Amphibian & Reptile Monitoring

During the 2005 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.

Methods

Egg-mass counts

Egg-mass counts took 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 (shown as Todd's Road on the attached map) 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: *Rana sylvatica* (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 melts and continue until egg-laying activity ends or the total number of egg-masses is declining.

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 coverboards 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 which 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. It is expected that these boards will need to be replaced on a rotating basis as they begin to deteriorate. 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 a Magnum 44 permanent marker or 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. The small salamander species which will be monitored using this method often lose all or a portion of their tails to predators (birds and small mammals) so the most reliable measure of size is their snout to vent length as opposed to their total length.

I am also keeping 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.

Snake-covers

The snake-covers are an experiment. 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. Those that had been marked previously with a Magnum 44 permanent marker needed to be remarked with the Mean Streak white paint sticks. The Mean Streak marks are easier to see and do not fade as quickly. A few broken slates were replaced during the early fall of 2005. New slates were slightly longer (610mm x 360 x 20-25 mm thick) but otherwise identical.

In 2005 we started checking the snake-covers on September 8. Starting 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 were checked once a week through October 19. Snake populations are often widely dispersed throughout the foraging season; consequently it was unknown whether forty pairs would attract enough snakes to provide useful data. Conditions under the covers are changing over the first couple years as remaining vegetation dies, invertebrates colonize them, and small mammals begin to tunnel under them. In some places the woods are creeping into the field. Initially the covers were approximately two meters from the woods. In the fall of 2005 we estimated some covers were only 1 meter from the edge of

the currently cut area. In one case the trees and shrubs have been mowed back and snake-cover #25 is farther than 2 m from the edge of the woods.

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 *Rana sylvatica* (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 overwintering 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 overwinters 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 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. The maximum size reported in Vermont has a snout-vent length (SVL) of 365 mm and a total body length (TBL) of 465 mm. That snake was unusually large. Of all the snakes we have with measurements

recorded for SVL and TBL (N=77) the average SVL is 169.4 mm and a TBL of 210.6 mm (Andrews, 2006). They are found throughout the state in forested areas (Andrews, 2006). The have a state rank of S5 and are the third most reported species in the state. They have a brown 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). 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 should be able to draw some conclusions regarding the sexual make up of the snakes using the snake covers.

During the falls of 2002-2005, two additional species were located under the snake-covers: *Thamnophis sirtalis* (Common Gartersnake) and *Lampropeltis triangulum* (Milksnake).

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). They are the most common snake in the state (Andrews, 2006) 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 a SVL of 360 mm – 390mm, females usually mature in two to three years at an SVL of 420 mm to 550 mm. Litter size ranges from 1 to 101 and averages 27. The young 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). Based on our records for adult and juvenile Common Gartersnakes found in Vermont the average SVL is 332 mm and TBL is 419 mm (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 2005 egg-mass counts were performed on six dates (April 13, April 20, April 26, May 4, May 11, and May 25) 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 first week of April had considerable rain, and the second week was relatively dry. The temperature during those first two weeks was generally above average and amphibians were found moving in the lowlands during the last week of March and the first week of April. The first Wood Frogs made it to the ponds in Lincoln early in April. Our high counts for Wood Frog egg masses in all four ponds were between April 19 and April 27. By the last count on May 25, all Wood Frog egg masses had hatched. Timing of the counts for the Spotted Salamander was also appropriate. There were very few egg masses seen on the first count and the peak egg-mass numbers were on the fourth and fifth counts (between May 3 and May 12). We extended our counts into late May to ensure that the no new egg masses were being added, and we found that by then most Spotted Salamander egg masses were green and many of the embryos had already developed gills.

Tables 5-8 show that the counts for Spotted Salamanders at all sites were considerably lower than the record high counts from other years. None of the pools had record high counts nor did they have record low counts. Guthrie did have its second lowest count of 83, which is considerably down from 2004 and considerably down from the highest count in 2003 when it was 230. 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), there are not enough data to make any statistically significant conclusions, but it appears that the number of high counts is on an upward trend (see Figure 1b). 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 just the high count numbers, this suggests that in 2003 the number of breeding females ranged from ~27 at Upper Fred Pierce to ~87 at Lower Fred Pierce. In 2004, the number of females ranged from ~31 at Upper Fred Pierce to ~55 at Lower Fred Pierce. In 2005 the number of breeding females ranged from ~28 in Guthrie to ~46 at Lower Fred Pierce.

This year the greatest number of Wood Frog egg masses were found at Lower Fred Pierce with 365 found on April 20. In previous years Guthrie has been the most productive in terms of Wood Frog egg masses. This is the first year that was not the case. Annual variation in these numbers is to be expected, and can be seen in Tables 5-8 and Figures 2a and 2b. Although there is year-to-year variation, it is not consistent from pond to pond (see Figure 2a). There are not enough data to make any statistically significant conclusions but it appears that the number of high counts is on an upward trend for Lower Fred Pierce and Guthrie (see Figure 2b). Wells remains relatively constant, and this may be due to its small size and limited substrate. The number of egg masses appears to be declining in Upper Fred Pierce. This year, like 2004, there was a great deal of Wood Frog egg mass destruction in Upper Fred Pierce. On April 13 we counted 26 masses and on April 20th the number of masses had increased to 60. On those days we also saw between 125 and 200 Green Frog (*R. clamitans*) tadpoles. By May 4th only 2 fresh egg masses were found. Green Frog tadpoles had seemingly destroyed the older masses. The tadpoles were constantly swimming through the masses eating the algae off the masses. For the second year in a row we did not see any Wood Frog tadpoles in Upper Fred Pierce. It appeared that

