Amphibian & Reptile Monitoring

During the 2008 Field Season

on the Lester and Monique Anderson Lands

in Lincoln, Vermont

Prepared for the

Colby Hill
Ecological Project

Prepared by

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

March, 2009

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.

Starting with the 2008 field season egg-mass counts and salamander cover-board surveys alternate annually. 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 this update was written. During the 2009 field season, cover-boards will be checked (if funding permits), but egg-masses will not be surveyed, and no update will be written. This alternation is expected to continue indefinitely as a cost-trimming measure.

In January of 2008, the Society for the Study of Reptiles and Amphibians published a new list of recommended common and scientific names for these two taxa (Crother et al., 2008). As a result, the scientific name for Wood Frog is now *Lithobates sylvaticus* instead of *Rana sylvatica*.

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.

These counts will be performed every other year beginning during the 2009 season. No egg-mass counts will take place in 2009, 2011, etc.

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).

During the fall of 2001, Middlebury College student Caitlin Corey gathered additional data on soil moisture, the sex of the salamanders found, salamanders found adjacent to the cover-boards, and interactions between different sex- and age-classes within cover-boards. Her most interesting and best

supported finding (Corey, 2002) was that adult Red-backeds would only rarely be found with adults of the same sex and much more often would be found with larger young or adults of the opposite sex. This strongly suggests that there is an upper limit to the number of adults that we can find under the boards since they exclude same sex adults. This is in addition to the apparent exclusion of the smallest size-classes by adults. Her analyses support our design concept that the multiple compartments formed by the visual barriers of the salamander condos allow adults to be physically quite close (a few centimeters) without excluding each other. She also points out that the age-class data generated by the cover-boards may not be representative of those in the larger populations as a result of the active exclusion of same sex adults and possible predation upon younger juveniles. She examined preferred positions within the cover-boards and found that over the course of the entire season salamanders were more often in one of the two ground contact positions (crack or ground), however, on certain days between the boards was the preferred position.

These counts will be performed every other year beginning during the 2008 field season. They did not take place in 2008, and will not take place in 2010, 2012 etc.

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 (610mm 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) will not be used for monitoring comparisons. A couple covers that appear to have been run over and broken during mowing (16 & 17), were replaced

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 snakes den.

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 all 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).

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). Over time, as small mammals start to tunnel under the boards, other species may start to use them.

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: Milksnakes 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 2008 egg-mass counts were performed on seven dates (April 9, April 18, April 23, April 30, May 7, May 14, and May 21) 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 semipermanent they usually hold some water even through dry years.

The results of this year's counts are shown in Tables 1-4. The 2007-2008 winter was generally warmer than average but had the second largest amount of snowfall on record. Snow cover remained from mid-

January through early April. Movement did not occur in the Champlain lowlands until the very end of March (March 31), but in the mountains snow remained until a series of warm days at the end of the first week in April followed by rain on the 10-12th. Although the first check was on April 9th, egg masses were first seen on April 18th. 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

The first adults and egg masses were seen on April 18th. Egg masses were seen at all ponds on that date (Tables 1-4). 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 and Lower Fred Pierce the number of Spotted Salamander egg-masses continues a four-year increase. At Wells and Upper Fred Pierce the numbers of egg-masses declined from last year. Tables 5-8 show that even the two increasing counts have not yet equaled record high levels. For all ponds except Guthrie, the record high counts for Spotted Salamander egg-masses occurred in 2002. The record low counts were in 1999 and 2000 in Guthrie, Wells, Lower Fred Pierce, and Upper Fred Pierce respectively. Although in 1999 some of the early egg masses were missed. The combined high count for all ponds was above average.

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 four your increase through this year. 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 seeing if numbers cycle on a regular multi-year pattern.

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 190 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. Lower Fred Pierce Pond continues to be the most productive breeding location and Upper Fred Pierce the least productive (Figure 3a).

Wood Frogs

The combined number of Wood Frog egg-masses from all ponds last year was at an all-time high of 1141. This year's combined total dropped to 723 (Table 9), the third-lowest total in our nine years of data. This total reflects drops in egg-mass numbers in each of the four monitored ponds. This is not cause for concern. As we have seen in the past, numbers of breeding females could rebound in a matter of just a couple years. As has been the case with the Spotted Salamanders, the greatest number of Wood Frog egg-masses this year was again found at Lower Fred Pierce (Figure 3b). Lower Fred Pierce Pond has been the most productive pond for Wood Frogs for the last four years and for Spotted Salamanders for six years (Figures 1a and 2a). On April 23rd three hundred and ninety two egg masses were counted at Lower Fred Pierce Pond (Table 1). This is a drop of 162 egg masses since last year.

Trend lines for breeding female Wood Frogs show an upward trend for Lower Fred Pierce, declining trends for Guthrie and Wells and a flat line for Upper Fred Pierce (see Figure 2b). Despite the presence of Green Frog tadpoles at Upper Fred Pierce, thousands of Wood Frog tadpoles hatched and were visible through the season (an estimated 2,400 remained on May 21st).

Figure 2c is new this year. In it we examine the relative numbers of Wood Frogs and Spotted Salamanders at all three ponds combined over the last nine years. This graph shows a very interesting negative correlation between Wood Frog and Spotted Salamander numbers at Colby Hill overall. This is entirely new to us. What the mechanics of such a relationship could be is difficult to tell. This relationship could be driven by conditions or relationships while in the pond, or perhaps weather. It is difficult to imagine how it could be the result of terrestrial interactions. It is a fascinating relationship but difficult to understand. Data from future years will show if this relationship holds true and may reveal additional clues to the mechanisms that drive it.

Another new figure (Figure 5) 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 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. In addition to species-specific differences, the timing of breeding also depends on elevation, aspect, spring temperatures, rainfall, and the amount of snow accumulated.

Also new this year (as requested by Lester) are Figures 4a and 4b. These figures show the relationship of rain events with the egg-mass counts. The April 12th rain event clearly began the season and brought on the spring amphibian migration to the ponds. Wood Frog egg-mass numbers peaked at all but Wells within ten days of this rain. Spotted Salamanders egg-mass numbers, on the other hand, peaked at all ponds about 10 days after the second rain event in late April.

We now have ten years of useful data from the ponds for Spotted Salamanders and nine 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 will move to an every-other year schedule of egg-mass monitoring. Consequently we will not survey in 2009 but will survey again in 2010.

Numerous birds were seen or heard in the vicinity of the ponds during the egg-mass counts including; American crow, American robin, Barred owl, Black-capped chickadee, Blue-headed vireo, Brown creeper, Dark-eyed junco, Eastern phoebe, Killdeer, Northern flicker, Northern oriole, Red-eyed vireo, Red-breasted nuthatch, Red-winged blackbird, Ruby-crowned kinglet, Ruffed grouse, Song sparrow, Tufted titmouse, Veery, White-throated sparrow, Winter wren, Yellow-bellied sapsucker, and Yellow-rumped warbler. Although we wrote down bird species seen or heard this in no way constitutes a complete list of the birds on the property.

Predaceous diving beetles (dytiscids) were seen in all ponds except Wells. Snails and large leeches (macrobdellans) were noted in Guthrie only. We saw moose tracks in Lower Fred Pierce Pond. We noted that the marsh marigolds were beginning to bloom on April 30th at Upper Fred Pierce.

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 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. Spring Peepers (*Pseudacris crucifer*) were seen on April 23 and first heard on May 7.

An **American Bullfrog** (*Lithobates catesbeianus*) was seen at Wells on May 14. This large lowland predator has 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. It will be interesting to see if this population grows in the coming years and what impact it may have on the current mix of amphibians.

Cover-boards

The cover-boards were not monitored during the 2008 field season. They will be checked again during the fall of 2009 and then every other year. Cover-board checking will alternate years with egg-mass counts. Cover-boards were checked for maintenance purposes on July 30th and renumbered or replaced as needed. Five boards and many spacers were in need of replacement. We replace very close to this number annually. 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, 85 Eastern Red-backed Salamanders were found. Also along the transects one American Toad *(Anaxyrus americanus*) and one Wood Frog were located.

Snake-covers

All snake-covers were checked 10 times at weekly intervals starting on Aug 28 with subsequent checks on Sept 4, 10, 17, and 24, Oct 1, 8, 15, 22, and 29, (Tables 10 and 11). Now that we have a few good years' data to work with, 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 our new monitoring table (Table 12) is simply the average number of snakes of each species using the covers per visit. As can be seen in Table 12, total snake captures of all three species combined, increased steadily through 2006 to 16.1, dropped steeply in 2007 to 4.9, and rebounded this year to 14.2.

Common Gartersnakes were captured in the highest numbers ever this year with 7.6 snakes on average per visit. Red-bellied Snakes were captured in their highest numbers since 2006 with 6.6 snakes per visit. Milksnakes have not been captured under the snake covers for the last three years during the regular season; however, one adult was seen using the old cellar foundation, and two other were using the covers earlier in the season. These three snake species are the most widespread and abundant snake species in Vermont. 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-five percent of the Common Gartersnake captures were neonates. Forty-seven percent of the Red-bellied Snake captures were neonates. This is in clear contrast to Milksnakes. In 2002, 33% of the Milksnakes found were neonates, in 2003, 25% were neonates, in 2004 none were neonates but we still caught an average of one older Milksnake per cover check. In 2005 adults dropped to 0.3 older Milksnakes per cover check. Since then we have not found any adults or young Milksnakes under the artificial covers during our regular checking period, although we have found some earlier in the year. It certainly appears that Milksnakes 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. A couple early season cover checks during this coming year should help us determine if they are still in the Guthrie area during 2009 and if so, if they are successfully reproducing.

