Preliminary Results of the Inventory and Monitoring of Amphibian Biodiversity in the Lye Brook Wilderness Region of the Green Mountain National Forest March-October, 1993

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Abstract

During our first field season at this site (April 28-Oct. 31), 6 field methods revealed 7 species of frog and 6 species of salamander. Three drift fences were built and local teams were selected and trained to run them. Three egg mass counting sites were also located. One partial set of baseline data has been gathered for long term monitoring purposes. The species inventory will be continued next spring but it is unlikely that we will discover any additional species. A comparison of inventory data from this site, Abbey pond, and Mt. Mansfield (all located within the Green Mountains) shows remarkable similarity. The species located at the three sites are identical, with the exception of *Rana catesbeiana* which is missing from Abbey pond (the site does not extend into the adjacent valley as do the other two sites). The most common salamander, *Notophthalmus viridescens*, and frog *Rana clamitans* are the same at Lye Brook and Abbey pond, I suspect due to the large amount of permanent water at both sites. The relative percentages of the other species differ between these two sites. The most notable differences being the higher percentages of stream salamanders; *Eurycea bisliniata*, *Gyrinophilus porphyriticus* and the toad *Bufo americanus* at Lye brook.

Introduction

This report is a summary of the efforts and results of work done in the first year of an initial 18 month study period in the Lye Brook Wilderness area of the Green Mountain National Forest. The intent of the study is to do an initial inventory of the amphibians located in the region and lay the ground work for the long-term monitoring of amphibian populations in the region. Concurrent with this effort is an initial inventory of another site within the main range of the Green Mountains at Abbey Pond outside of Middlebury VT. In this report I have also compared the inventory data from these two sites. In addition long-term monitoring continues in its third year at Mt. Mansfield, Underhill, Vermont.

This region is located in the towns of Manchester, Sunderland, Stratton and Winhall in Bennington County, Vermont. Most of the region consists of a plateau at about 2500 ft. in elevation. It has been logged heavily in the past, but is now protected. The plateau forest consists primarily of a mix of of northern hardwoods and conifers with many bogs, swamps, small lakes, beaver dams and old beaver meadows. The water bodies and the soils of the plateau tend to be acidic. The region drains primarily to the west, dropping in elevation to approximately 800 ft. in elevation. The west facing slopes hold a higher percentage of the northern hardwood forests and a number of fast moving streams. The high point of the region reaches close to 3000 ft.

Methods

At this site six different methods have been used to date.

Active searches are a concentrated effort in a predetermined area to locate amphibians in the leaf litter, under rocks and logs, within rotten logs or under bark. These searches usually are not effectively sustained for more than 1.5 hours.

Site checks are a less localized form of active search that includes time spent searching for and traveling between the best microhabitats.

Canoe searches are used when it it is easier to do a visual search of a lake or pond margin from the water than from the shore.

Drift fences are semi-permanent structures built to interrupt the feeding and migratory movements of amphibians on rainy nights or nights immediately after rains. They are constructed of 30 m

lengths of aluminum flashing. Tangential with the flashing and buried flush with the ground surface are a series of cans and buckets that can be opened prior to evenings of expected amphibian activity. In addition traps that roughly resemble minnow traps made out of window screening are placed parallel to and abutting the fence. This method is the easiest to standardize and hence I feel it is the best method for reliable long-term monitoring. A copy of my drift fence protocol is available upon request from the author.

Night-time visits are made to selected sites in an effort to hear the calls of breeding and territorial anurans (frogs). They should be spread out to cover the full range of breeding seasons and weather conditions.

Night-time road searches are not possible at most remote sites. They involve driving a set route at a speed of ten to fifteen mph with the vehicle window open to hear calling anurans, and eyes on the road and road margins to see amphibians crossing the route. The method can be very effective in roaded areas.

Accidental discoveries are often made while employing a method not intended to locate that specific species or scouting or working at a site. Individuals located accidentally are identified as such in the data base and in the figures.