the thicker and firmer gel on the Spotted Salamander egg masses was protected them from the Green Frog tadpoles as those masses were not affected. Green Frogs tadpoles often overwinter for at least one winter, and the tadpoles found in Upper Fred Pierce probably hatched the previous summer. Based on our records Green Frog egg masses are found in Vermont between May 19 – and July 30 (Andrews, 2006). It would be interesting to survey the pond in June or July to look for Green Frog egg masses. Again this year, the later egg deposition of Spotted Salamander versus Wood Frog is clearly seen (see Figures 3A and 3B). In addition to species-specific differences, the timing of breeding also depends on elevation, aspect, spring temperatures, rainfall, and the amount of snow accumulated.

To establish useful baseline indices, I had previously recommended at least five years of egg-mass counts. We now have seven years of data from the ponds, however the first year was poorly timed. Annual counts from now on will help us to determine breeding trends and responses to weather events, predators, and habitat changes. What this gives us is a rough, relatively inexpensive indicator of the productivity of these ponds and their surrounding woodlands for these two species.

Invertebrates noted this year included predaceous water beetles, water boatman, macrobodellan leeches, and caddis fly larvae. Two macrobodellan leeches were found swollen and covered with ice crystals on the grass near Guthrie on April 13. They possibly had attempted to attach to a mammal while the mammal in the pond, and then fell off after the animals moved away from the pond. Numerous birds were seen or heard in the vicinity of the ponds during the egg mass counts including; American Kestrel, American Robin, Barn Swallow, Barred Owl, Black-capped Chickadee, Black-throated Green Warbler, Blue-headed Vireo, Blue Jay, Chipping Sparrow, Common Raven, Dark-eyed Junco, Eastern Phoebe, Northern Flicker, Ovenbird, Purple Finch, Red-breasted Nuthatch, Red-tailed Hawk, Red-winged Blackbird, Rock Pigeon, Rose-breasted Grosbeak, Ruffed Grouse, Savannah Sparrow, Sapsucker, Tufted Titmouse, and White-throated Sparrow

During egg mass counts we also found Green Frogs *(Rana clamitans)* and Eastern Newts (*Notophthalmus viridescens*) at all the breeding ponds. These species lay eggs during the late spring or summer and are not suitable for spring egg-mass monitoring. Both of these common species spend their adult lives in or near still water. Spring Peepers (*Pseudacris crucifer)* were heard or seen at all of the egg-mass survey ponds. This is a common spring-breeding species but it does not deposit conspicuous egg-masses, so it is not as convenient a species to monitor. We also heard or saw American Toads (*Bufo americanus*) on two occasions. American Toads don't usually call or become active until the temperatures are relatively warm. On both occasions the day was between 64 F and 68 F and the previous days had been even warmer.

Cover-boards

The cover-boards were checked on eight dates: June 28, August 3, Sept 7, 14, 21, 28, Oct. 5, 12, 19 (Table 10 and 11). We did not continue to check the cover-boards into November as we had in previous years. This year instead we did two counts in the summer, and stopped the counts in the fall once we determined the numbers of salamanders seen each week was decreasing.

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 using the boards. Twelve Red Efts were found this year (Aug 3, Sept 7, 14, 21, and Oct 5). For the second year in a row a Two-lined Salamander (*Eurycea bislineata*) was also found under a cover-board. This species is predominantly found in saturated soils. None of these sightings were included in Table 10.

In 2005 the high count for numbers of Red-backed Salamanders found under the cover-boards on one day was 101 (9/7) (Table 10). In 2004 the high count was 92 (9/29), in 2003 it was 119 (9/19), in 2002 it was 109 (9/12), in 2001 it was 94 (9/16), and in 2000 it was 36 (10/27). With the exception of 2001, and 2004, the high count has always been the first count in the fall. Last year we started a few weeks earlier and the high count was on the fourth count. This year we added the two summer counts and started earlier in September. We found the high count to be on our first fall count on September 7, but the numbers remained fairly high and 87 were found on Sept 28. 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 recent results published by Marsh and Goicochea (2003). They also found no difference between covers checked every week and covers checked every three weeks. One possible explanation for high numbers in early fall may be that the 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 numbers are due to salamanders congregating together for mating before dispersing underground for over wintering. Another possible reason for the increase in the fall is the addition of young of the year. Based on Vermont data, juvenile Red-backed Salamanders are most often found from late July through November (Andrews 2006). The counts on June 28 and August 3 were added to examine the cover-board use in the summer and to verify that the high counts do occur in the fall. We found 73 and 68 Eastern Red-backed Salamander respectively (Table 10).

This year, the bulk of the population under the boards continues to be in the 31-40 size-class (61%) and there were no salamanders over 50-mm snout to vent length this year (see Table 11). In 2003 and 2004 the same pattern was seen. In 2004, 31% of the salamanders were in the 21-30 mm category[1], which was a change from 2003 when only 14.47% were in that category (see Table 12). This year 16 % were found in this category. The reason for the large increase in juveniles between 2003 and 2004 was not known and it now appears the cohort of juveniles is decreasing slightly as those salamanders continue to grow and have moved into the larger size category. Female Red-backed Salamanders reach sexual maturity within 3.5 years when they are between 34-39 mm and males reach sexual maturity when they reach 32-37 mm (Petranka 1998). It appears that this population has a

[1] Approximate numbers were calculated by doubling the number of salamanders found under the odd cover-boards in 2004 and cover-boards A in 2003.

high number of sexually mature adults. It is interesting to note that the first young of the year was seen on Sept 7 (size class 1-20 mm) and a few more were seen October 5, 12, and 19.