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, we found nine adult Red-bellied Snakes using the covers (Table 14). All of them were gravid. Palpating revealed from 7 to 11 young in each adult. 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. Also found under the covers during the maintenance effort were a juvenile Red-bellied Snake, one Common Gartersnake, and two Milksnakes. Why the Milksnakes were seen on July 30th, but not seen under the covers again later in the season is unclear, but it is good to know that they are still using the area. As a result of the unusual and interesting results of July 30, we plan to check the covers a couple times earlier during the year during future efforts.

An additional adult Milksnake was found on October 8 using the old foundation for cover. The foundation is an excellent piece of habitat for snakes. It provides good thermal retention and lots of refugia between the stones of the foundation.

Last year (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 had been measured at covers 20, 21, 22, and 25 (17, 44, 22, and 24 snakes respectively), while no snakes had been seen under covers 23 and 24. Many snakes had also been found under covers 39 (16 snakes) and 40 (55 snakes). This year snakes used covers 23 and 24 for the first time, and hardly any were found under cover 39 (Figure 6A). Covers 21 and 25 continue to be heavily used. 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 30 to the location of the hedge and stone wall at cover 40 (Figure 6B) 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 this year to check our hypothesis. It will take a few more years of data from the new covers to see if our hunch is correct.

It appears a bear visited the artificial covers and methodically flipped and checked many of them prior to our first regular check on August 28 but after our July 30th visit. The bear flipped all the covers from 24 through 40 and cleaned out most of the ants that were underneath the covers. It also conveniently cleaned out a yellow jackets nest under cover 14. It did not check any of our newly placed covers. We used some spray to remove the remaining wasps under cover 14, so that we could continue to check it. We do not now, if a bear would eat any snakes found under the covers as well.

As usual, many invertebrates were found using the snake-covers. These were rarely identified to species and this is not a comprehensive list. However, in 2008 we noted ground beetles, earthworms, fall crickets, Isabella tiger moth larvae, large millipedes, pill bugs, red and black ants, yellow jackets, wolf spiders, other spiders, slugs, and snails.

Summary

We now have ten years of **egg-mass** data (nine 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 was 570 compared to 534 Spotted Salamander egg masses in 2007. This steady increase in combined numbers is in its fourth year. **Wood Frog** egg-mass numbers dropped from last year at all four ponds. The nine-year trend shows increases at Lower Fred Pierce, slight declines at Wells and Guthrie, and a flat line at Upper Fred Pierce. One or two exceptional years can still have a major impact on the trend lines. That effect will diminish over time. We counted a total of 723 Wood Frog egg masses compared to last year's combined total of 1141.

The apparent negative correlation between Spotted Salamander egg-mass numbers and Wood Frog egg-mass numbers is new to us, new to science, and unexplained at this time. 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 see so in Figure 5. 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.
The relative response to the first two major rain events of spring shown in Figures 4a and 4b appears to show a very clear relationship as well, however, this is based on only one-year's data and needs to be examined for a few more years before we can be confident in the generality of that relationship.

During the 2008 season we located an adult **Bullfrog** at Wells Pond. This is the first Bullfrog documented from the Colby Hill Ecological Preserve and the first documented from Lincoln.

Cover-boards for Red-backed Salamanders were not monitored during 2008 and may be monitored only every-other year from now on depending on budgets.

We now have seven solid years of data from the **snake-covers** and we have examined population trends for the first time in Table 12. Average cover usage this year rebounded from last year's drop to their second highest numbers (14.2 snakes per check). However, this is driven by high numbers of Red-bellied Snakes and Common Gartersnakes while Milksnakes have virtually disappeared from the transect site at Guthrie. This is the third 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. However, we did locate three outside of the regular monitoring period.

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. 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. It would be useful to add four more pairs of covers along the edge of the field on the other side of the hedge row to the north to help us determine what some of the significant variables are.

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.

Acknowledgments

Erin Talmage, Birch Andrews, Amybeth Alfieri, Kiley Briggs, and Roberta Summers helped gather data at the snake covers. Erin Talmage, Kir Talmage, and Kaile Burgess helped count egg-masses.

Literature Cited

Andrews, J.S. 2002. The atlas of the reptiles and amphibians of Vermont. James S. Andrews, Middlebury, Vermont 90 pp.

Andrews, J.S. and E.K. Talmage. 2005. Amphibian & Reptile Monitoring During the 2004 Field Season on the Lester and Monique Anderson Lands in Lincoln, Vermont. Report prepared for the Colby Hill Ecological Project.

Andrews, J.S. and E.K. Talmage. 2006. Amphibian & Reptile Monitoring During the 2005 Field Season on the Lester and Monique Anderson Lands in Lincoln, Vermont. Report prepared for the Colby Hill Ecological Project.

Andrews, J.S. and E.K. Talmage. 2007. Amphibian & Reptile Monitoring During the 2006 Field Season on the Lester and Monique Anderson Lands in Lincoln, Vermont. Report prepared for the Colby Hill Ecological Project.

Andrews, J.S. 2006. Database for the atlas of the reptiles and amphibians of Vermont.

Andrews, J.S. 2007. Database for the atlas of the reptiles and amphibians of Vermont.

Bishop, S.C. 1941. Salamanders of New York. New York State Museum Bulletin 324, University of the State of New York, Albany, New York, 365 pp.

Corey, C.L. 2002. Factors influencing the effectiveness of artificial cover objects as a method for sampling the terrestrial salamander, *Plethodon cinereus*, Senior high-honors thesis, Middlebury College, 62 pp.

Corn, P.S., and L.J. Livo. 1989. Leopard Frog and Wood Frog reproduction in Colorado and Wyoming. Northwest Naturalist 70:1-9

Craig, B., C. Rikley, B. Slade, A. Way, and N. Wilson. 1999. Evaluating four types of salamander cover-boards at Smithsonian Institution forest biodiversity permanent plots utilizing student volunteers. In abstracts of the Canadian Amphibian and Reptile Conservation Networks Quebec 1999 annual meeting.

Crother, B.I. (ed). 2008. Scientific and standard English names of amphibians and reptiles of North America north of Mexico. SSAR Herpetological Circular 37. Committee on Standard English and Scientific Names, Brian I. Crother Chair, Society for the Study of Amphibians and Reptiles. 84 pp.

Ernst, C.H., and R.W. Barbour. 1989. Snakes of Eastern North America, George Mason University Press, Fairfax, Virginia 282 pp.

Ernst, C.H., and E. M. Ernst. 2003. Snakes of the United States and Canada. Smithsonian Books, Washington 668 pp.

Harding, J. H., 1997. Amphibians and Reptiles of the Great Lakes Region. The University of Michigan Press, Ann Arbor, Michigan 379 pp.

Hertzig, J. 1998. Lester and Monique Anderson lands, small mammal and herps survey, April-June 1998, Unpublished Technical Report.

Heyer, W.R., M.A. Donnelly, R.W. McDiarmid, L. C. Hayek, and M. Foster (editors). 1994. Measuring and monitoring biological diversity: Standard methods for amphibians. Smithsonian Institution Press. 364 pp.

Marsh, D.M., and M. A. Goicochea. 2003. Monitoring terrestrial salamanders: biases caused by intense sampling and choice of cover objects. Journal of Herpetology, Vol. 37 #3.

Mitchell, J.C. 1994. The Reptiles of Virginia. Smithsonian Institution Press, Washington 352 pp.

NAAMP, The North American Amphibian Monitoring Program website. http://www.mp1-pwrc.usgs.gov/amphibs.html

Petranka, James S. 1998. Salamanders of the United States and Canada. Smithsonian Institution Press, Washington 587 pp.