None of these methods alone will survey the complete range of amphibians possible in an area. A combination of these methods must be employed in an initial inventory effort. In tables 1-4 at the end of this report I have broken down the results and amount of effort by method.

Overview of the Results and Work Effort for the 1993 Field Season

During the first year of this inventory project, 6 salamander species and 7 frog species were located in or near the Lye Brook Wilderness region of the Green Mountain National Forest. Field teams visited ~28 sites in the region and located 564 individuals of 13 species. In addition, 91 egg masses, 20 choruses of breeding frogs and a variety of amphibian larvae were identified. Aside from scouting and building drift fences, data were gathered on 22 different days, using 6 different methods, producing a total of 55 data gathering efforts between the dates of April 28th and October 31st, 1993.

When the raw data are examined using all methods combined, including all metamorphosed individuals (no eggs or larvae) and not including chorusing data, the following percentages are generated;*

Caudates (Salamanders);

Notophthalmus viridescens	Eastern newt	53%
Eurycea bislineata	Two-lined salamander	20%
Plethodon cinereus	Redback salamander	18%
Gyrinophilus porphyriticus	Spring salamander	6%
Ambystoma maculatum	Spotted salamander	2%
Desmognathus fuscus	Dusky salamander	2%

Anurans (Frogs);

Rana clamitans	Green frog	48%
Bufo americanus	American toad	23%
Rana sylvatica	Wood frog	12%
Pseudacris crucifer	Spring peeper	12%
Rana palustris	Pickerel frog	4%
Hyla versicolor	Gray tree frog	.5%
Rana catesbeiana	Bullfrog	.5%

Though not purposefully sought, one snake species was also located;

Thamnophis sirtalis	Common Garter snake

It is important to keep in mind that these percentages are only a rough indicator of the relative abundance of the species in this wilderness area. They are effected by the relative amounts of effort spent using the

different methods. In addition, the time of year during which each method was used, the specific sites surveyed and the weather conditions also have an effect on which species are most likely to be located. For example, I expect that spring peeper and spotted salamander will be found in larger numbers next spring using the drift fences that were built this season. I have tried to show clearly in the figures included later in this report, the results relative to the method, time of year, number of sites and amount of effort. For the purposes of long-term monitoring, results need to be compared between the same methods and sites, sampled during the same mix of times, in similar weather conditions and standardized for the amount of effort.

In addition to the above data gathering efforts, the field teams located sites for and installed three drift fences that are designed to be used as long-term monitoring sites as well as inventory devices. Two of these sites are located on the high plateau south of the wilderness area boundary. A field team of faculty from the Stratton Mt. School has been trained to open and check both fences as well as record the data. The third fence is located at an elevation of close to 800 feet in the extreme northwest corner of the region within the National Forest but just outside of the wilderness area. Due to the large size of the region a separate team of teachers and students from the Burr and Burton Seminary has been trained to open and record data from this fence. In order to effectively use drift fences for monitoring, an individual (or group of individuals) needs to be continually on call to make trips to open the fences when the right environmental conditions exist. I was fortunate to find reliable and interested individuals who live in the vicinity. Although I presently have one adult and a group of students for this fence, I am still looking for a second adult. I now have data from essentially one half of the field season from these fences and will have a full years data by the conclusion of this contract in July of next year.

Of the many potential breeding sites visited, three sites have been designated for long-term monitoring of egg masses. Egg masses of *Rana sylvatica* (Wood Frog) and *Ambystoma maculatum* (Spotted salamander) have been located at these sites. These species are both early spring breeders with obvious and easily identified egg masses. I refer to these sights as Benson Pond, North Alder Dam and Kelly Stand Dam. They are all associated with beaver dams or in beaver meadows, although the Benson Pond site is adjacent to what is apparently a man made permanent pond. At these sites I will standardize a protocol and begin gathering data this spring. I have not located sites that meet the criteria of a classic vernal pool in this area. I am not totally satisfied with the sites I have chosen. Because they are associated with beaver dams or meadows they may be

subject to manipulation and change over time. If I locate more appropriate sites I will relocate the egg mass counts.