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. Occasionally we can surmise that we are seeing the same salamander more than once, for example on September 21, 2006 a lead phase Eastern Red-backed Salamander was found under cover-board 8A with measurements of 42 SVL and 94 TBL. On September 28 a lead phase salamander was seen under cover-boards 8B that escaped. On October 5, 2006 under cover-boards 8B another lead phase salamander was found with a measurement of 42 SVL and 94 TBL. Generally lead phase salamanders are rare at this site. Of the 581 Red-backed Salamanders observations made at this site over the season, only 8 were lead phase.

Many invertebrates are found during the study season including slugs, their eggs, ants, spring tails, millipedes, centipedes, camel crickets, ground beetles, earthworms, and a huge number of mosquitoes were noticed during the summer counts. Metamorph American Toads (*Bufo americanus*) and Wood Frogs were found accidentally while checking the cover-boards on September 14.

Snake-covers

All snake-covers were checked at weekly intervals starting on Sept 8 with succeeding checks on September 14, 21, 28, October 12 and 19 (Table 13). In 2002 we saw the species total rise from one to three and the total number of captures rise from five to 31, in 2003 the number of captures was 11, in 2004 it was 30, and in 2005 it was 19. As mentioned previously, the two new species were *Thamnophis sirtalis* (Common Gartersnake) and *Lampropeltis triangulum* (Milksnake). Both of these were found along with *Storeria occipitomaculata* (Red-bellied Snake). Neither of these species is rare and both had been located on this parcel of land during Jeremy Hertzig's (1998) inventory. This year, based on the measurement and location data we caught eight different Common Gartersnakes, two Milksnakes, and nine Red-bellied Snakes. Last year we caught the same three species: fourteen Common Gartersnakes, six Red-bellied Snakes, and ten Milksnakes (see Table 14). Since some snakes of the same species were very close in size and measurements of live snakes vary with the behavior of the snake, and the experience of the measurer, it is possible that a snake, although slightly different in measurement, could be caught more than once. In 2005 there were no snakes that appeared to be caught more than once during the season.

Common Gartersnakes give birth in the late summer. In 2004 on September 15 we caught nine juvenile Common Gartersnakes under the covers, the next week (September 22) we caught 2, and the following week (September 29) we caught 4. This year we found four juveniles (based on size) on Sept 8, one on September 14, and one on Sept 28.

Although the fifth year of results, these results should be considered only the fourth year of the baseline data using this method. After the first year, the new covers were replaced

with thicker slabs that would resist breaking when the grass is cut. Unlike year one, these remained in place successfully throughout the year. In addition, the local microhabitat that exists in and around the covers was still stabilizing over the first year. Vegetation under the covers was dying and small mammals and invertebrates were colonizing them. The small mammals and invertebrates create tunnels in which the snakes travel and the invertebrates serve as food and may be creating overwintering microhabitat (see the 2002 report for details). Changes in vegetation immediately surrounding the cover-board, colonization, and tunneling may be ongoing but were far less visible this year. Although for a few cover-boards there has been a change in the distance the cover-boards are from the woods.

As usual, many invertebrates were found using the snake-covers. These were not identified to species. Woolly bears, and ants were seen every time. Small mammal tunnels were visible under many of the covers.

Summary

The **egg-mass** counts were timed well. We now have six solid years of data and are starting to be able to look at year-to-year comparisons. The high counts of Wood Frog egg-masses were slightly above average. We will continue to watch with great interest the interaction between the Wood Frogs and the Green Frog tadpoles at Upper Fred Pierce. The numbers of Spotted Salamander egg-masses were slightly below average with no records broken either with high or low counts. As we collect more years worth of data, we will be able to look at trends that are statistically meaningful.

We now have five solid years of data from the **cover-boards.** Our high count of Eastern Red-backed Salamanders was again in the second week of September. Adding summer counts reinforced that we are not disturbing the cover-boards enough to cause a dip in the numbers, and reinforces that the high counts occur in the fall.

We also have four solid years of data from the **snake-covers**. Our techniques continually improve and we have been learning how to sex snakes using probes and hope to use this technique next year. This could give us additional data on annual growth rates and perhaps other aspects of their natural history. In 2005 as in 2004 we found a high number of juvenile Common Gartersnakes. This indicates a successful year for reproduction. In the future, we will separate juveniles from adults in the tables.

Opportunities for long-term monitoring are both exceptionally rare and very valuable. Most funding for these projects is short-term. This greatly limits the type of data that can be gathered. We appreciate the opportunity that has been created for us through the Colby Hill Ecological Project.

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Table 1. Spring 2005 egg-mass data from Lower Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont.