Table 1. Spring 2008 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	Until this week it has been cold with snow on the ground. Last few days have been sunny and ice and snow are melting. There was some amphibian movement in the valley March 31st and April 1st. Visibility good to excellent. Polarizing glasses used
April 18	3 Spermatophores seen.	263 We saw one female depositing eggs; we scared off the male by accident. Five other pairs seen. Some of the eggs looked very fresh (minutes? hours?). We saw about 140 adults on the surface and heard a chorus as we approached.	Sunny and warm last 4 days. Amphibian movement in Champlain Valley on April 11 and 12, there have been very few wet warm nights. Visibility excellent. Polarizing glasses used.
April 23	14 Two adults were seen.	392 Some egg-masses were hatching, green with little ones on top; others look very close to hatching.	It has been unseasonably warm and sunny last 10 days or so. Today's winds are coming from SSE at 3 miles/hour, and rainfall for the month is 0.94 inch, today's barometer reading is 29.74. Visibility ok to poor. Polarizing glasses used. Found *L. clamitans* tadpoles and found an adult *P. crucifer*.
April 30	127 Seven masses were opaque, two had nonviable eggs. More than 4 spermatophore clumps seen throughout the pond.	185 Most egg-masses were green, floating, or have dead eggs More than 5000 tadpoles. Tadpoles on masses, and on bottom of pond, many hidden so probably even more.	After two weeks of warm weather a cold front came in and there was a rainy night and day on April 28 and 29. There were snow flurries this a.m. in Huntington. Visibility ok, sun came back out during *A. maculatum* count. Polarizing glasses used.
May 7	251 Eleven egg-masses were opaque, some fairly fresh, some very fresh, seven have some nonviable eggs.	25 Egg-masses have all hatched, just remnants remain. More than 30,000 tadpoles.	Cold front with rain on May 3, then sunny days, and cool evenings for the last few days. Rainfall for month 0.19 inches. Today is 55 F, 43% humidity, barometer reading is 29.60. Visibility good to excellent, lots of stuff floating. Polarizing glasses used. *L. clamitans* (adults and tadpoles) seen.
May 14	246 Some egg-masses were semi-fresh, twelve have some nonviable eggs, seven were opaque, and one has entirely nonviable eggs.	0 More than 35,000 tadpoles. Tadpoles (seems like more than last week). Tadpoles were swimming all around pond, they were noticeably bigger than last week.	Yesterday was sunny in low 60s F, last night in 40's F. Visibility good to excellent some stuff on surface making it hard to see in certain spots. Polarizing glasses used. *L. clamitans* tadpoles seen.
May 21	236 Many egg-masses were green and close to hatching, embryos moved when eggs were poked.	0 More than 25,000 tadpoles. Tadpoles clumped along edge while some dispersed throughout the pond, no big clumps like Guthrie and Upper Fred Pierce.	It has been generally dry the last week except for May 19 and May 20 when it rained occasionally. We have had cool evenings. Visibility poor to good - sun came out and we could see masses pretty clearly along edge of water. Polarizing glasses used. *L. clamitans* tadpoles seen.

Table 2. Spring 2008 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	Until this week it has been cold with snow on the ground. Last few days have been sunny and ice and snow are melting. There was some amphibian movement in the valley March 31st and April 1st. Lots of algae floating on top (rising as pond turns over?) even so visibility good to excellent. Polarizing glasses used.
April 18	2	63 Some very fresh. Adults seen.	Sunny and warm last 4 days. Amphibian movement in Champlain Valley April 11 and 12, there have been very few wet warm nights. Visibility excellent. Polarizing glasses used.
April 23	3 Spermatophores seen.	53 One mass starting to hatch.	It has been unseasonably warm and sunny last 10 days or so. Today's winds are coming from SSE at 3 miles/hour, and rainfall for the month is 0.94 inch, today's barometer reading is 29.74. Visibility ok to poor. Polarizing glasses used.
April 30	34 Some very fresh.	32 Mostly nonviable dead eggs left. More than 250 tadpoles seen.	After two weeks of warm weather a cold front came in and there was a rainy night and day on April 28 and 29. There were snow flurries this a.m. in Huntington. Visibility poor, cloudy, water is very dark. Polarizing glasses used.
May 7	77 Some very fresh.	16 All egg-masses hatched, just remnants left. More than 2200 tadpoles seen.	Cold front with rain on May 3, then sunny days, and cool evenings for the last few days. Rainfall for month 0.19 inches. Today is 55 F, 43% humidity, barometer reading is 29.60. Visibility good to excellent, some shadows on water. Polarizing glasses used.
May 14	63	2 More than 2500 tadpoles some spread throughout pond, but most congregated in one clump.	Yesterday was sunny in low 60s F, last night in 40's F. Visibility good to poor, lots of stuff on surface. Polarizing glasses used.
May 21	65 Egg-masses turning green, some have nonviable eggs.	0 Two tight clumps of tadpoles, similar to Guthrie, More than 2400 seen.	It has been generally dry the last week except for May 19 and May 20 when it rained occasionally. We have had cool evenings. Visibility poor - still cloudy, water very dark. Polarizing glasses used.

Table 3. Spring 2008 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	Until this week it has been cold with snow on the ground. Last few days have been sunny and ice and snow are melting. There was some amphibian movement in the valley March 31st and April 1st. Visibility excellent, all ice is gone, big rock has about 10 cm of water on it. Polarizing glasses used.
April 18	2 Two adults seen.	221 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 last 4 days. Amphibian movement in Champlain Valley April 11 and 12, there have been very few wet warm nights. Water still high, top of big rock has about 2 cm of water, bottom has about 15 cm on top of it. Visibility excellent. Polarizing glasses used.
April 23	12 Four masses had some nonviable eggs.	203 Some egg-masses were green. Tadpoles have hatched and were on top of some of the masses. Adults also seen, two males on top of one female.	It has been unseasonably warm and sunny last 10 days or so. Today's winds are coming from SSE at 3 miles/hour, and rainfall for the month is 0.94 inch, today's barometer reading is 29.74. Visibility good. Polarizing glasses used.
April 30	36 A few masses were very fresh. Eight masses have nonviable eggs.	232 Some egg-masses were not hatched but embryos are visible. Some were hatched and tadpoles were swimming or laying on rocks, or on cattails. The big clump has hatched and tadpoles were all over them. More than 9000 tadpoles.	After two weeks of warm weather a cold front came in and there was a rainy night and day on April 28 and 29. There were snow flurries this a.m. in Huntington. Water is high. Visibility ok to poor, cloudy. Polarizing glasses used.
May 7	128 Nine masses were on the surface of the water, some were pretty fresh, three were opaque, eight have nonviable eggs.	7 Only 5 tadpoles seen. Where are they?	Cold front with rain on May 3, then sunny days, and cool evenings for the last few days. Rainfall for month 0.19 inches. Today is 55 F, 43% humidity, barometer reading is 29.60. Water dropped about one foot, the big rock is exposed. Visibility excellent. Polarizing glasses used.
May 14	98 Three have mostly nonviable eggs.	0 Only 3 tadpoles seen.	Yesterday was sunny in low 60s F, last night in 40's F. Visibility poor to good, pollen on surface and cattails are growing. Polarizing glasses used.
May 21	76 Seven have primarily nonviable eggs, some were pretty green and spread out.	0 More than 5000 tadpoles, lots of tadpoles in two large tight clumps with streams from clump to clump or to shore. The tadpoles are about 3/4 inch long, can see white/gold belly when they come to surface.	It has been generally dry the last week except for May 19 and May 20 when it rained occasionally. We have had cool evenings. The cattails are growing and lifting up some masses and hiding others. Water looks to be even lower. Visibility poor to good (in spots). Polarizing glasses used.

Table 4. Spring 2008 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	Until this week it has been cold with snow on the ground. Last few days have been sunny and ice and snow are melting. There was some amphibian movement in the valley March 31st and April 1st. Visibility good to excellent, all ice is gone. Polarizing glasses used.
April 18	10 Most egg-masses were down on bottom, two were intermingled with spermatophores. Masses will be hard to count unless visibility is excellent.	27 Snail seen on one egg mass, three are older and one is very fresh (laid this morning?). Adults seen.	Sunny and warm last 4 days. Amphibian movement in Champlain Valley April 11 and 12, there have been very few wet warm nights. Visibility excellent. Polarizing glasses used.
April 23	15 On egg-mass was nonviable and two were opaque.	36 Can see embryos in egg mass but none have hatched.	It has been unseasonably warm and sunny last 10 days or so. Today's winds are coming from SSE at 3 miles/hour, and rainfall for the month is 0.94 inch, today's barometer reading is 29.74. Visibility ok. Polarizing glasses used.
April 30	47 Some were very fresh, a few had *L. sylvaticus* tadpoles on them.	11 Most egg masses were hatched and green. More than 500 tadpoles.	After two weeks of warm weather a cold front came in and there was a rainy night and day on 4/28 and 4/29. There were snow flurries this a.m. in Huntington. Visibility poor, cloudy and snow flurries. Polarizing glasses used.
May 7	114 Thirteen egg-masses very fresh, two opaque, one had nonviable eggs.	5 More than 500 tadpoles.	Cold front with rain on May 3, then sunny days, and cool evenings for the last few days. Rainfall for month 0.19 inches. Today is 55 F, 43% humidity, barometer reading is 29.60. Visibility excellent. Polarizing glasses used. Adult *L. clamitans* seen.
May 14	107 Three egg-masses had nonviable eggs. Some were green and embryos visible, found at least one mass that had almost completely hatched.	0 More than 250 tadpoles scattered along sunny side, no big clumps seen.	Yesterday was sunny in low 60s F, last night in 40's F. Visibility good. Polarizing glasses used. Adult *L. clamitans* seen.
May 21	97 At least one egg-mass has mostly nonviable eggs, masses turning green (not as far along as Guthrie) can see embryos.	0 More than 100 tadpoles spread out on edge in shallow water.	It has been generally dry the last week except for May 19 and May 20 when it rained occasionally. We have had cool evenings. Visibility poor - starting to sprinkle, water very dark. Polarizing glasses used. Adult *L. clamitans* seen.

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 2008.

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.

