	#17 between	
Sept. 9	*T. sirtalis*			next to #44	Shed skin
Sept. 9	*T. sirtalis*	140	170	#24 surface	
Sept. 9	*T. sirtalis*	140	180	#21 surface	
Sept. 9	*T. sirtalis*	140	180	#28 surface	
Sept. 9	Unidentified snake	140	180	#28 surface	
Sept. 9	*T. sirtalis*	142	187	#35 surface	
Sept. 9	*T. sirtalis*	150	193	#25 surface	
Sept. 9	*T. sirtalis*	155	195	#25 surface	
Sept. 9	*T. sirtalis*	158	198	#28 surface	
Sept. 9	*T. sirtalis*	155	200	#25 surface	
Sept. 9	*T. sirtalis*	165	200	#25 surface	
Sept. 9	*T. sirtalis*	160	200	#35 surface	
Sept. 9	*T. sirtalis*	165	210	#6 surface	
Sept. 9	*T. sirtalis*	250	307	#25 surface	
Sept. 9	*T. sirtalis*	320	415	#3 between	
Sept. 16	*T. sirtalis*	130	168	#25 surface	
Sept. 16	*T. sirtalis*	140	168	#25 surface	
Sept. 16	*T. sirtalis*	140	170	#25 surface	
Sept. 16	*T. sirtalis*	135	180	#37 between	
Sept. 16	Unidentified snake	145	185	#3 between	
Sept. 16	*T. sirtalis*	140	185	#25 surface	
Sept. 16	*T. sirtalis*	150	190	#21 surface	
Sept. 16	*T. sirtalis*	150	193	#28 surface	
Sept. 16	*T. sirtalis*	155	200	#25 surface	
Sept. 16	*T. sirtalis*	160	205	#35 surface	
Sept. 16	*T. sirtalis*	170	220	#35 surface	
Sept. 16	*T. sirtalis*	235	285	#25 surface	
Sept. 23	*T. sirtalis*	135	160	#21 surface	
Sept. 23	*T. sirtalis*	155	200	#21 surface	
Sept. 23	*T. sirtalis*	155	202	#27 surface	Stress caused regurgitation of partially digested worm - 90 mm of worm still there. Male - based on hemipene
Sept. 30	*T. sirtalis*	135	180	#25 surface	
Sept. 30	*T. sirtalis*	170	220	#30 between	
Sept. 30	*T. sirtalis*	185	233	#25 surface	
Oct. 14	*T. sirtalis*	136	170	#20 surface	
Oct. 14	*T. sirtalis*	153	196	#25 surface	
Oct. 21	*T. sirtalis*	150	194	#21 surface	
Oct. 21	*T. sirtalis*	150	194	#21 surface	
Oct. 21	*T. sirtalis*	160	203	#21 surface	
Oct. 21	*T. sirtalis*	170	214	#19 surface	
Oct. 21	*T. sirtalis*	173	288	#43 between	
Sept. 9	Unidentified snake			#37 between	Shed skin - scraped off
Sept. 9	Unidentified snake			#7	Shed skin - scraped off

Table 11. Fall 2009 snake-cover results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for the Red-bellied Snake (*S. occipitomaculata*). This is the ninth year of results. In 2009, 21 Red-bellied Snakes and 39 Common Gartersnakes (*T. sirtalis*) were captured.

Date	Species	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Mass and Physical Info
Sept. 2	*S. occipitomaculata*	80	96	#33 between	
Sept. 2	*S. occipitomaculata*	185	242	#11 between	
Sept. 9	*S. occipitomaculata*	195	240	#19 between	
Sept. 26	*S. occipitomaculata*	157	194	#43 surface	Not used for multi-year comparisons
Oct. 7	*S. occipitomaculata*	77	97	#38 between	
Oct. 7	*S. occipitomaculata*	150	191	#40	
Oct. 7	*S. occipitomaculata*	215	275	#35 surface - coiled together with another *S. occipitomaculata*	
Oct. 7	*S. occipitomaculata*	235	285	#35 surface - coiled together with another *S. occipitomaculata*	
Oct. 14	*S. occipitomaculata*	70	96	#15 surface	
Oct. 14	*S. occipitomaculata*	181	191	#29 surface	Stub tail
Oct. 14	*S. occipitomaculata*	183	220	#40 surface	
Oct. 14	*S. occipitomaculata*	182	228	#21 surface	
Oct. 14	*S. occipitomaculata*	215	265	#25 surface	
Oct. 14	*S. occipitomaculata*	235	280	#35 surface	
Oct. 21	*S. occipitomaculata*	80	100	#8	
Oct. 21	*S. occipitomaculata*	83	111	#21 surface	
Oct. 21	*S. occipitomaculata*	155	207	#21 surface	
Oct. 21	*S. occipitomaculata*	180	233	#21 surface	
Oct. 21	*S. occipitomaculata*	232	287	#35 surface	
Oct. 21	*S. occipitomaculata*	173	288	#29 surface	
Oct. 28	*S. occipitomaculata*	235	288	#35 surface	