Location/Date	*Ambystoma maculatum* egg-masses	*Rana sylvatica* egg-masses	Notes
April 13	16	199	Visibility good to excellent.
April 20	9	365	Visibility ok, sun going in and out of clouds, used polarized glasses. Some *R. sylvatica* tadpoles are moving within the eggs, some are very freshly hatched with little tadpoles congregated on eggs. Some masses are very fresh (hours); although most eggs are hatched or about to be. Some eggs look like they have dried out and have formed a crust on top.
April 26	108 Some very fresh, lots in groups on the submergent vegetation and hard to see. Spermatophore found throughout pond.	307 There are about 5 fresh masses Lots of masses on side facing south, many of which are green with moving embryos.	Visibility good to excellent. *R. sylvatica* tadpoles ~ 5000.
May 4	137 Eight masses were opaque. Can still see some Spermatophore. Most egg masses are on bottom in huge piles on submergent vegetation.	147 Lots of remnants, remaining masses are green and eggs are hatching.	Visibility excellent.
May 11	135 Two were fresh, 8 nonviable, and 6 opaque.	3 All 3 are nonviable.	Visibility good, polarizing glasses used. Yesterday (May 10) was warm and in the 70's F. *R. sylvatica* tadpoles > 7000.
May 25	115 Five are opaque, and 9 are nonviable. Hard to see clumps on bottom, probably missed some. Masses are mostly green, and many embryos have gills.	0	Visibility poor, cloudy with slight breeze. *R. sylvatica* tadpoles > 10,000.

Table 2. Spring 2005 egg-mass data from Upper Fred Pierce Pond on Lester Anderson lands in Lincoln, Vermont.

Location/Date	*Ambystoma maculatum* egg-masses	*Rana sylvatica* egg-masses	Notes
April 13	8	26	Visibility good to excellent. Greater than 125 *R. clamitans* tadpoles seen.
April 20	9	60 Egg masses from last week are surrounded by *R. clamitans* tadpoles; one mass is pretty broken up. One egg masses was laid in between the first walk around the pool and the second walk, its diameter was about an inch.	Visibility ok, sun going in and out of clouds, used polarized glasses. Weather has been warm and sunny the last few days, yesterday was almost 70 F, after dark it was still in the 60's. Greater than 200 *R. clamitans* tadpoles seen around the *R. sylvatica* egg masses. They seem to be burrowing in and around them -- for the algae?
April 26	57 Spermatophores were found near the Marsh Marigolds.	30	Visibility good except when wind blows. *R. clamitans* tadpoles are now inundating the R. sylvatica masses on the southeast side of the pond that were fresh last week. Most masses have been broken apart.
May 4	113 Two very fresh. Overall they do not look damaged by *R. clamitans* tadpoles.	2 Two very fresh. All other egg masses are gone, the 2 new masses are on the side of the pond where water drains out.	Visibility good to excellent. Most masses are covered with silt. On the side with Marsh Marigolds, there were so many *R. clamitans* tadpoles the dirt was roiled up.
May 11	104 1 nonviable	0 No masses, but can see little piles of eggs on the bottom.	Visibility ok, water covered with buds, masses covered with silt, polarizing glasses used. More than 500 *R. clamitans* tadpoles, a few have back legs. Some on *A. maculatum* egg masses, but those masses don't appear to have broken through.
May 25	44 Mostly green, three are nonviable, others had nonviable eggs here and there.	0	Visibility poor, cloudy, silt, has settled on bottom. Greater than 115 *R. clamitans* tadpoles, some were resting on *A. maculatum* egg masses, but masses look pretty solid and not harmed by tadpoles. Marsh marigold in bloom.

Table 3. Spring 2005 egg-mass data from Guthrie Pond on Lester Anderson lands in Lincoln, Vermont.

Location/Date	*Ambystoma maculatum* egg-masses	*Rana sylvatica* egg-masses	Notes
April 13	3	100	Visibility ok. Yesterday was sunny, clouded over a little in the evening, cool evening, low in the 30's F
April 20	7	280 Two distinct bunches, of older ones and newer ones. One dragged out onto land. More than 1/2 are new, some aren't fully expanded.	Visibility good to excellent, polarized glasses used. Weather has been warm and sunny the last few days, yesterday was almost 70 degrees F, after dark still in the 60's. Water is still high,
April 26	51 All very fresh.	193 Lots of tadpoles have hatched from big pile. One egg mass pulled out on land.	Visibility good, a little windy. R. sylvatica tadpoles >25.
May 4	52 Two were nonviable, some pretty fresh.	47 Big raft of masses hatched and disintegrated, some old ones with nonviable eggs are left, some that were fresh from last week are still there.	Visibility poor to good, on second time around sun came out, so only used 2nd count. R. sylvatica tadpoles >500.
May 11	83 Eight were primarily nonviable, 1 is fairly fresh about one week old.	10 One was primarily nonviable.	Visibility good, polarizing glasses used. Sun was out, and it was slightly breezy. R. sylvatica tadpoles >15000.
May 25	53 Mostly green. 7 nonviable.	0 Tadpoles have dispersed from edge, a few ones on far side but most are in a black cloud about 3-4 feet from edge. Cloud is 3 feet wide and 2 feet deep, hard to see how far into the pond it goes, maybe 2 feet.	Visibility poor, water high so it was hard to get to edge. Can see nonviable eggs better. Cattails coming up, a gigantic beetle was seen crawling on emergent vegetation, about 2/5 inches long. Heard 3-4 gunshots. R. sylvatica tadpoles >5000.

Table 4. Spring 2005 egg-mass data from Wells Pond on Lester Anderson lands in Lincoln, Vermont.