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 2008.

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.

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.

Table 8. Maximum counts of egg-masses in the Wells Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2008.

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.

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		
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

Table 10. Fall 2008 snake-cover results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for the Common Gartersnake (*Thamnophis sirtalis*) and unidentified snakes. This is the eighth year of results. In 2008 a record 158 snakes and seven shed skins were recorded. (A previous record of 113 snakes were found and measured in 2006.) Two species were caught: the Common Gartersnake, and the Red-bellied Snake (*Storeria occipitomaculata)* during the normal count season. Milksnakes were caught earlier in the summer (see Table 16).

Date	*Species*	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Physical Info
Aug. 28	*T. sirtalis*	420	520	between #8	
Aug. 28	*T. sirtalis*	145	185	between #8	
Aug. 28	*T. sirtalis*	132	167	surface #11	
Aug. 28	*T. sirtalis*	145	190	between #12	Young of year
Aug. 28	*T. sirtalis*			between #14	Shed skin
Aug. 28	*T. sirtalis*	165	210	between #21	
Aug. 28	*T. sirtalis*			between #26	Shed skin
Aug. 28	*T. sirtalis*	300	390	surface #43	
Aug. 28	Unidentified snake			between #7	Shed skin, keeled scales
Sept. 4	*T. sirtalis*	145	185	between #4	F?
Sept. 4	*T. sirtalis*	165	205	between #5	M?
Sept. 4	*T. sirtalis*	155	195	between #6	
Sept. 4	*T. sirtalis*	165	210	surface #11	
Sept. 4	*T. sirtalis*	160	205	between #11	
Sept. 4	*T. sirtalis*	335	425	between #11	
Sept. 4	*T. sirtalis*	150	180	between #12	
Sept. 4	*T. sirtalis*	140	180	between #15	
Sept. 4	*T. sirtalis*	165	225	between #20	
Sept. 4	*T. sirtalis*	140	175	between #21	
Sept. 4	*T. sirtalis*	125	155	surface #21	
Sept. 4	*T. sirtalis*	140	175	surface #21	
Sept. 4	*T. sirtalis*	160	200	surface #25	
Sept. 4	*T. sirtalis*			between #26	shed skin
Sept. 4	Unidentified snake			surface #30	shed skin
Sept. 4	*T. sirtalis*	360	430	between #37	missing tip of tail, about to shed
Sept. 4	*T. sirtalis*			between #37	crushed between cover boards
Sept. 10	*T. sirtalis*	155	200	surface #6	no hemipenes
Sept. 10	*T. sirtalis*	160	203	surface #6	
Sept. 10	*T. sirtalis*	150	195	between #12	
Sept. 10	*T. sirtalis*	130	170	surface #21	
Sept. 10	*T. sirtalis*	170	225	surface #21	
Sept. 10	*T. sirtalis*	142	187	between #25	scar at 75 mm (measuring from head)
Sept. 10	*T. sirtalis*	145	180	between #25	
Sept. 10	*T. sirtalis*	140	180	surface #25	
Sept. 10	*T. sirtalis*	140	180	surface #25	
Sept. 10	*T. sirtalis*	145	192	surface #25	
Sept. 10	*T. sirtalis*	142	184	surface #35	
Sept. 10	*T. sirtalis*	130	135	surface #36	missing most of tail, scar at 27
Sept. 10	*T. sirtalis*	139	184	surface #43	in small hole with two others
Sept. 10	*T. sirtalis*	142	185	surface #43	in small hole with two others
Sept. 10	*T. sirtalis*	145	190	surface #43	in small hole with two others
Sept. 10	*T. sirtalis*	140	184	surface #44	
Sept. 10	*T. sirtalis*	145	189	surface #44	
Sept. 10	*T. sirtalis*	160	205	surface #44	
Sept. 17	*T. sirtalis*	155	200	surface #3	
Sept. 17	*T. sirtalis*	160	210	surface #3	
Sept. 17	*T. sirtalis*	160	200	surface #3	

Sept. 17	*T. sirtalis*	140	185	surface #6	

Table 10. Continued

Date	*Species*	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Physical Info
Sept. 17	*T. sirtalis*	145	190	surface #8	
Sept. 17	*T. sirtalis*	165	210	between #14	
Sept. 17	*T. sirtalis*	135	175	surface #21	
Sept. 17	*T. sirtalis*	160	210	surface #21	
Sept. 17	*T. sirtalis*	185	240	surface #21	
Sept. 17	*T. sirtalis*	145	187	surface #25	just ate
Sept. 17	*T. sirtalis*	150	190	surface #25	
Sept. 17	*T. sirtalis*	155	195	surface #25	neck injury
Sept. 17	*T. sirtalis*	162	197	surface #25	
Sept. 17	*T. sirtalis*	152	192	surface #26	scar at 75 mm
Sept. 17	*T. sirtalis*	155	195	surface #28	
Sept. 17	*T. sirtalis*	140	180	surface #35	
Sept. 17	*T. sirtalis*	150	185	surface #42	
Sept. 17	*T. sirtalis*	140	180	surface #43	
Sept. 17	*T. sirtalis*	145	190	surface #43	
Sept. 17	*T. sirtalis*	148	188	surface #43	
Sept. 17	*T. sirtalis*	150	195	surface #43	
Sept. 17	*T. sirtalis*	155	195	surface #43	
Sept. 17	*T. sirtalis*	155	205	surface #43	
Sept. 17	*T. sirtalis*	165	210	surface #43	
Sept. 24	*T. sirtalis*	150	190	between #14	
Sept. 24	*T. sirtalis*	160	210	surface #15	
Sept. 24	*T. sirtalis*	160	205	surface #20	
Sept. 24	*T. sirtalis*	140	180	surface #21	
Sept. 24	*T. sirtalis*	160	200	surface #21	
Sept. 24	*T. sirtalis*	167	206	surface #25	
Sept. 24	*T. sirtalis*	155	196	surface #26	
Sept. 24	*T. sirtalis*	145	195	surface #28	
Sept. 24	*T. sirtalis*	140	178	surface #35	
Sept. 24	*T. sirtalis*	340	445	between #38	
Sept. 24	*T. sirtalis*	150	190	surface #40	
Sept. 24	*T. sirtalis*	162	207	surface #43	
Sept. 24	*T. sirtalis*	155	201	surface #44	
Sept. 24	*T. sirtalis*	164	209	surface #44	
Oct. 1	*T. sirtalis*	150	195	surface #37	
Oct. 1	*T. sirtalis*	165	215	surface #3	
Oct. 1	*T. sirtalis*	175	220	between #9	
Oct. 1	*T. sirtalis*	150	190	between #20	
Oct. 1	*T. sirtalis*	165	205	between #26	
Oct. 1	*T. sirtalis*	135	140	between #36	stub tail
Oct. 1	*T. sirtalis*	140	180	between #38	
Oct. 1	*T. sirtalis*	160	200	between #38	stub tail
Oct. 1	*T. sirtalis*	165	215	between #38	
Oct. 1	*T. sirtalis*	140	175	between #43	
Oct. 8	*T. sirtalis*	157	202	between #9	
Oct. 8	*T. sirtalis*	165	213	between #21	
Oct. 8	*T. sirtalis*	165	211	surface #25	
Oct. 8	*T. sirtalis*	150	195	surface #37	
Oct. 8	*T. sirtalis*	140	177	surface #43	
Oct. 22	*T. sirtalis*			surface #24	in ant hole

Table 11. Fall 2008 snake-cover results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont for the Red-bellied Snake (*Storeria occipitomaculata*). This is the eighth year of results. In 2008 a record 158 snakes and seven shed skins were recorded. (A previous record of **113** snakes were found and measured in 2006.) Common Gartersnakes and Red-bellied Snakes were found using the covers during the normal count season. Milksnakes were caught earlier in the summer (see Table 14).