As a result of the need for the long-term monitoring sites to be readily accessible from April through October under a variety of weather conditions, they have been located outside of the wilderness area boundaries, however my inventory efforts sampled a wide variety of sites inside the wilderness area and I feel that the sites selected are representative of the habitats within.

The location of the drift fences, and proposed sites for long-term egg mass counts are shown in figures 1 and 2. Maps of the total area surveyed have been forwarded to the GMNF.

* *Notophthalmus viridescens* (Eastern Newt) were sometimes found in large numbers while we were counting egg masses, building drift fences or using a method designed to locate a different species. Occasionally these were entered simply as "many" in the database. Each reference to "many "was counted as 10 individuals in the data analysis. I believe this is a conservative treatment of these entries.

Brief Discussion of the Results to Date

The overall diversity found at this site fits well with a pattern that is beginning to emerge as a result of our work at a variety of sites through out the western half of the state. Keeping in mind that comparable data from other Vermont sites were not available until the beginning of my efforts in 1988, a clearer picture of the expected diversity at any given site will continue to emerge as I examine the results of my efforts at more sites. However, based on my recent efforts at Abbey Pond and Mt. Mansfield the species located at this site are what I would have expected given the location of the site along the main range of the Green Mts., the age and mix of tree species, the pH of the soils and the amount of permanent and semi-permanent water available.

The species list generated so far is almost identical to that of the two other central Green Mountain sites where I have fairly complete data sets (Mt. Mansfield and Abbey Pond). However, the proportions of each species differ. Keep in mind that I have a different balance of methods used at this point in the inventory.

There are approximately 22 species of amphibian reported in Vermont. Many of these are either very rare, localized in other regions of the state, or found in habitat types which were not found in this region. As stated above the diversity at this site is very similar to that found at the two other Green Mountain sites I have studied. However, compared to sites outside of the Green Mts., but still in west central Vermont, this site has less diversity of both reptile and amphibian species. Whether this is a result of the decreased buffering capacity of the bedrock, habitat types, elevation or other direct or indirect effects of a change in microclimate is not yet clear.

Species that appear to be absent from this site, but have been located in Addison, Rutland or Bennington counties in recent years are;

Amphibians Missing

Ambystoma jeffersonianum	Jefferson salamander
Ambystoma laterale	Blue-spotted salamander
Hemidactylium scutatum	Four-toed salamander
Necturus maculosus	Mudpuppy
Rana pipiens	Leopard frog

Of these species *Necturus maculosus* (Mudpuppy) would be expected primarily in Lake Champlain and its major tributaries, hence not at this site. Although I am just beginning to get a picture of the distribution

within the state of most of these species, I would have suspected the absence of some of them from this site based on an emerging picture of preference for habitat types which are not represented in this region. Habitats missing and some of the species possibly associated with them include; deep and permanent water bodies with extensive vegetation at low elevations (Leopard frog), flood plains with vernal pools and surrounding woods (Blue-spotted salamander), or oak-hickory ridges with semipermanent pools of neutral pH (Jefferson salamander). Their absence however was by no means certain and one or more of them may yet be located here in the next field season. The absence of *Hemidactylium scutatum* (Four-toed salamander) and *Ambystoma jeffersonianum* and *laterale* (Jefferson and Blue-spotted salamanders) from this, the third Green Mountain site I have surveyed, is very interesting. It suggests that they are entirely limited in distribution to foot hills and floodplains. I had thought that if I was to locate them at all in the Green Mountains, it might be on the west flank of the mountains in lower elevation hardwood forests. Clearly most of this region is not that type of woodland, but I did locate one of the drift fence and egg mass sites at only 800 feet in elevation, on the extreme western edge of this region. In addition I performed site checks and active searches along the western border. It is in this area that I located the one and only *Rana catesbeiana* (Bullfrog), calling in the pond near the access to Lye Brook Falls. If some of the other "foothill" and lowland species, are later found in the wilderness, I would expect to find them along the western border of the area. In fact I located one of the *Ambystoma* hybrids (*jeffersonianum x laterale*) in the Batten Kill valley less than 1 km west of the wilderness area. Also in this adjacent valley area are higher numbers of Bullfrogs and Gray tree frogs. I located only one individual of *Hyla crucifer* (Gray tree frog) within the survey area. In fact I never heard it at all, but my younger (better ears?) field assistants claim to have heard one, when we were at Branch pond one evening. I suspect that I will find more Gray tree frogs next spring. It is difficult to locate them, other than by call, during night-time visits. To complicate matters they call primarily in May and June on warm humid nights often before thunder showers. I will make an effort to spend a few nights in the woods this coming summer under those conditions to see if they are indeed in the survey area.