Table 12. Average captures per highest three counts under snake-covers 1-40 over entire season (2001-2009) on Lester Anderson lands in Lincoln, Vermont.

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009
S. occipitomaculata	1.67	5.67	1.67	1.0	2.0	17.0	3.33	11.0	5.0
T. sirtalis	0.0	2.67	1.33	5.67	2.67	12.33	9.33	19.0	10.0
L. triangulum	0.0	1.0	1.0	2.67	0.67	0.0	0.0	0.33	0.00

Table 13. Percentage of young-of-the-year captured under snake-covers 1-40 (2001-2009) on Lester Anderson lands in Lincoln, Vermont. 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
S. occipitomaculata	40%	63%	60%	50%	38%	56%	40%	47%	25%
T. sirtalis	N/A	89%	100%	93%	75%	100%	91%	95%	93%
L. triangulum	N/A	33%	25%	0%	0%	N/A	N/A	N/A	N/A

Table 14. Snakes captured under snake-covers, or seen in the vicinity, previous to and during the 2010 season.

Date	Species	Location Cover # - Cover Area	Physical Info
July 8	*S. occipitomaculata*	Cover #8	205 SV, 257 TL; 10 embryos
July 8	*S. occipitomaculata*	#10	161 SV, 213 TL
July 8	*S. occipitomaculata*	#14	186 SV, 259 TL; 6 embryos
July 8	*S. occipitomaculata*	#14	205 SV, 248 TL; 6 embryos
July 8	*S. occipitomaculata*	#23	214 SV, 264 TL; 5 embryos
July 8	*S. occipitomaculata*	Grass next to #23	201 SV, 247 TL; 5 embryos
July 8	*S. occipitomaculata*	#33	180 SV, 225 TL; 5 embryos
July 8	*S. occipitomaculata*	#36	200 SV, 245 TL; 6 embryos
July 8	*S. occipitomaculata*	#8	205 SV, 257 TL
July 8	*T. sirtalis*	#14	245 SV, 318 TL
July 8	*T. sirtalis*	#14	243 SV, 313 TL
July 8	*T. sirtalis*	#19	254 SV, 315 TL
July 8	*T. sirtalis*	#27	243 SV, 306 TL
July 8	*T. sirtalis*	#28	490 SV, 560 TL
July 8	*T. sirtalis*	#33	260 SV, 330 TL
July 8	*T. sirtalis*	#36	231 SV, 286 TL
July 8	*T. sirtalis*	#36	200 SV, 255 TL
July 8	*T. sirtalis*	#36	240 SV, 307 TL
July 8	*T. sirtalis*	#37	230 SV, 285 TL
July 8	*T. sirtalis*	#40	340 SV, 420 TL
July 8	*T. sirtalis*	#43	220 SV, 285 TL
Sept 24	*T. sirtalis*	#35 SU	Random check of snake covers, no physical data
Sept 24	*T. sirtalis*	#27 between	Random check of snake covers, no physical data
Sept 24	*T. sirtalis*	#15 between	Random check of snake covers, no physical data
Sept 24	*T. sirtalis*	#7 SU	Random check of snake covers, no physical data

Table 15. Fall 2010 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*).