Date	Species	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Mass and Physical Info
Aug. 28	*S. occipitomaculata*	70	90	between #5	young of the year
Aug. 28	*S. occipitomaculata*	160	200	between #13	
Aug. 28	*S. occipitomaculata*	145	180	between #14	Snake found, but then yellow jackets found so snake was put back under #15!
Aug. 28	*S. occipitomaculata*	195	255	between #16	pale underside, getting ready to shed
Aug. 28	*S. occipitomaculata*	185	225	between #21	
Aug. 28	*S. occipitomaculata*			between 30	snake was squished (and dead) – board was a little crooked, like it had been stepped on by something big (bear?)
Sept. 4	*S. occipitomaculata*	75	95	between #5	
Sept. 4	*S. occipitomaculata*	185	225	surface #21	
Sept. 4	*S. occipitomaculata*	165	200	between #22	
Sept. 4	*S. occipitomaculata*	185	215	surface #24	
Sept. 4	*S. occipitomaculata*	185	230	surface #25	
Sept. 4	*S. occipitomaculata*	180	225	surface #25	
Sept. 4	*S. occipitomaculata*	205	250	surface #25	Missing tip of tail, not gravid
Sept. 10	*S. occipitomaculata*	160	212	between #26	
Sept. 10	*S. occipitomaculata*	65	85	between #5	
Sept. 10	*S. occipitomaculata*	80	100	between #5	
Sept. 10	*S. occipitomaculata*	80	99	surface #5	
Sept. 10	*S. occipitomaculata*	145	190	between #5	
Sept. 10	*S. occipitomaculata*	195	240	surface #21	
Sept. 10	*S. occipitomaculata*	176	226	surface #25	
Sept. 10	*S. occipitomaculata*	215	260	surface #25	missing tip of tail not gravid
Sept. 17	*S. occipitomaculata*	75	90	between #14	shed skin keeled scales counted 14 or 15 across body – a little hard to see because it was so little
Sept. 17	*S. occipitomaculata*	75	90	between #14	
Sept. 17	*S. occipitomaculata*	160	205	surface #25	
Sept. 17	*S. occipitomaculata*	175	230	surface #40	very little taper
Sept. 24	*S. occipitomaculata*	95	120	surface #3	
Sept. 24	*S. occipitomaculata*	235	287	between #23	
Sept. 24	*S. occipitomaculata*	195	241	surface #24	
Sept. 24	*S. occipitomaculata*	160	205	surface #25	
Sept. 24	*S. occipitomaculata*	240	300	surface #37	
Sept. 24	*S. occipitomaculata*	225	295	surface #40	
Oct. 1	*S. occipitomaculata*	70	90	between #7	
Oct. 1	*S. occipitomaculata*	85	110	between #7	
Oct. 1	*S. occipitomaculata*	85	110	between #8	
Oct. 1	*S. occipitomaculata*	200	250	between #9	
Oct. 1	*S. occipitomaculata*	200	240	between #13	

Table 11. Continued

Date	Species	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Mass and Physical Info
Oct. 1	*S. occipitomaculata*	155	195	between #14	
Oct. 1	*S. occipitomaculata*	80	105	between #25	
Oct. 1	*S. occipitomaculata*	185	230	surface #26	
Oct. 1	*S. occipitomaculata*	90	115	between #36	
Oct. 8	*S. occipitomaculata*	75	96	between #2	
Oct. 8	*S. occipitomaculata*	70	90	surface #3	Black face
Oct. 8	*S. occipitomaculata*	95	115	surface #3	
Oct. 8	*S. occipitomaculata*	75	96	surface #8	
Oct. 8	*S. occipitomaculata*	77	100	surface #8	
Oct. 8	*S. occipitomaculata*	200	248	surface #8	
Oct. 8	*S. occipitomaculata*	150	200	surface #21	
Oct. 8	*S. occipitomaculata*	160	205	surface #21	
Oct. 8	*S. occipitomaculata*	186	241	surface #21	
Oct. 8	*S. occipitomaculata*	175	233	surface #24 hole	
Oct. 8	*S. occipitomaculata*	82	107	surface #25	
Oct. 8	*S. occipitomaculata*	78	101	surface #27	
Oct. 8	*S. occipitomaculata*	81	106	between #36	
Oct. 8	*S. occipitomaculata*	84	106	surface #36	
Oct. 8	*S. occipitomaculata*	190	228	surface #40	
Oct. 15	*S. occipitomaculata*	68	80	surface #5	Dark charcoal
Oct. 15	*S. occipitomaculata*	75	95	between #9	
Oct. 15	*S. occipitomaculata*	200	260	between #9	
Oct. 15	*S. occipitomaculata*	70	90	surface #20	
Oct. 15	*S. occipitomaculata*	84	107	between #21	
Oct. 15	*S. occipitomaculata*	85	110	between #21	
Oct. 15	*S. occipitomaculata*	146	194	between #21	
Oct. 15	*S. occipitomaculata*	80	102	surface #25	Dark Charcoal
Oct. 15	*S. occipitomaculata*	140	167	surface #45	
Oct. 22	*S. occipitomaculata*	80	100	surface #25	
Oct. 22	*S. occipitomaculata*	86	112	surface #39 hole	
Oct. 29	*S. occipitomaculata*			surface #8 surface depression	Young of year lost in the snow

Table 12. Total captures per visit under snake-covers 1-40 over entire season (2001-2008) on Lester Anderson lands in Lincoln, Vermont.

Species	2001	2002	2003	2004	2005	2006	2007	2008
S. occipitomaculata	0.7	2.4	0.7	0.6	1.3	8.7	1.8	6.6
T. sirtalis	0.0	1.1	0.6	1.8	1.1	7.4	3.1	7.6
L. triangulum	0.0	0.4	0.6	1.0	0.3	0.0	0.0	0.0
Total	**0.7**	**3.9**	**1.8**	**3.4**	**2.7**	**16.1**	**4.9**	**14.2**

Table 13. Percentage of young-of-the-year captured under snake-covers 1-40 (2001-2008) 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
S. occipitomaculata	40%	63%	60%	50%	38%	56%	40%	47%
T. sirtalis	N/A	89%	100%	93%	75%	100%	91%	95%
L. triangulum	N/A	33%	25%	0%	0%	N/A	N/A	N/A

Table 14. Snakes captured under snake-covers, or seen in the vicinity, previous to and during the 2008 season.

Date	Species	S-V length in mm	Total length in mm	Location Cover # - Cover Area	Mass and Physical Info
July 30	*L. triangulum*	730	840	#38 - between	Missing tip of tail. Complete Y, fairly tan background color, 4 is broken on left, 5 L's to right, 7 L's to right, 8 is broken, 12 Y's right, 25 is broken, 27 is broken, 30 is broken to right, 33 L's left, 34 L's left, 35 L's left, 37 is broken left and r (CHECK DATABASE FOR REST)
July 30	*L. triangulum*	220	250	#7 - between	Y complete and enclosed. Not counting the Y blotch, 10 is a zigzag with lower extension on right, 15 is broken on left, vent between 33-34, 39 is broken in middle, 43 to tip.
July 30	*S. occipitomaculata*	210	260	#11 - between	Gravid, 8 embryos palpated
July 30	*S. occipitomaculata*	225	275	#11 - between	Gravid, 7 embryos palpated
July 30	*S. occipitomaculata*	210	260	#20 - between	Gravid, 8 embryos palpated
July 30	*S. occipitomaculata*	190	238	#21 - between	Gravid, 9 embryos palpated
July 30	*S. occipitomaculata*	210	239	#21 - between	Gravid, 11 embryos palpated
July 30	*S. occipitomaculata*	235	290	#21 - between	Gravid, 10 embryos palpated
July 30	*S. occipitomaculata*	195	240	#27 - between	Gravid, 10 embryos palpated
July 30	*S. occipitomaculata*	200	245	#27 - between	Gravid, 8 embryos palpated
July 30	*S. occipitomaculata*	210	260	#27 - between	Gravid, 8 embryos palpated
July 30	*S. occipitomaculata*	140	185	#8 - ground	
July 30	*T. sirtalis*	245	328	#32 - between	
Oct. 8	*L. triangulum*	800	920	In foundation	Y is a U, count 1st dark spot,1-2 connected RT, 7 is Y RT, 20 is Y LFT, 41 is vent, 45 Y RT, 51 to tip. Dark very little red garter skin.

Figure 1a: High Counts of Spotted Salamander egg masses on Lester Anderson Lands, Lincoln Vermont (1999-2008)

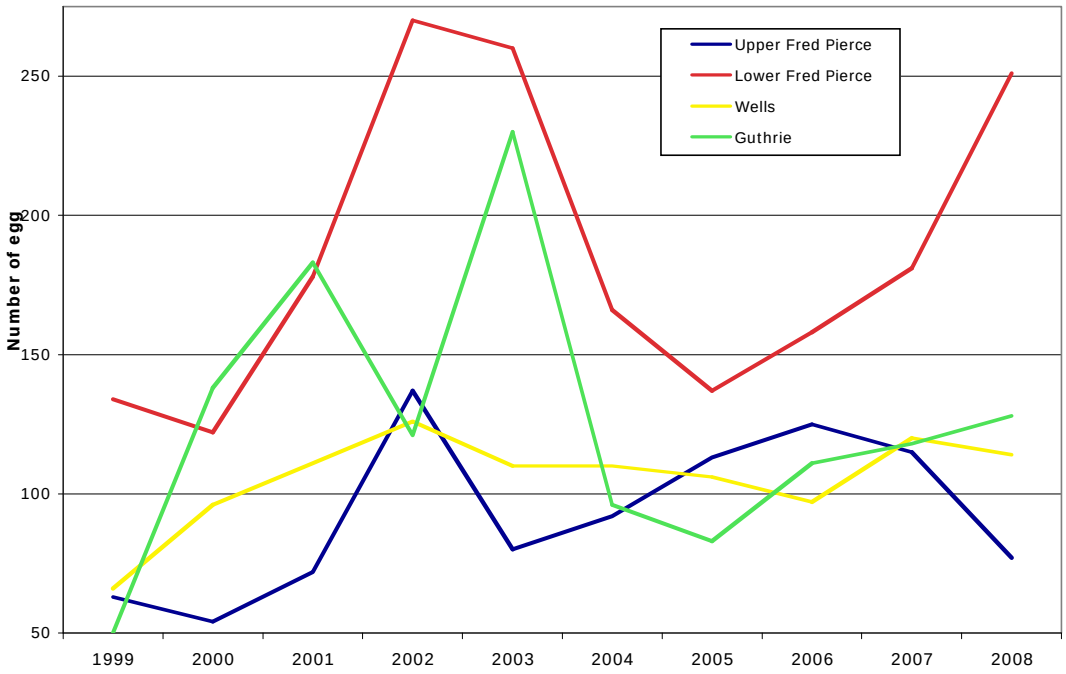

Figure 1b: High-count Trend Lines for Spotted Salamander egg masses on Lester Anderson Lands, Lincoln Vermont (1999-2008)