The amphibian species listed below have been located in Vermont but not in Bennington county. Hence their absence from this site is not remarkable.

Pseudacris triseriata	Northern Chorus frog
Rana septentrionalis	Mink frog

The Northern chorus frog has only been located on Grand Isle as part of an extended range reaching into the Lake Champlain Valley from the north and west. It is not known from any other site within Vermont, nor has it been relocated in recent years on Grand Isle.

The Mink frog would have been a remote possibility at this site. It is a northern species that is frequently found within the belt of northern conifers. However it appears that its range does not reach this far south in Vermont although the habitat and local climate appear to be suitable.

Comparisons

The most responsible comparison that can be made at this point between Lye Brook and Abbey Pond involves balancing the relative effort of three methods; drift fences, site checks and active searches. For example if the amount of person-hours spent in active searches at Lye Brook was half that spent at Abbey pond, the amphibian numbers should be doubled for that method before they are compared. Once the figures for each method are standardized (active searches x 2, site checks x 1.7 and fence-nights x 1.23) they can then be combined and compared. If this is done the following figures are generated.

	Lye Brook		Abbey Pond	
Caudates (Salamanders)				
Eastern newt	436	49%	583	61%
Two-lined salamander	202	23%	70	7%
Redback salamander	152	17%	140	15%
Spring salamander	59	7%	2	.2%
Spotted salamander	20	2%	59	6%
Dusky salamander	19	2%	102	11%
Total	888	100%	956	~100%
Anurans (Frogs);				
Green frog	104	49%	114	53%
American toad	40	19%	20	9%
Wood frog	28	13%	54	25%
Spring peeper	26	12%	22	10%
Pickerel frog	13	6%	6	3%
Gray tree frog	0	0%	1	.5%
Bullfrog	0	0%	0	0%
Total	211	~100%	217	~100%

the reason that they usually breed in temporary ponds where fish can not survive. However they do breed very successfully in permanent and semipermanent ponds that do not hold predators. If fish are introduced to these ponds, the fish would be expected to have a greater impact on those species who are not generally found with them. *Rana clamitans* on the other hand are frequently found in lakes, ponds and streams with fish populations. Hence, the natural presence or introduction of fish to these ponds, may have helped to increase the relative abundance of Green frogs relative to Wood frogs. Unlike Abbey pond the second most abundant frog so far at this site is *Bufo americanus* (American toad). Why this species is also more abundant than the Wood frog, I don't yet have a clue. Equally perplexing are the low numbers of the Spotted salamander and the Dusky salamander relative to Abbey Pond. At this point I would venture that the numbers of Spotted salamanders will balance out to some extent after the spring season. In the case of the Dusky on the other hand I have had only limited success in locating breeding sites in the Lye Brook Wilderness.