Snout to Vent Length							
Date	1-20 mm	21-30 mm	31-40 mm	41-50 mm	51-60 mm	Unk.[1]	Total
9/3/10	0	7	27	10	0	1	45
9/10/10	0	5	38	20	0	0	63
9/17/10	0	3	33	15	0	0	51
9/24/10	0	3	25	6	0	0	34
10/1/10	0	0	18	7	0	2	27
10/8/10	0	2	10	6	0	0	18
10/15/10	0	3	12	3	0	0	18
Total	**0**[2]	**23**[2]	**163**[2]	**67**[2]	**0**[2]	**3**[2]	**256**[2]

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

Table 16. Percentage of totals for each cohort of Eastern Red-backed Salamanders (*Plethodon cinereus*) found during fall 2010 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]
9/3/10	0.00%	15.56%	60.00%	22.22%	0.00%	2.22%	100.00%
9/10/10	0.00%	7.94%	60.32%	31.75%	0.00%	0.00%	100.00%
9/17/10	0.00%	5.88%	64.71%	29.41%	0.00%	0.00%	100.00%
9/24/10	0.00%	8.82%	75.53%	17.65%	0.00%	0.00%	100.00%
10/1/10	0.00%	0.00%	66.67%	25.93%	0.00%	7.41%	100.00%
10/8/10	0.00%	11.11%	55.56%	33.33%	0.00%	0.00%	100.00%
10/15/10	0.00%	16.67%	66.67%	16.67%	0.00%	0.00%	100.00%
	0.00%	**8.98%**	**63.67%**	**26.17%**	**0.00%**	**1.17%**	**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 17. Dates and Averages of top three high 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 (2001-2010).

Eastern Red-backed Salamander		
Year	Date	Value[1]
2001	Sept. 16. Sept. 29, Oct. 6	76.67
2002	Sept. 12, Sept. 27, Oct. 4	83.33
2003	Sept. 19, Sept. 25, Oct. 2	89.67[1]
2004	Sept. 8, Sept. 15, Sept. 29	83.33[1]
2005	Sept. 7, Sept. 14, Sept. 28	88.67
2006	Sept. 5, Sept. 12, Sept. 26	100.00
2007	Sept. 5, Sept. 12, Sept. 19	122.67
2010	Sept. 3, Sept. 10, Sept. 17	106.00[1]

[1]Approximate totals had both cover-boards been checked, based on the doubling of the number of salamanders found under odd numbered cover-boards in 2004 and Cover-boards A in 2003 and 2010.

Table 18. Percentage of totals for each cohort of Eastern Red-backed Salamanders (*Plethodon cinereus*) found on high counts days during cover-board monitoring on the Lester Anderson lands on the Bristol/Lincoln border in Vermont (2001-2010).

Snout to Vent Length						
Date	1-20 mm	21-30 mm	31-40 mm	41-50 mm	51-60 mm	Unk.[1]
2001 (9/16)	0.00%	20.21%	63.83%	12.77%	1.06%	1.08%
2002 (9/12)	0.00%	8.26%	79.82%	10.09%	0.00%	1.83%
2003 (9/19)	1.68%	10.08%	66.39%	21.01%	0.00%	0.84%
2004[2] (9/29)	0.00%	36.96%	54.35%	6.52%	0.00%	2.17%
2005 (9/7)	0.99%	20.79%	66.34%	9.90%	0.00%	1.98%
2006 (9/5)	7.32%	11.38%	50.41%	28.46%	0.81%	1.62%
2007 (9/5)	1.22%	28.05%	53.05%	17.07%	0.00%	0.61%
2010 (9/10)	0.00%	7.94%	60.32%	31.75%	0.00%	0.00%
Average/Year	**1.60%**	**20.52%**	**70.64%**	**21.22%**	**0.27%**	**1.45%**

[1]Salamanders escaped before measurements were taken.

[2]Approximate totals had both cover-boards been checked, based on the doubling of the number of salamanders found under odd numbered cover-boards in 2004 and Cover-boards A in 2010..

Figure 1a: High Counts of Spotted Salamander egg masses on Lester Anderson Lands, Lincoln Vermont (1999-2010)