Location/Date	*Ambystoma maculatum* egg-masses	*Rana sylvatica* egg-masses	Notes
April 13	9	10	Visibility good. Cattails have been cut or pulled there is less egg laying substrate than in previous years. Jim threw in a 4-prong stick.
April 20	15 One mass of a group of nine masses had mostly white eggs.	70 Chorus as we approached, we could see 25 floating in water, they got quiet as we approached.	Visibility okay, sun going in and out of clouds. Used polarized glasses. Pond is still full.
April 26	61 Some are fresh.	74 Eleven masses were on the stick J.A. threw in on April 13.	Visibility good to excellent.
May 4	101 One is primarily white. Some are pretty fresh, one is very fresh (just a few hours).	63 10 were on the stick JA threw in April 13, 2-4 are hatching, some look ready to hatch, most are green.	Visibility excellent, sun came out, no wind, can see to bottom of pond.
May 11	106 Four masses are nonviable. Some masses are pretty fresh.	49 Mostly hatched, tadpoles hanging off masses. Eight masses are primarily nonviable.	Visibility ok. slight breeze, sun going in and out of clouds, polarizing glasses used. R. sylvatica >2500 tadpoles
May 25	88 Four are nonviable. We can see embryos in most masses. Four masses are very fresh, laid in the last 2 weeks.	0 .	Visibility good on one side, poor on the other, water clear, little wind. R. sylvatica >500, primarily on bottom along shore, didn't see any big congregations.

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 2005.

Lower Fred Pierce Pond	*Ambystoma maculatum*	*Rana sylvatica*	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 R. sylvatica 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 days: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	137	365	Timed well, went slightly later than normal

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 2004.

Upper Fred Pierce Pond	*Ambystoma maculatum*	*Rana sylvatica*	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 R. sylvatica 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 days: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	113	60	Timed well, went slightly later than normal

Table 7. Maximum counts of egg-masses in the Wells Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2004.

Wells Pond	*Ambystoma maculatum*	*Rana sylvatica*	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 R. sylvatica 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 days: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	106	74	Timed well, went slightly later than normal

Table 8. Maximum counts of egg-masses at Guthrie Pond on the Lester and Monique Anderson lands in Lincoln from 1999 to 2004.

Guthrie Pond	*Ambystoma maculatum*	*Rana sylvatica*	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 R. sylvatica 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 R. sylvatica irregular spring with 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 days: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	83	280	Timed well, went slightly later than normal

Table 9: Combined high counts for all ponds of egg-masses for *Ambystoma maculatum* and *Rana sylvatica* found on Lester Anderson lands in Lincoln, Vermont.

Lester Anderson Lands (total egg masses)	*Ambystoma maculatum*	*Rana sylvatica*
1999 count dates: 5/5, 5/18	313	76
2000 count dates: 4/17, 4/29, 5/14	410	846
2001 count dates: 5/1, 5/7, 5/14, 5/21	544	587
2002 count dates: 4/23, 5/1, 5/10, 5/20	654	460
2003 count dates: 4/17, 4/25, 5/3, 5/9, 5/20	680	755
2004 count dates: 4/9, 4/15, 4/22, 4/29, 5/6, 5/12	464	808
2005 count days: 4/13, 4/20, 4/26, 5/4, 5/11, 5/25	439	779

Table 10. Fall 2005 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	Unk.[1]	Total
6/28/05	0	3	48	19	3	73
8/3/05	0	1	41	23	3	68
9/7/05	1	21	67	10	2	101
9/14/05	0	19	47	11	1	78
9/21/05	0	9	49	12	0	70
9/28/05	0	19	44	23	1	87
10/5/05	1	10	45	15	2	73
10/12/05	2	15	38	7	0	62
10/19/05	1	9	18	12	1	41
Total	**5**	**106**	**397**	**132**	**13**	**653**

[1]Salamanders escaped before measurements were taken.

Table 11. Percentage of totals for each cohort of Eastern red-backed Salamanders found during fall 2005 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	Unk.[1]	Total
6/28/05	0.00%	4.11%	65.75%	26.03%	4.11%	100.00%
8/3/05	0.00%	1.47%	60.29%	33.82%	4.41%	100.00%
9/7/05	0.99%	20.79%	66.34%	9.90%	1.98%	100.00%
9/14/05	0.00%	24.36%	60.26%	14.10%	1.28%	100.00%
9/21/05	0.00%	12.86%	70.00%	17.14%	0.00%	100.00%
9/28/05	0.00%	21.84%	50.57%	26.44%	1.15%	100.00%
10/5/05	1.37%	13.70%	61.64%	20.55%	2.74%	100.00%
10/12/05	3.23%	24.19%	61.29%	11.29%	0.00%	100.00%
10/19/05	2.44%	21.95%	43.90%	29.27%	2.44%	100.00%
Average	**0.77%**	**16.23%**	**60.80%**	**20.21%**	**1.99%**	**100.00%**

Table 12. Percentage of totals for each cohort of Eastern red-backed Salamanders found during fall 2004-2005 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]
2000	2.10%	21.05%	61.05%	15.79%	0.00%	0.00%
2001	2.44%	9.23%	63.31%	23.37%	0.54%	1.08%
2002	0.22%	11.83%	63.17%	23.43%	0.45%	0.89%
2003[2]	2.20%	14.47%	70.60%	12.28%	0.00%	0.44%
2004[2]	3.57%	30.55%	50.79%	13.50%	0.00%	1.59%
2005	0.77%	16.23%	60.80%	20.21%	0.00%	1.99%
Average	**1.88%**	**17.23%**	**61.62%**	**18.09%**	**0.165%**	**0.99%**

[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 cover-boards A in 2003 and odd cover-boards in 2004.