It is also very interesting to compare the relative abundances of *Eurycea bislineata* (Two-lined salamander) at Lye Brook and Abbey pond. At Lye Brook it makes up 23% of the salamanders found. It is second in abundance only to the Eastern newt. While at Abbey pond, it makes up only 7% and ranks fourth in abundance. Unlike the toad situation, it is fairly easy to come up with a logical hypothesis that might well explain this difference. Once one moves off the central plateau of the Lye Brook Wilderness area, there are many fast well oxygenated brooks and streams. This is not the case at Abbey pond. The survey area at Abbey pond contains only one short section of this habitat type. These streams are the favored habitat of this salamander. This hypothesis is further supported by the increase in relative abundance of *Gyrinophilus porphyriticus* (Spring salamander). At Abbey pond it is the least most common salamander at only .2% while at Lye brook it comprises 7% and is the 4th most abundant. This large stream predator is also found in the same habitat type. However it is slightly premature to discuss apparent proportions before the spring field season. In addition comparisons between two large regions, although useful, are less reliable in showing small proportional differences than comparisons between the same sites over time.

Future Plans

Diseased Organisms

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Rana sylvatica metamorphs were found on two occasions with one of the rear legs undeveloped. *Notophthalmus viridescens* adults were located with large light colored crippling growths on their bodies and on a few occasions emaciated individuals were located. At this site I have seen only one of the emaciated newts, one adult newt dying with no external signs of disease and a few dead adults. I have obtained permits from the state, and made the necessary arrangements with an out of state laboratory to determine the causes of these problems on any "diseased" specimens I locate next field season. At present there is little evidence of these problems at Lye Brook. However I will now be looking for them at this site as well as Abbey Pond and others.

Long-term Monitoring Methods

The methods I originally intended to use at this site on an annual basis for long-term monitoring were drift fences and egg mass counts only. Structures are in place, sites chosen and field workers trained to continue the monitoring beyond this contract period. These two methods will be effective in monitoring a wide variety of amphibians at this site, but not all. As a result of the high numbers of stream salamanders and streams located at this site, a third method could be employed if funding permits. Active searches along three predetermined stretches of stream could be run. These searches would give us data on the Two-lined and Spring salamanders which were surprisingly abundant at this site. Protocol could be easily developed to standardize these counts. Periodic inventories using the total range of methods are still recommended. The first years monitoring data will be included in next falls report.

Context

As stated in the introduction this site will become one of three long-term monitoring sites located within the Green Mountains of Vermont. In addition the current inventory work at these and many other sites in Vermont is helping us to understand distribution patterns of amphibians throughout Vermont and the factors which may determine them. To date a great deal has been learned. The data gathered at these sites have been used in a preliminary set of maps showing the known distribution of amphibians and reptiles in Vermont.

Acknowledgments

In addition to the author, a number of other individuals were tremendously valuable in the gathering of data in this region. Catherine

Herzog served as a field assistant for the duration of the field season. Timothy Bernard, a Middlebury College student assisted over the summer, supported by a grant from the Howard Hughes Medical Institute. Faculty from the Stratton Mountain School are monitoring the upper two drift fences under the direction of Lee Petty. Students and faculty from the Burr and Burton Seminary are monitoring the low elevation fence under the supervision of Tom Hopkins.

Thanks are also due to Dr. Steve Trombulak of Middlebury College for the use of his lab and equipment as well as his continued support and guidance.

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Table 1

A Summary of Field Efforts in the Lye Brook Region, 1993

Month	Active Searches	Canoe Searches	Drift-fence nights	Night Visits	Night Road Searches	Site Checks	Accidental Disc's.	Visitation Days
April	29			28		28,29		2
May	12,27	11		11	11	11,26	11,12	4
June	16			16		17	16,17	2
July	8,9			1,8		1,2,8,9	2,27*	4
August				4				1
September			9,18,19			14	14	4
October	12		13,17, 21,22				12,31*	5
Total # of times each method was used	**14**	**2**	**7 nights, 3 fences, 13 fence nights**	**7**	**1**	**18**		**55 data gathering efforts, on 22 days**
# of Sites	**12**	**1**	**3**	**5**	**1 Route**	**16**	**10**	**28*** Sites**
Significant Units**	~30 Person-hours	2 Canoe-hours	4 Nights Upper Fences (2), 5 Nights Lower Fence	4 hours	1 Route at ~12 km	50 Person-hours at 16 Sites		