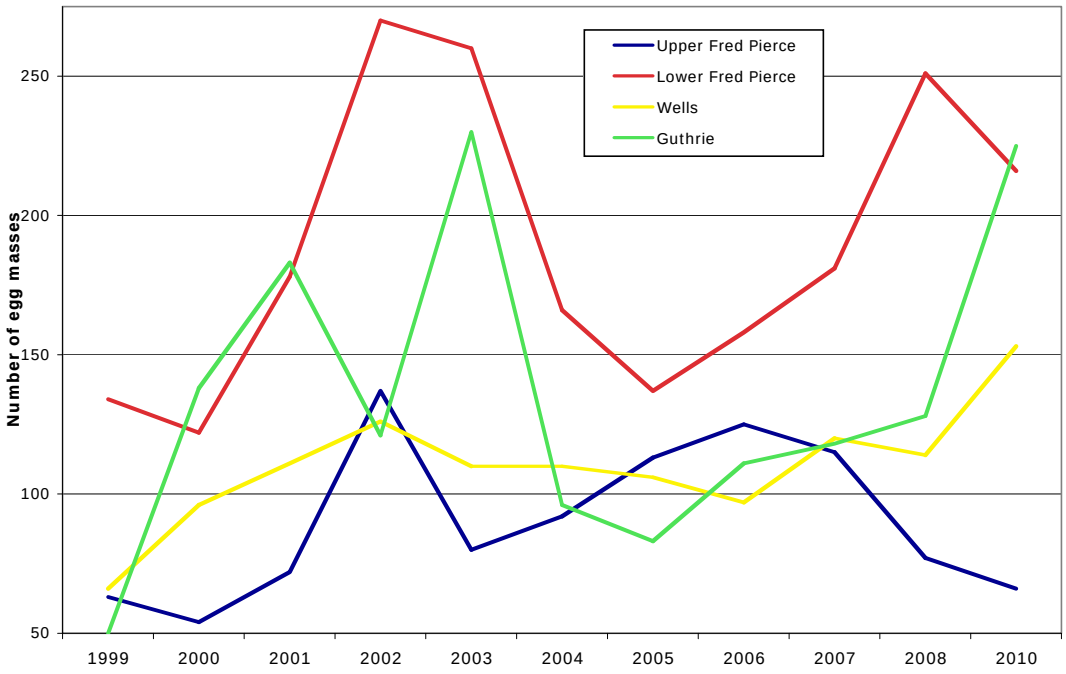

Figure 1b: High Count Trend Lines for Spotted Salamander egg masses on Lester Anderson Lands, Lincoln Vermont (1999-2010)

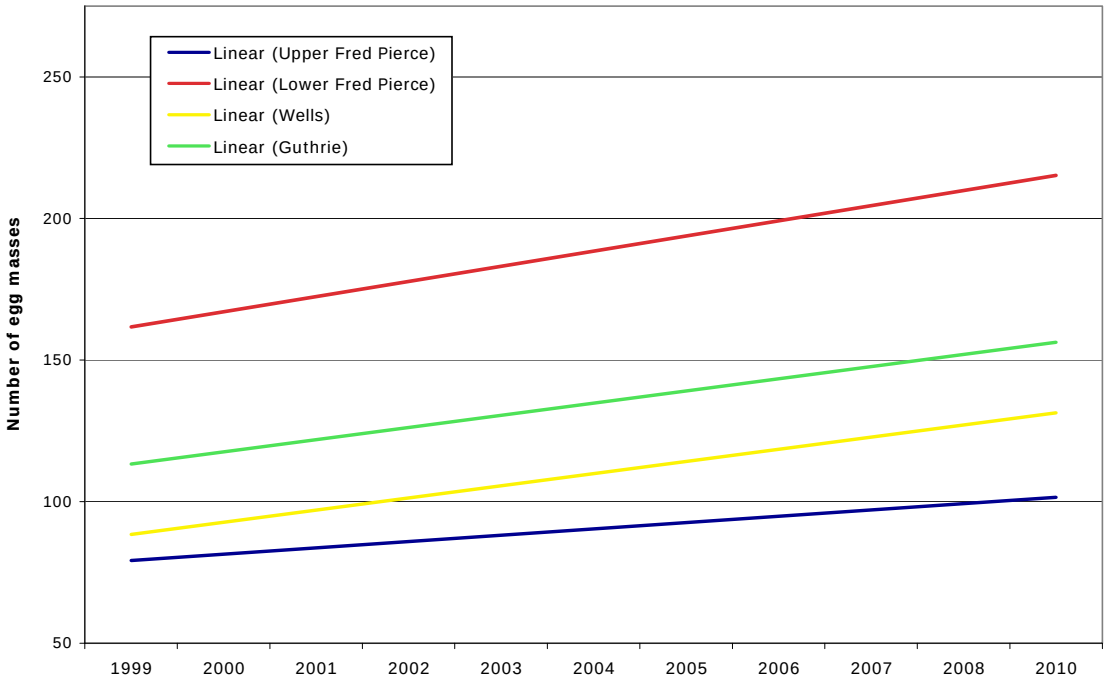

Figure 2a: High Counts of Wood Frog egg masses on Lester Anderson Lands, Lincoln, Vermont (2000-2010)