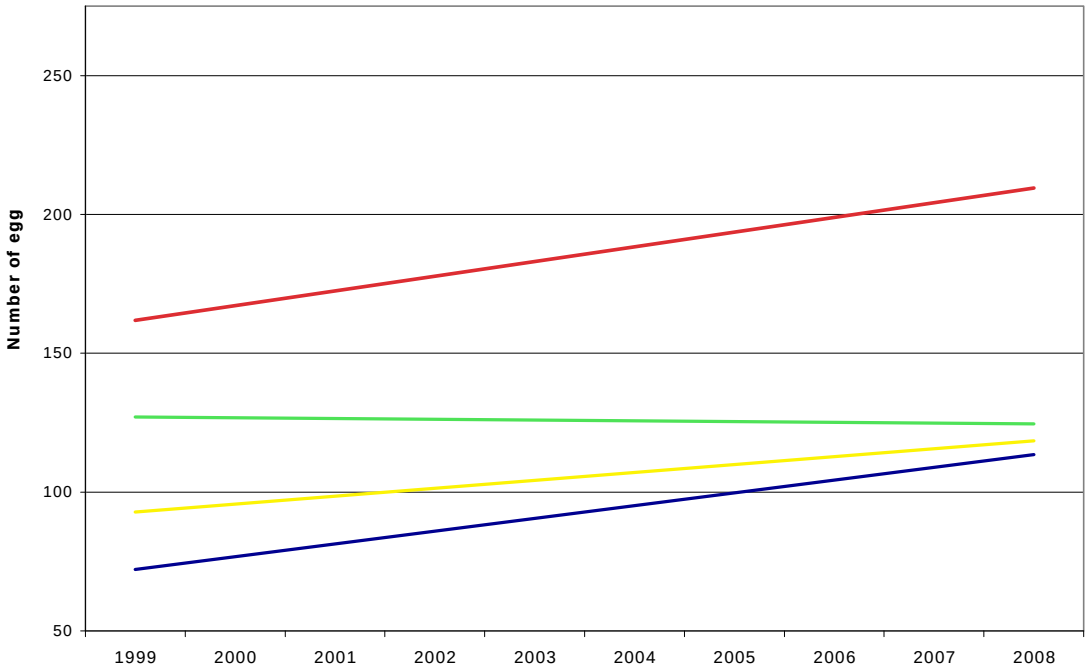

Figure 2a: High Counts of Wood Frog egg masses on Lester Anderson Lands, Lincoln, Vermont (2000-2008)

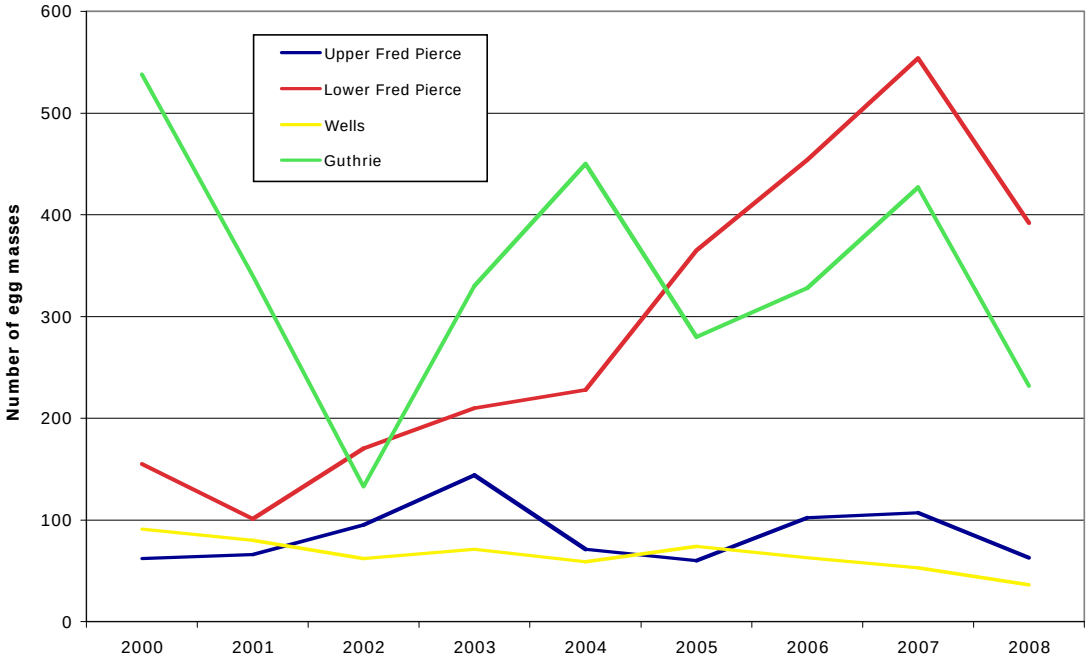

Figure 2b: High-count Trend Lines for Wood Frog egg masses on Lester Anderson Lands, Lincoln, Vermont (2000-2008)

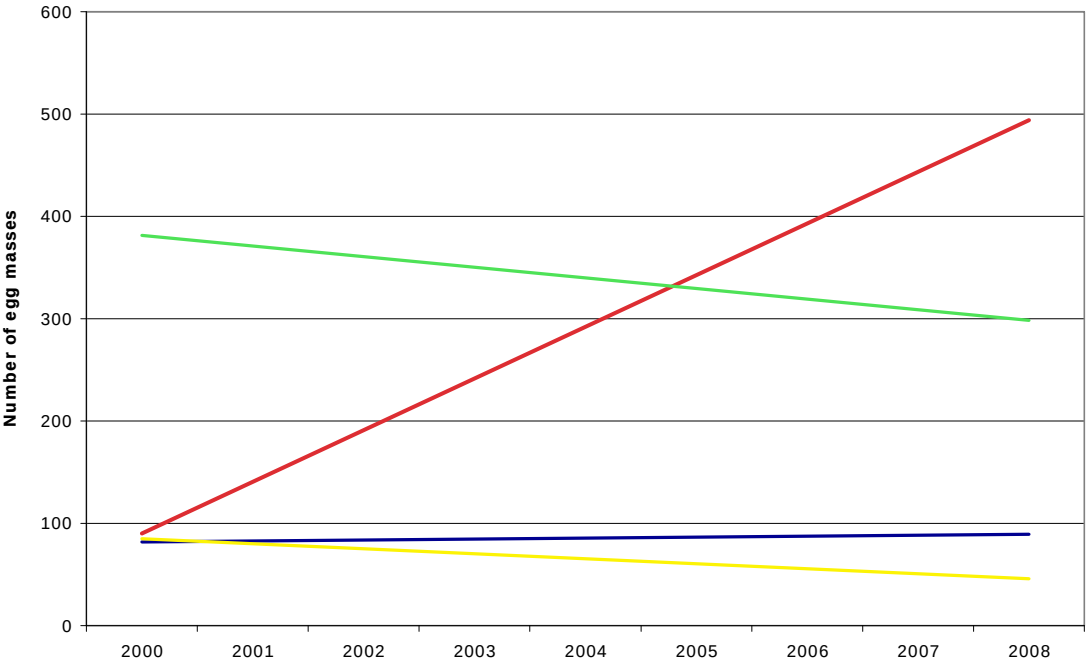

Figure 2C: Average High Counts of Wood Frog and Spotted Salamander egg masses on Lester Anderson Lands, Lincoln, Vermont (2000-2008)