* not counted as a data gathering day (drift fence building or maintenance),
** hours rounded to the nearest quarter-hour,
*** more than one method was used at most sites, hence this number is not the sum of the this row

Table 2

Salamanders Located in the Lye Brook Region, 1993

Species	Active Searches	Canoe Searches	Drift Fences	Night Visits	Night Road Searches	Site Checks	Accidental Discoveries	Totals	% of All Caudates
Ambystoma maculatum **Spotted Salamander**	4 egg masses	11 egg masses	10		4	21 egg masses	18 egg masses	14 54 egg masses	2%
Desmognathus fuscus **Dusky Salamander**	6					4	1	11	2%
Eurycea bislineata **Two-lined Salamander**	65		1			42 6 egg masses	2	110 6 egg masses	20%
Gyrinophilus porphyriticus **Spring Salamander**	14					18		32	6%
Notophthalmus viridescens **Eastern Newt**	117	10+	51	20+	1	82+	17+	298+	53%
Plethodon cinereus **Redback Salamander**	26		22			43	8	99	18%

# of Species	6	2	4	1	2	6	5	6	
# Individuals	228	10+	84	20+	5	189	28	564	
# Egg Masses	4	11				27	18	60	
% of Caudates	100%	33%	67%	17%	33%	100%	83%	100%	

Table 3

Frogs Located in the Lye Brook Region, 1993

Species	Active Searches	Canoe Searches	Drift Fence Nights	Night-time Visits	Night-time Road Searches	Site Checks	Acci-dental Disc's.	Totals	% of All Frogs
Bufo americanus **American Toad**	4		1	3 2 choruses	13 1 chorus	18 1 tadpole site	7	**46 3 choruses 1 tadpole site**	**23%**
Hyla versicolor **Gray Tree Frog**				1?				**1?**	**.5%**
Pseudacris crucifer **Spring Peeper**	7	1		6 3 choruses	2 10 choruses	7	1 1 chorus	**24 14 choruses**	**12%**
Rana catesbeiana **Bullfrog**				1				1	**.5%**
Rana clamitans **Green Frog**	18	6		20 2 choruses	2	40	10	**96 2 choruses**	**48%**
Rana palustris **Pickerel Frog**	3					4	1	**8**	**4%**
Rana sylvatica **Wood Frog**	4	4 egg masses	4	5	2	9 1 chorus 25 egg masses	2 egg masses	**24 1 chorus 31 egg masses**	**12%**

Table 4

Totals for Frogs

Species	Active Searches	Canoe Searches	Drift Fence Nights	Night-time Visits	Night-time Road Searches	Site Checks	Accidental Discoveries	Totals
# of Species	5	3	2	6	4	5	5	7
# Individuals	36	7	5	36	19	78	19	200
# of Egg Masses		4				25	2	31
# of Choruses				7	11	1	1	20
# Tadpole Sites						1		1
% of All Frogs	71%	43%	29%	86%	57%	71%	71%	100%

Combined Totals for all Amphibians

# of Species	11	5	6	7	6	11	10	13
# Individuals	264	17+	89	56+	24	267	47	764
# of Egg Masses	4	15				52	20	91
# of Choruses				7	11	1	1	20
# Tadpole sites						1		1
% of All Amphibian Species	85%	38%	46%	54%	46%	85%	77%	100%