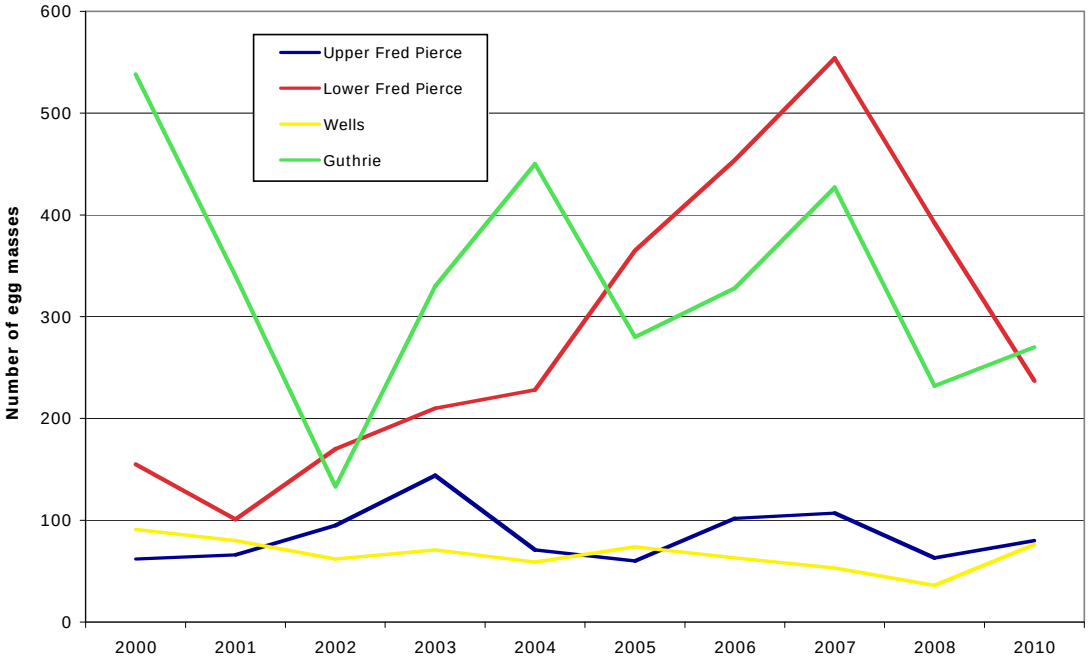

Figure 2b: High Count Trend Lines of Wood Frog egg masses on Lester Anderson Lands, Lincoln, Vermont (2000-2010)

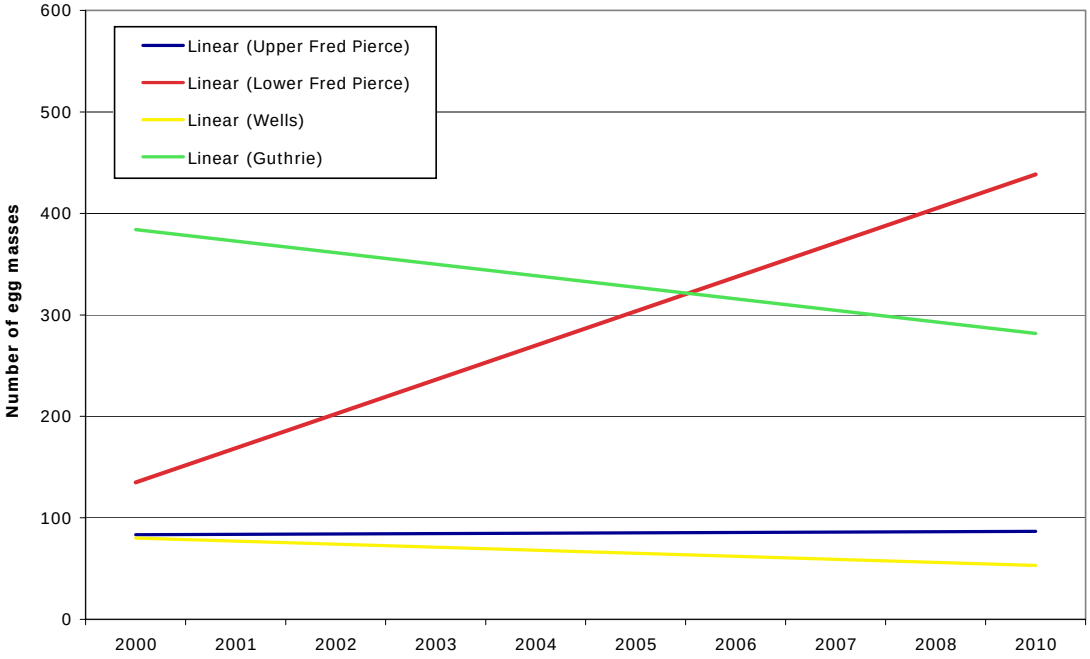

Figure 2C: Average High Counts of Wood Frog and Spotted Salamander egg masses on Lester Anderson Lands, Lincoln, Vermont (2000-2010)