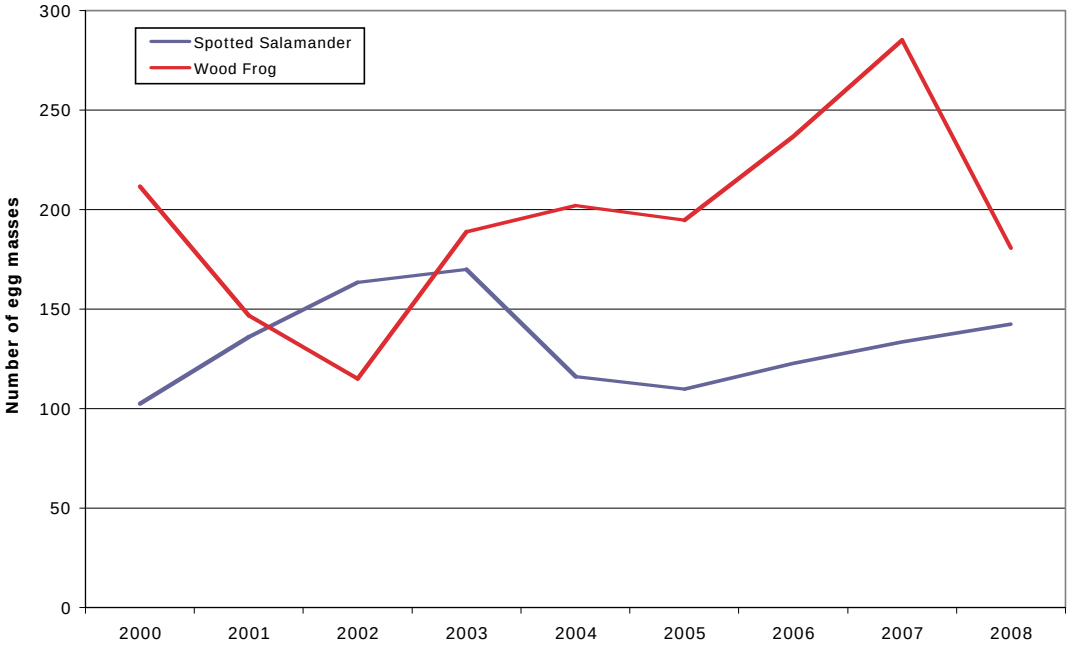

Figure 3a: Number of Spotted Salamander egg masses throughout the spring of 2008 on Lester Anderson Lands, Lincoln Vermont

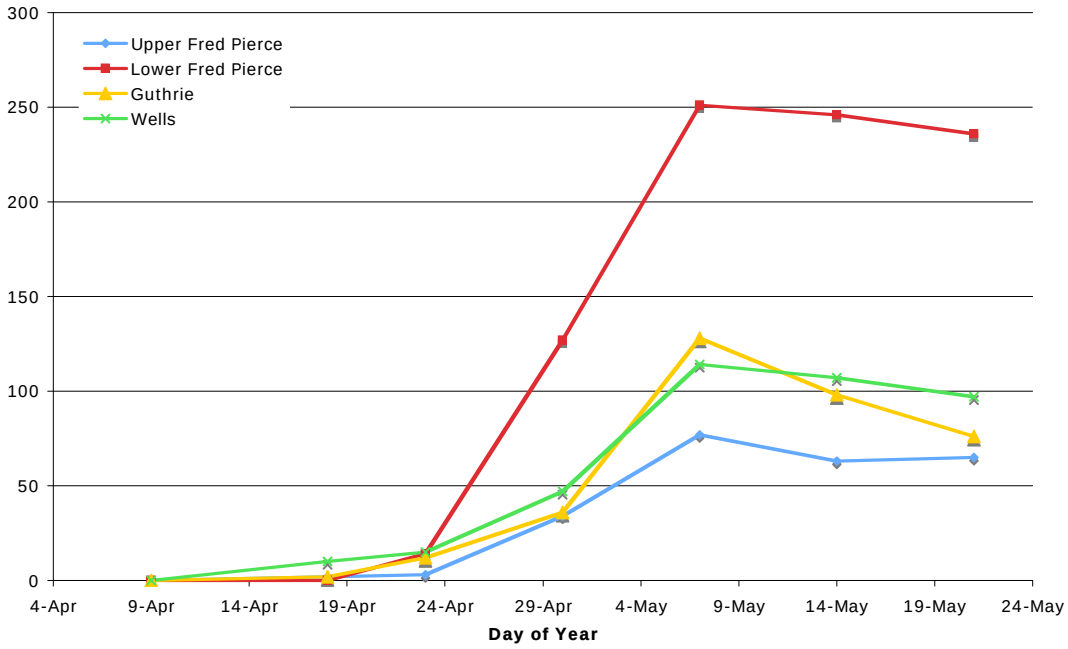

Figure 3b: Number of Wood Frog egg masses throughout the spring of 2008 on Lester Anderson Lands, Lincoln, Vermont

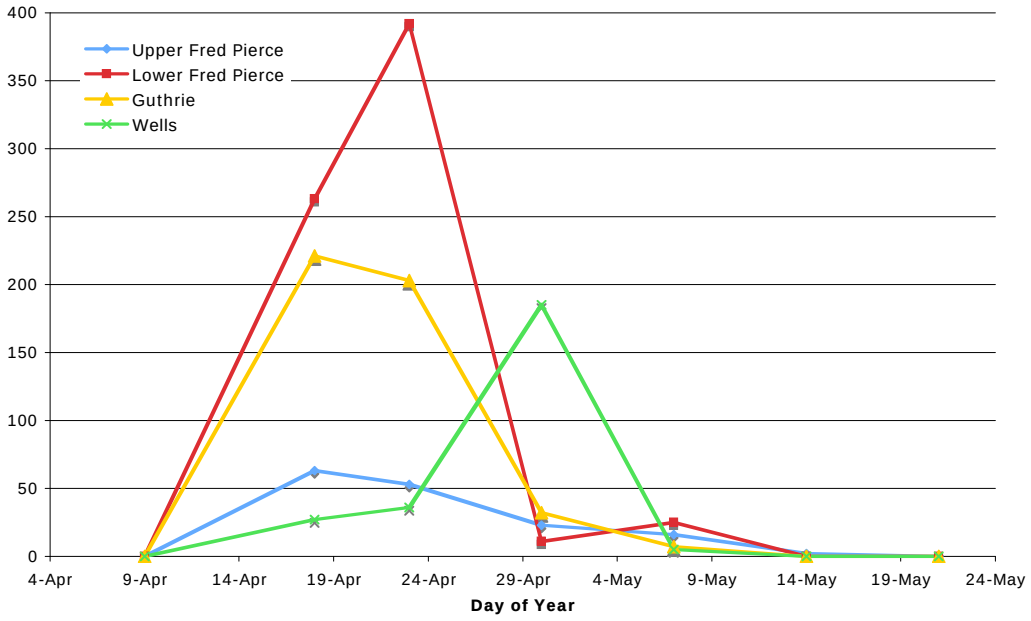

Figure 4a: Number of Spotted Salamander egg masses and rainfall throughout the spring of 2008 on Lester Anderson Lands, Lincoln Vermont

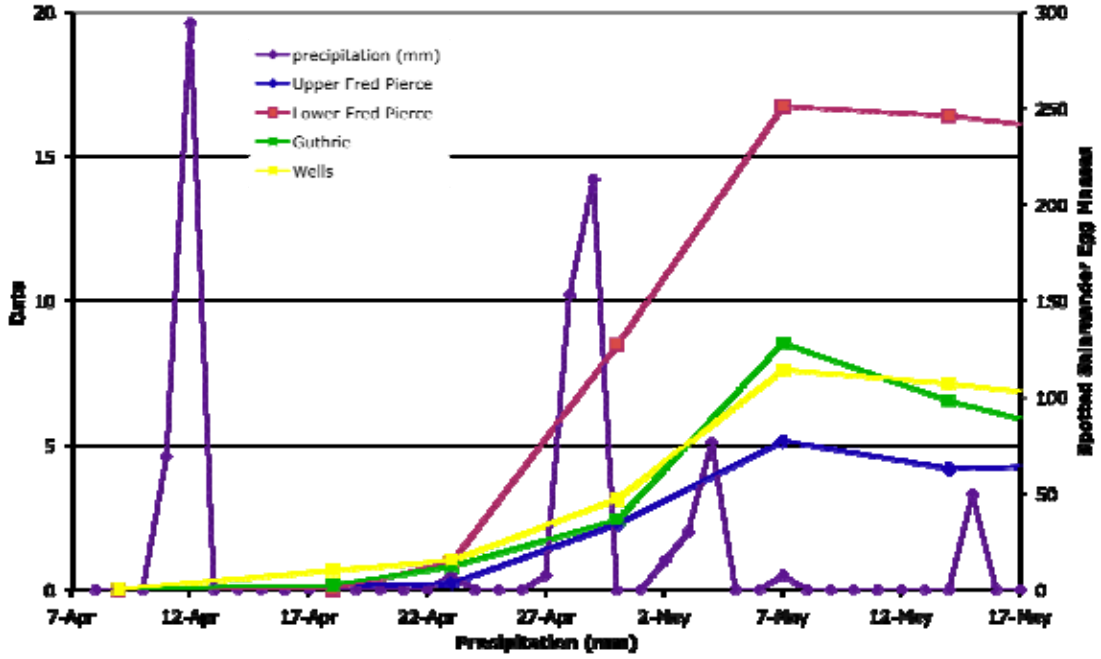

Figure 4b: Number of Wood Frog egg masses and rainfall throughout the spring of 2008 on Lester Anderson Lands, Lincoln Vermont