Reptiles Located in the Lye Brook Region, 1993

Thamnophis sirtalis Common Garter Snake	3					5	3	11

Figure 1

Drift Fence and Egg Mass Survey Locations

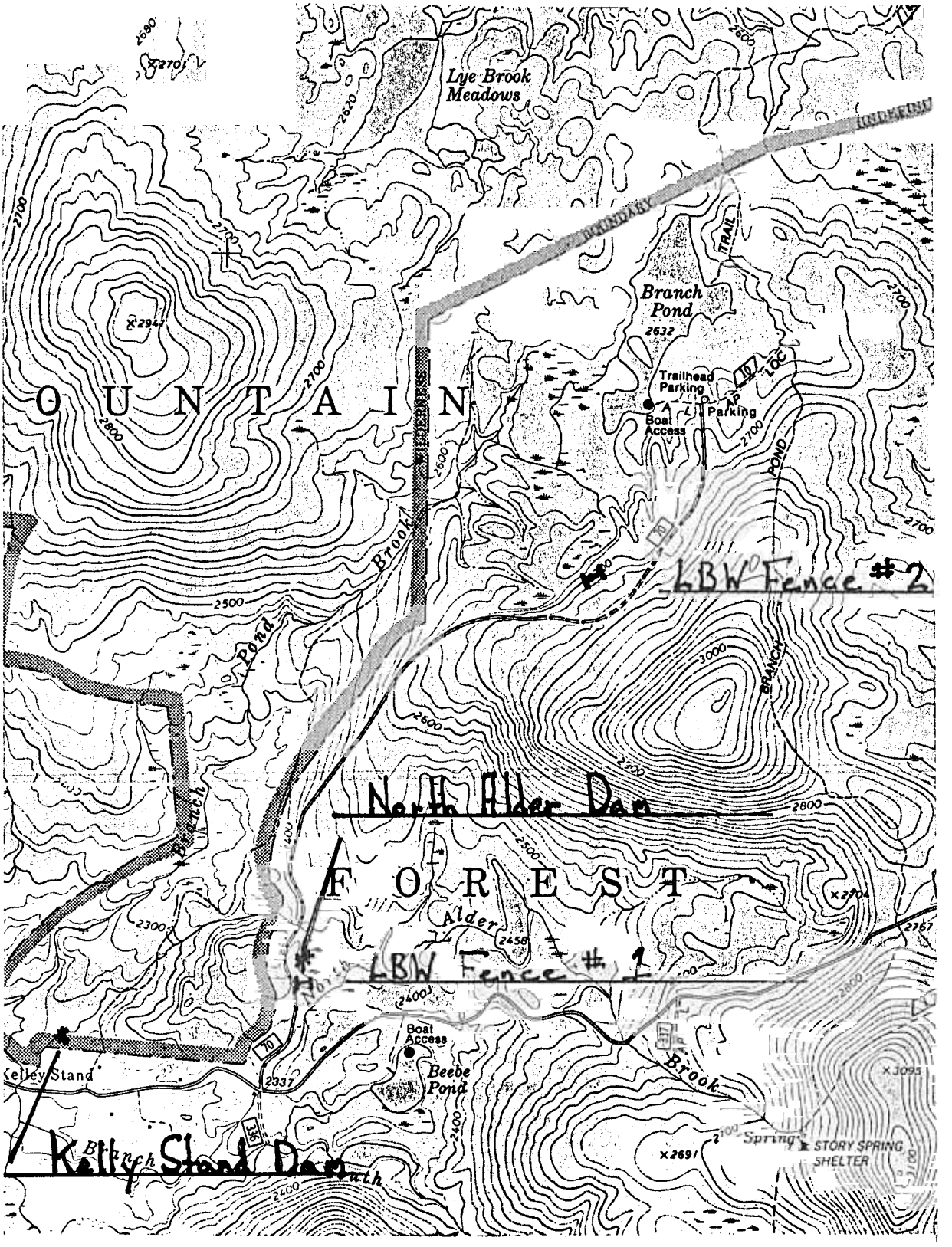

Figure 2

Drift Fence and Egg Mass Survey Locations