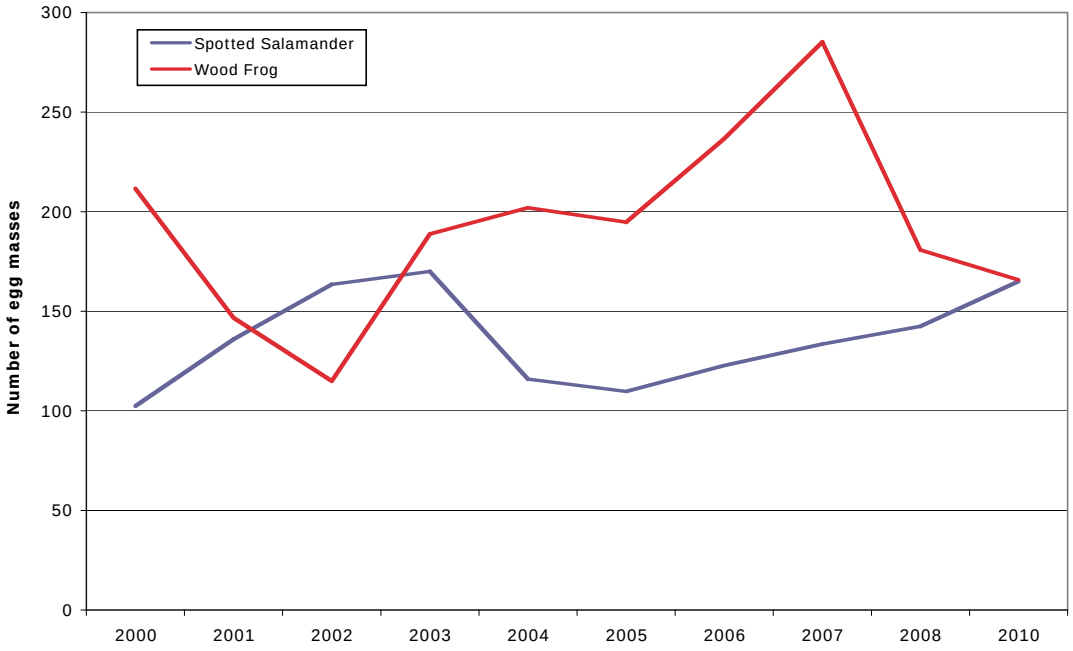

Figure 3a: Number of Spotted Salamander egg masses throughout the spring of 2008 on Lester Anderson Lands, Lincoln Vermont