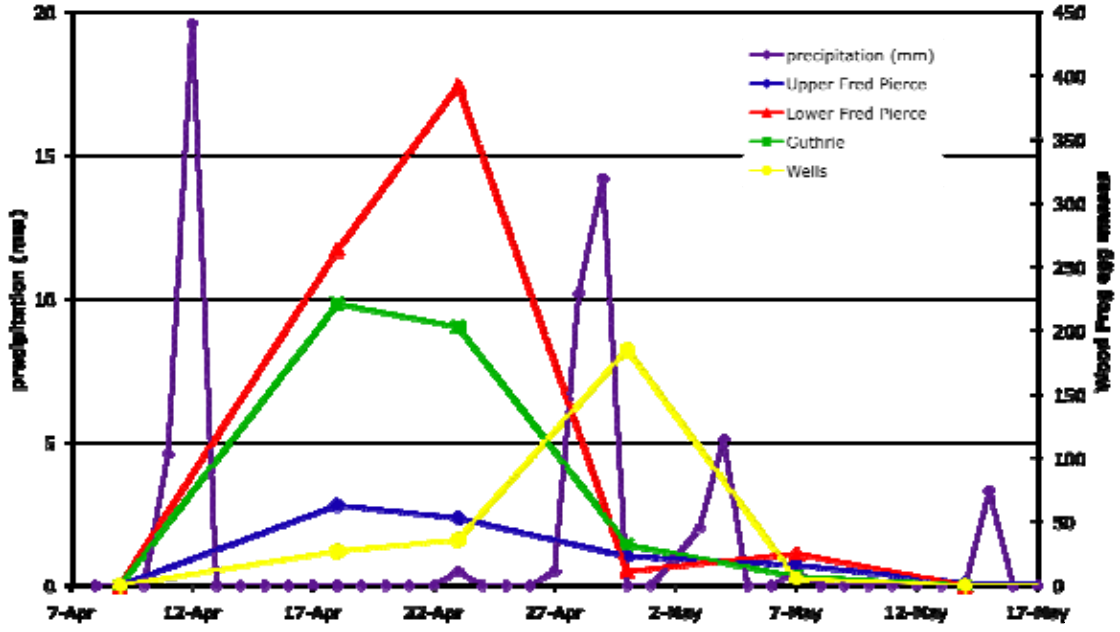

Figure 5: Average Egg-mass numbers at four permanent manmade ponds between 1100 and 1500 feet at the Colby Hill Ecological Project in Lincoln, VT 2000-2008

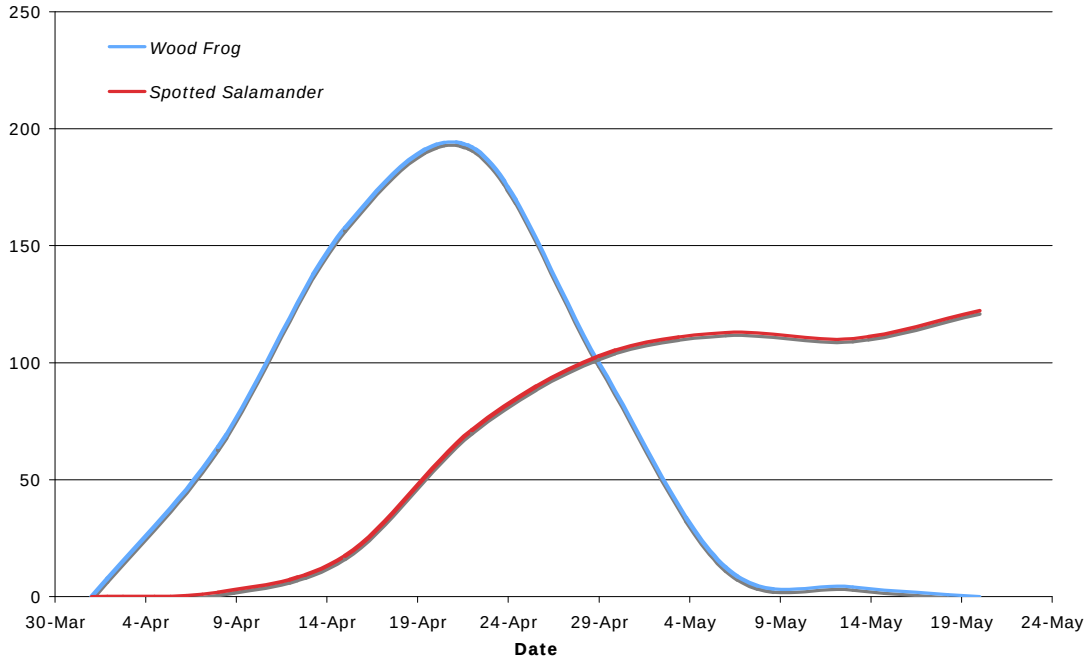

Figure 6A: Number of total snakes seen at each snake cover (2008) on Lester Anderson Lands, Lincoln, Vermont

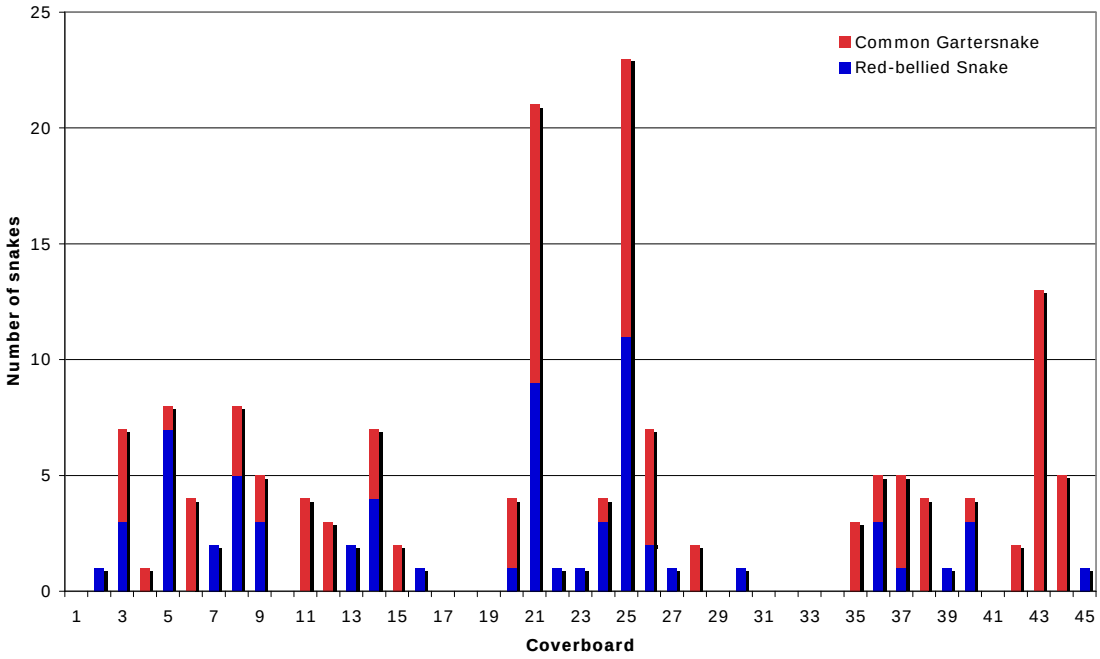

Figure 6b: Number of total snakes seen at each snake cover (2001-2008) on Lester Anderson Lands, Lincoln, Vermont

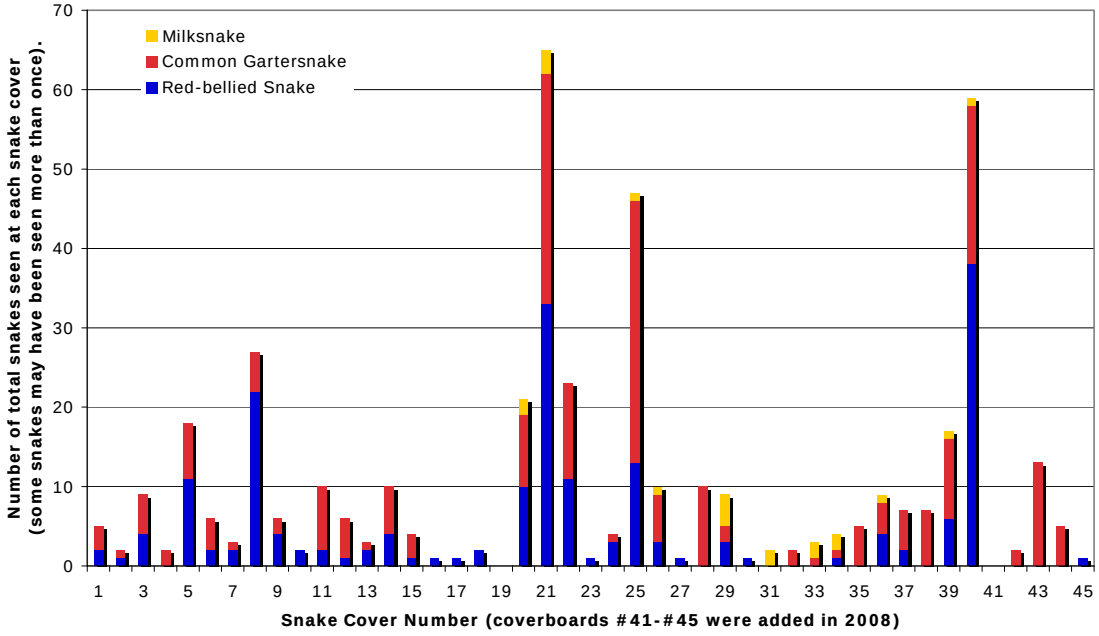

Figure 6c: Increase in egg-mass volume of human embryo at Guthrie. We believe we know the cause and mechanics of this increase.