Table 13. Fall 2005 snake-cover results from the Lester Anderson lands on the Bristol/Lincoln border in Vermont. This is the fifth year of results. Nineteen individuals were caught in 2005[1]. Like last year, three species were caught: the Common Gartersnake (*Thamnophis sirtalis),* the Milksnake (*Lampropeltis triangulum)*, and the Red-bellied Snake (*Storeria occipitomaculata).* The right hand column indicates the exact cover number and whether the snakes were found between the two layers of slate or on the ground underneath the two slate covers.

Date	Species	S-V length in mm	Total length in mm	Location Cover # - Cover Area
Sept. 8	*T. sirtalis*	165	205	32-between slates
Sept. 8	*T. sirtalis*	170	215	39-between slates
Sept. 8	*T. sirtalis*	185	235	11-on the surface
Sept. 8	*T. sirtalis*	185	245	11-on the surface
Sept. 8	*T. sirtalis*	360	445	40-between slates
Sept. 8	*L. triangulum*	380	430	20-between slates
Sept. 8	*L. triangulum*	435	490	21-between slates
Sept. 8	*S. occipitomaculata*	225	275	10-between slates
Sept. 14	*T. sirtalis*	215	265.5	11-on the surface
Sept. 14	*T. sirtalis*	350	455	39-between slates
Sept. 21	*S. occipitomaculata*	105	130	12
Sept. 21	*S. occipitomaculata*	203	268	39
Sept. 28	*T. sirtalis*	195	220	5-on the surface
Sept. 28	*S. occipitomaculata*	200	240	1-between slates
Sept. 28	*S. occipitomaculata*	220	250	5-on the ground
Oct 12	*S. occipitomaculata*	100	120	39-between slates
Oct. 12	*S. occipitomaculata*	185	230	11-on the surface
Oct. 19	*S. occipitomaculata*			21-on the surface
Oct. 19	*S. occipitomaculata*	120	140	21-on the surface

[1]Since accuracy of measurement can vary slightly and young snakes grow quickly, snakes within +/- 9 mm caught at nearby sites (within 2 cover-boards either direction) may be previously recorded individuals. None of the snakes found this year were found more than once.

Table 14. Fall 2001-2005 snake-cover results from the Lester Anderson lands in Lincoln, Vermont.

Species	2001	2002	2003	2004	2005
S. occipitomaculata	5	15-19	5	6	9
T. sirtalis	0	9	3	14	8
L. triangulum	0	3	3	10	2
Total	5	31	11	30	19

Figure 1a: High Counts of *Ambystoma maculatum* egg masses on Lester Anderson Lands, Lincoln Vermont (1999-2005)

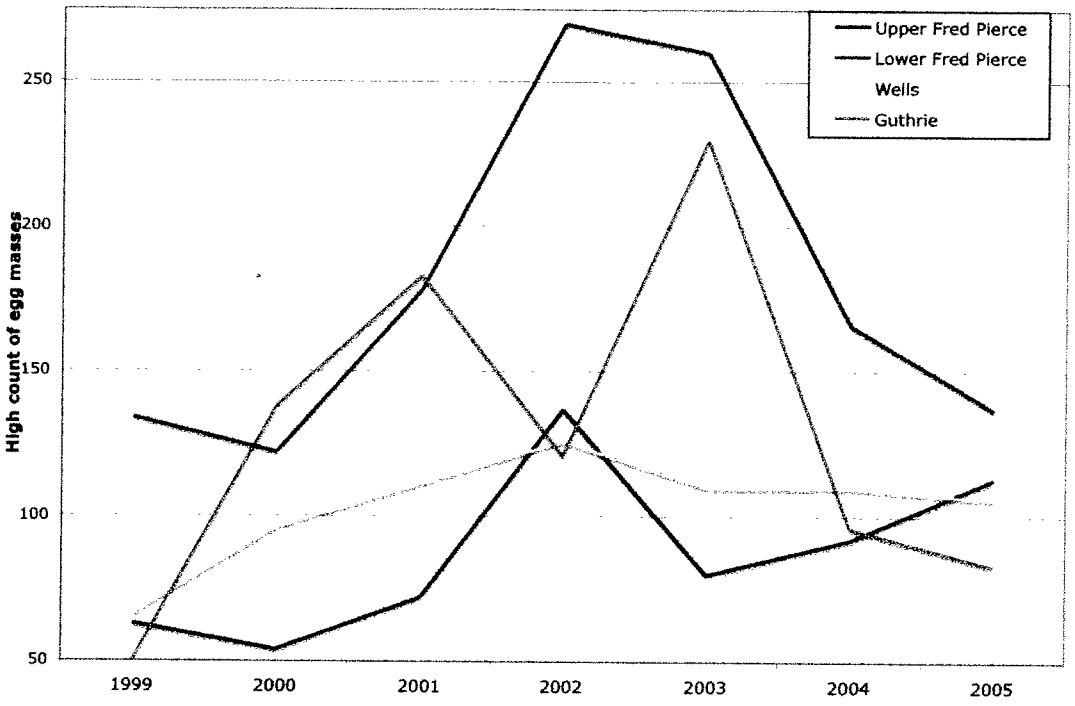

Figure 1b: High Counts Trend Lines for *Ambystoma maculatum* egg masses on Lester Anderson Lands, Lincoln Vermont (1999-2005)