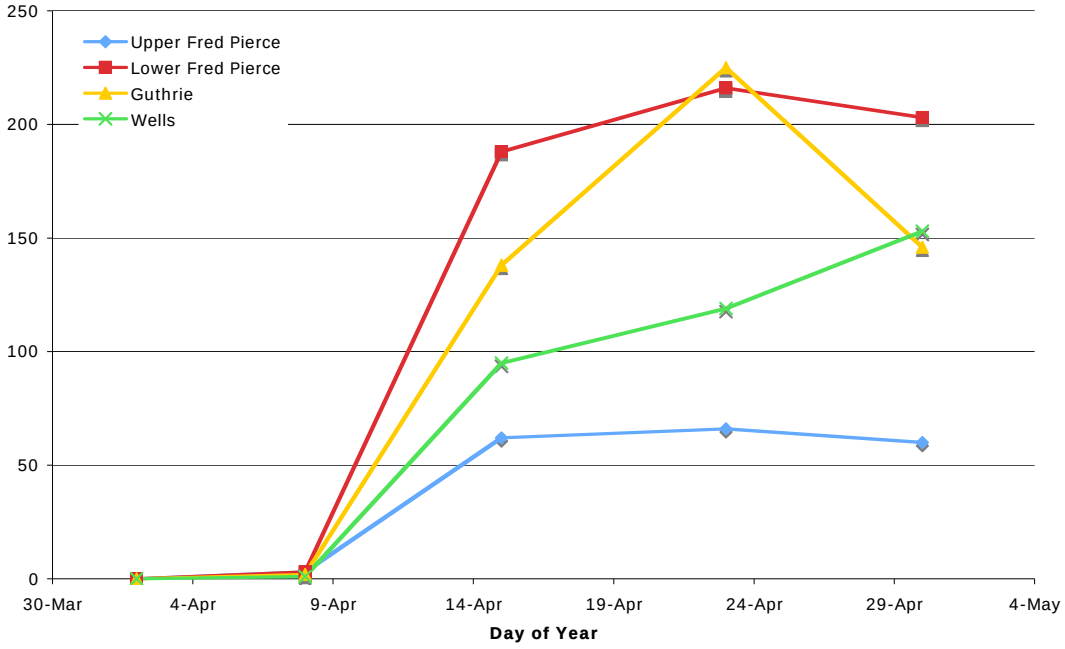

Figure 3b: Number of Wood Frog egg masses throughout the spring of 2010 on Lester Anderson Lands, Lincoln, Vermont

Figure 4: Average Egg-mass numbers at four permanent manmade ponds between 1100 and 1500 feet at the Colby Hill Ecological Project in Lincoln, VT 2000-2010

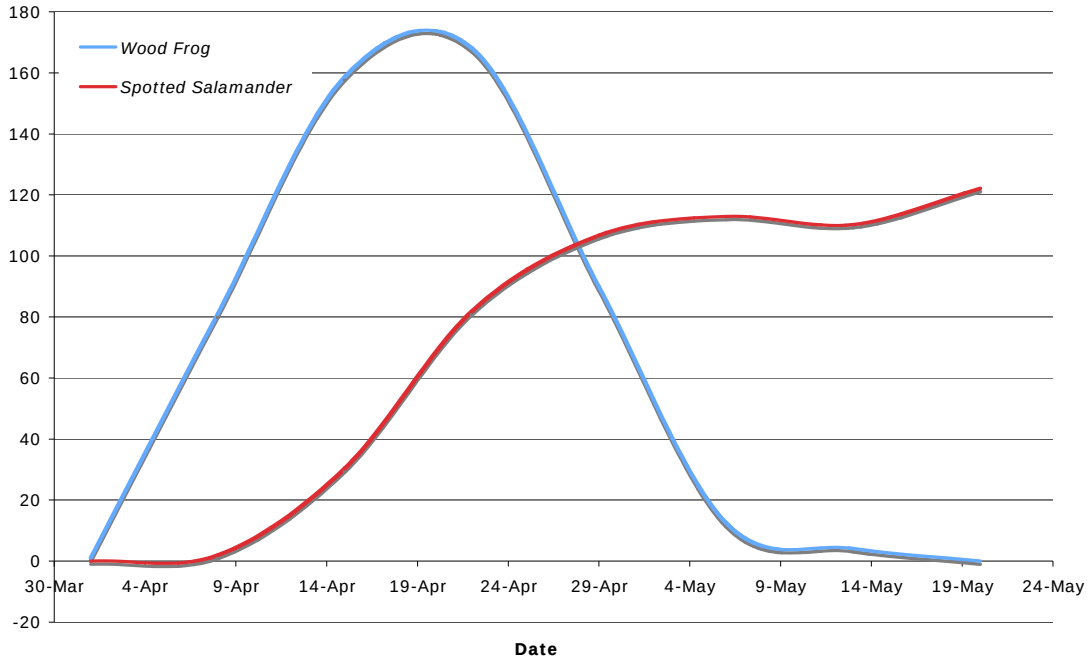

Figure 5: Average of three highest counts per year for *Plethodon cinereus* on Lester Anderson Lands, Lincoln, Vermont (2001-2010)