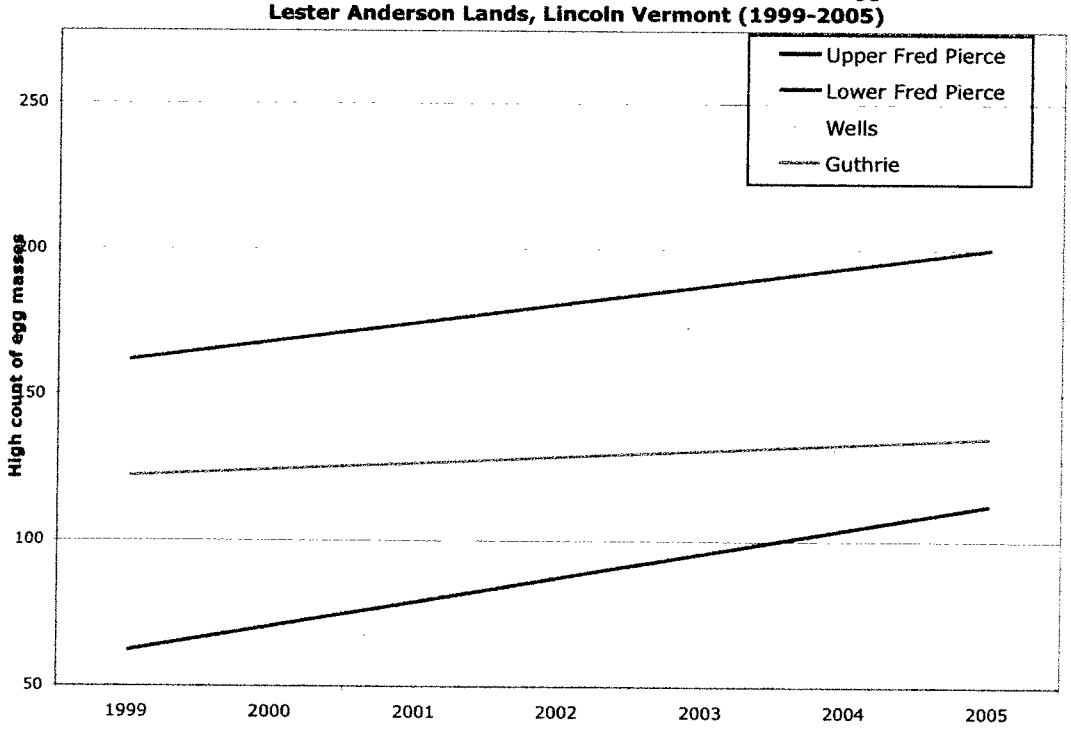

Figure 2a: High Counts of *Rana sylvatica* egg masses on Lester Anderson Lands, Lincoln, Vermont (1999-2005)

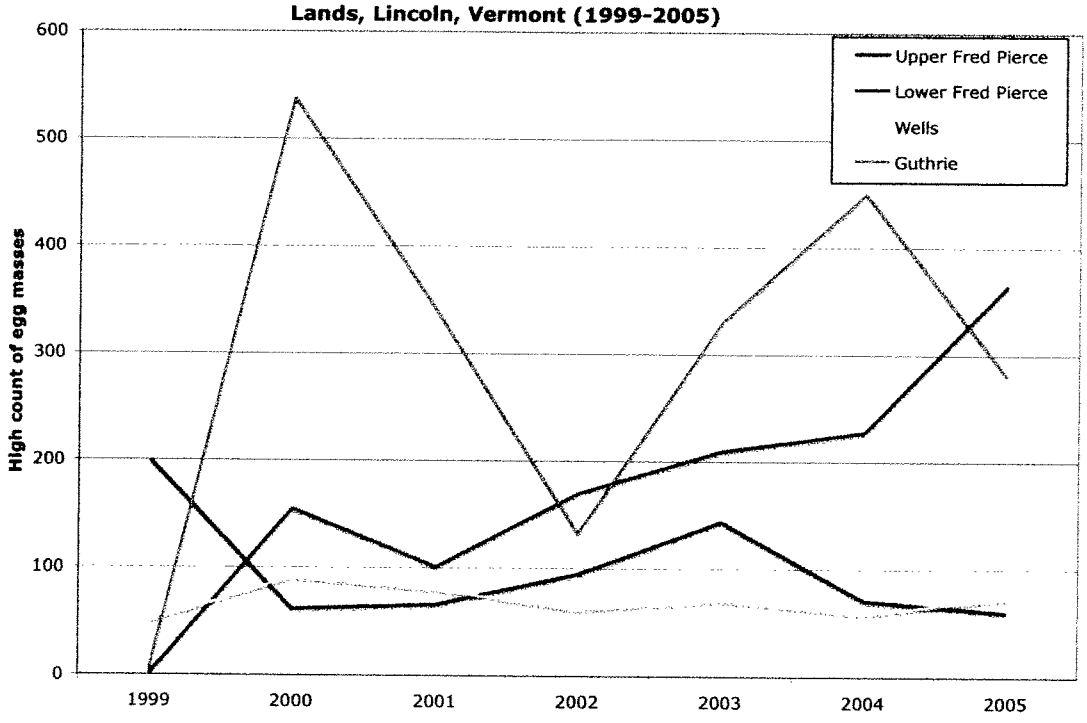

Figure 2b: High Counts of *Rana sylvatica* egg masses on Lester Anderson Lands, Lincoln, Vermont (1999-2005)