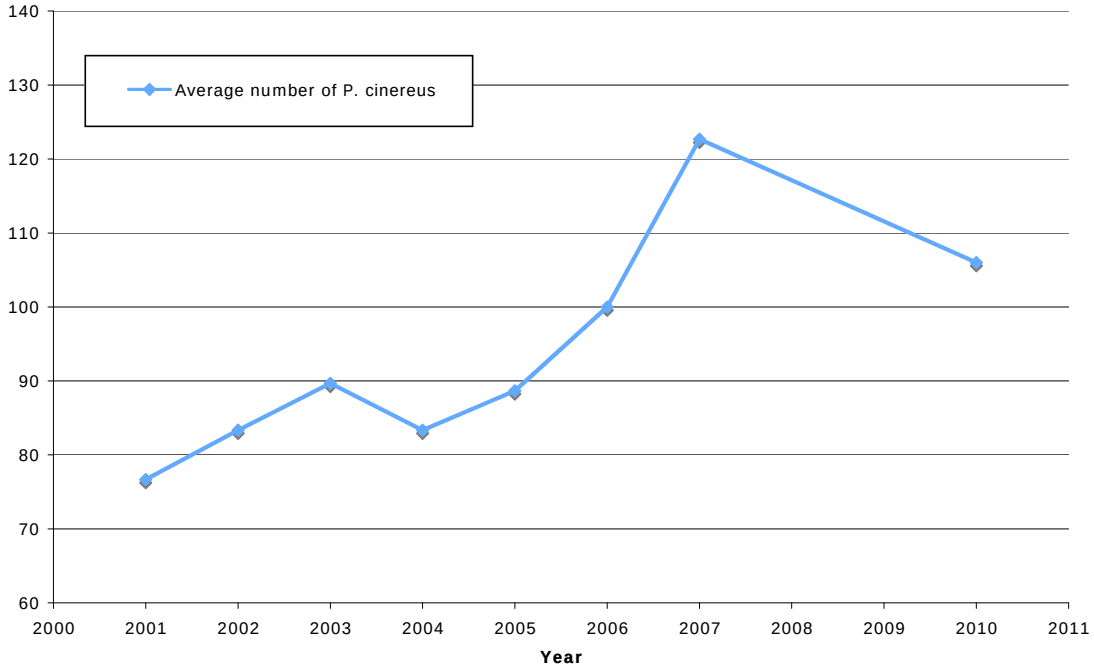

Figure 6: Size-class categories on high-count days for *Plethodon cinereus* on Lester Anderson Lands, Lincoln, Vermont (2001-2010)

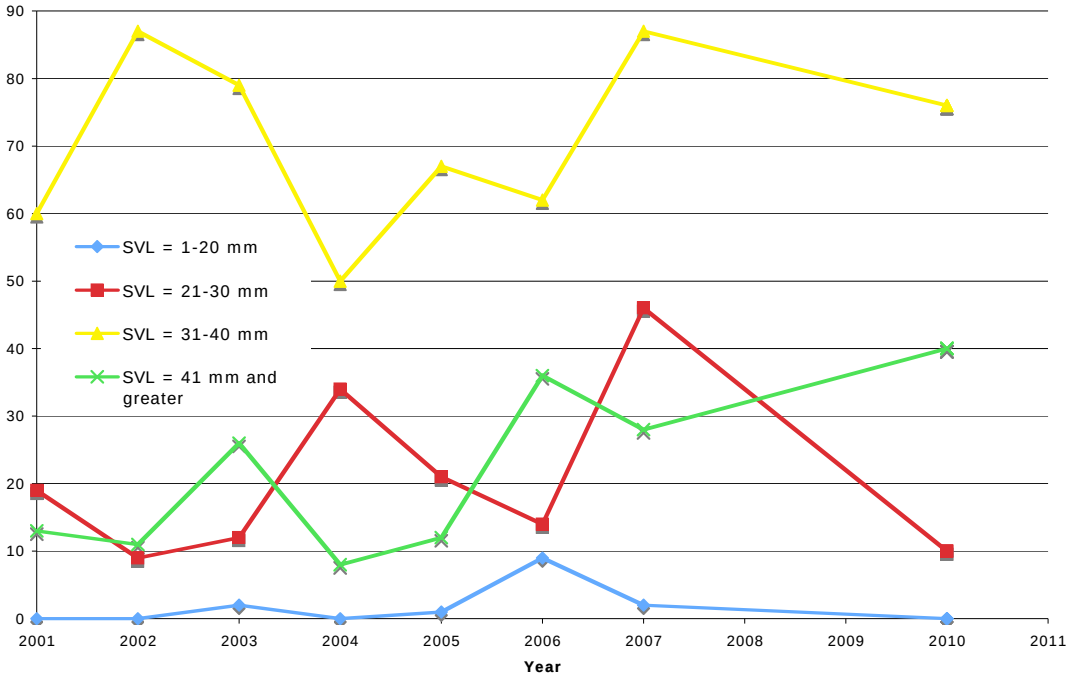

Figure 7: Number of total snakes seen at each snake cover (2001-2009) on Lester Anderson Lands, Lincoln, Vermont