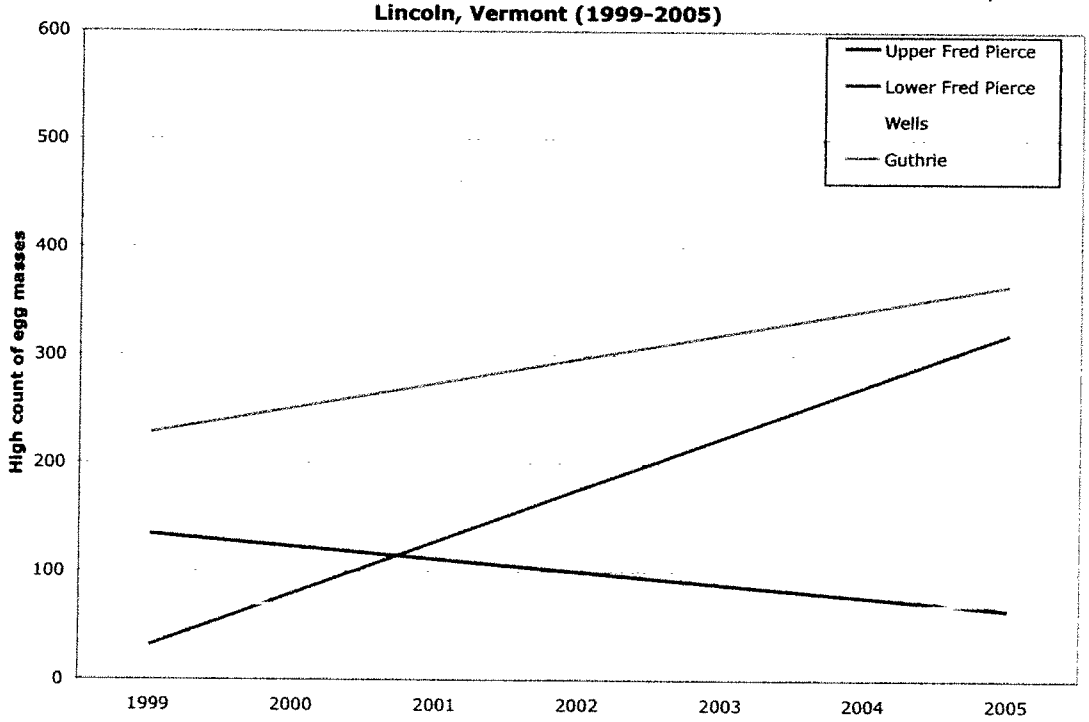

Figure 3a: Number of *Ambystoma maculatum* egg masses throughout the spring of 2005 on Lester Anderson Lands, Lincoln Vermont.

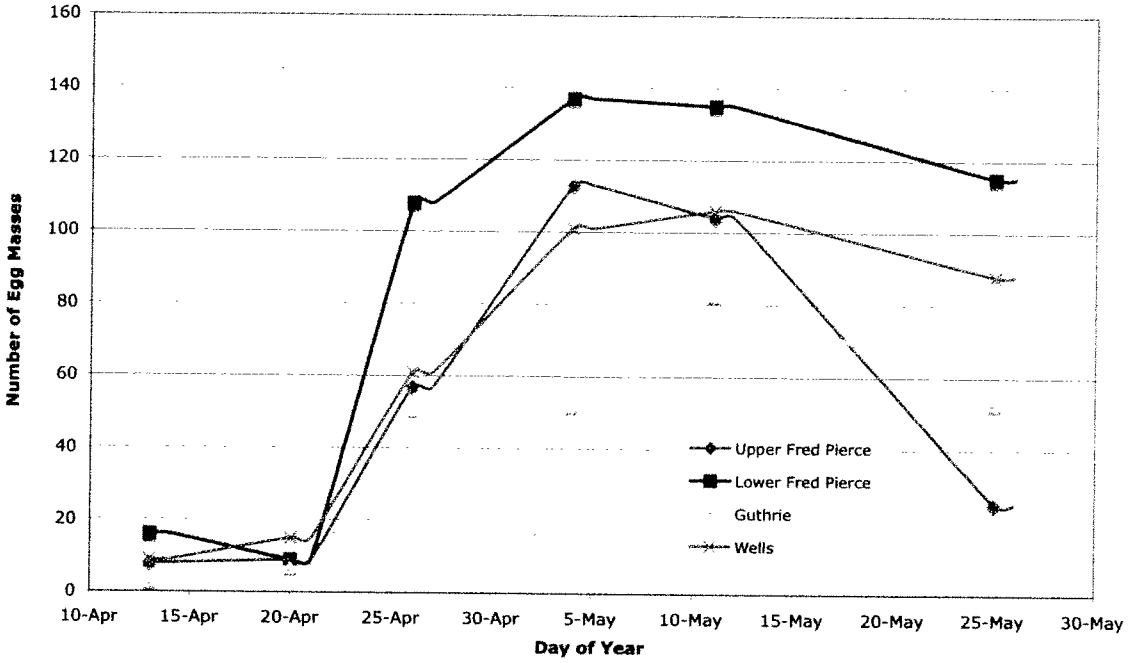

Figure 3b: Number of *Rana sylvatica* egg masses throughout the spring of 2005 on Lester Anderson Lands, Lincoln Vermont