


LONG-TERM, COMMUNITY-BASED CONSERVATION PLANNING AND MANAGEMENT
E. L. ROSE CONSERVANCY OF SUSQUEHANNA COUNTY, PA
2008 ANNUAL REPORT

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THE E.L. ROSE CONSERVANCY of SUSQUEHANNA COUNTY

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ABSTRACT

James P. Lassoie

This year (2008) marked the tenth anniversary of the collaboration between Cornell University's Department of Natural Resources (DNR) and the E. L. Rose Conservancy of Susquehanna County, Pennsylvania (ELRC). Over this past decade, numerous projects under the overall program title: Long-term, Community-Based Conservation Planning and Management, have supported the Conservancy's mission "*to protect natural resources through land and water conservation, provide sanctuary for wildlife, and preserve scenic beauty*" (see: http://www.elrose.org/). This mutually beneficial relationship has provided a 'living laboratory' for DNR faculty and students to experience conservation planning and programming by a land trust, while developing and conducting applied scientific investigations important to the functioning of the ELRC. The stability of long-term financial support from the Actus Foundation has allowed this collaboration to mature, thereby enabling the pursuit of conservation priorities that require continuity from year-to-year. Such a long-term collaborative triad involving a public university, a land trust, and a philanthropic organization is very rare, hence the accomplishments have been unique and numerous – and 2008 was no exception.

The Conservation Enhancements for a Living Landscape project (Sullivan and Morreale) developed and refined standardized sampling methodology that can be used for assessment of forest ecosystems. Their efforts in 2008 provided a baseline to monitor potential changes in frog calling phenology, and forest composition and health. This strong, repeatable monitoring scheme will allow them to track changes and predict future trajectories regionally. Locally, these efforts provide an essential baseline for developing future conservation activities specifically targeted toward ecosystem improvements on ELRC lands.

The project by Jirka, Rudstam, and Kraft (*Biological Assessment of Silver Lake: 2008*) continued to monitor the aquatic ecology of Silver Lake. This work has given them the opportunity to make interesting and useful observations about rectifying the impacts of fish introductions on water quality. Simply stated, the program that they recommended two years ago to reduce alewife abundance by stocking trout seems to be having a positive impact on water quality in Silver Lake. They consider this to be a fine example of how science can prove to be useful in the real world.

Three projects falling under the general theme of *The People and Landscapes of Susquehanna County* and supervised by Lassoie were carried out during 2008. Two were continuations from 2007. Myron added 48 historical repeat photo-pairs to the database and compiled all historical repeat photographs and data into Google Earth. Herring completed the video documentary, *The Landscapes and Future of Susquehanna County, PA*. Myron initiated a new project, *A Photo-Audio Perspective of the People and Places of Susquehanna County,* and completed a pilot photo-audio interview with Patty Bloomer, which is packaged with Herring's documentary DVD for wide distribution by the ELRC.

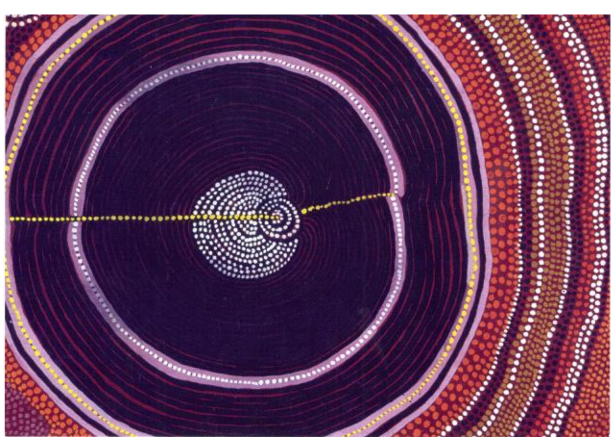
ACKNOWLEDGEMENTS

James P. Lassoie

The Cornell Team is very grateful to have the opportunity to work with the E.L. Rose Conservancy of Susquehanna County (ELRC) over such a long period of time. This collaboration has transcended a simple working relationship to become more like ‘family’, most likely because of the wonderful hospitality so often provided by John and Barbara Wilkerson. Without a doubt, no Cornellian will quickly forget the warmth and fun afforded them during an ELRC event at the Wilkerson’s Barn. To John, Barbara, and their family we owe much.

We have always benefited greatly from the support of the ELRC Board members, and this year was no exception. We appreciated editorial suggestions from many members and Tim Matthews’ extraordinary assistance in completing *The Landscapes and Future of Susquehanna County, PA*. Final production of this documentary video proved to be far more complicated than we originally expected, and likely would have failed without Tim’s assistance. Patty Bloomer, of course, was ‘everywhere’, but we especially thank her for working with Lindsay to develop a pilot photo-audio interview. Patty and Billy also were kind enough to offer boat, motor, and dock in support of the *Biological Assessment of Silver Lake* project. We would like to especially thank Tim and the E.L. Rose board for their continued support of biodiversity conservation, and their efforts to establish on-the-ground habitat enhancements and demonstration areas. Special thanks to Bob Alspaugh, Tim and Terry Matthews, Fred and Rae Marie Bostrom, and Keith and Roxie Oberg for participating in the annual frog call surveys. As the Cornell Team leader, I have especially appreciated the leadership provided by Tim and Patty in developing research priorities critical to the ELRC. To all Board members, thank you for the many comments and suggestions, and much support you provided throughout 2008.

Lastly, we remain deeply grateful to Chris Wilkerson for his stewardship of the Cornell-ELRC collaboration and to the Actus Foundation for continuing financial support. This is the ‘fuel’ for a very special engine that has taken us all to new places personally as well as professionally. Thank you.



SHORTY LUNGKARTA TJUNGURRAYI (PINTUPI, 1920-1987), *MYSTERY SAND MOSAIC* (DETAIL), 1974
Collection of John and Barbara Wilkerson

Program: Conservation Enhancements for a Living Landscape

Kristi L. Sullivan and Stephen J. Morreale
Cornell University

2008 Conservation Activities

E.L. Rose Conservancy

2008 Overview

In 2008, a cooperative conservation and monitoring effort was undertaken by the Cornell Conservation Education Program, E.L. Rose Conservancy members and volunteers, and Cornell's Arnot Forest Intern Program. Over the course of the year, this team focused on the need to understand and document baseline biological conditions in the face of environmental change. We collaborated on joint educational outreach activities; we expanded a frog call survey initiated in 2007; we re-sampled the bird community at High Point Preserve; and we established permanent forest inventory plots to serve as the foundation for long-term monitoring at High Point Preserve. Through outreach, research, and monitoring, our cooperative efforts, which are ongoing, continue to build the foundation for science-based conservation in the region.

Frog Call Surveys and Community Involvement

Outreach and Community Involvement

In March, we held an informal refresher course for last year's frog call survey participants and for new participants. During this training, we re-visited frog call identification, answered questions about calling intensity and protocols, and encouraged participants to expand the geographic coverage of their monitoring sites. We also highlighted key characteristics useful for identifying the northern leopard frog. Although the leopard frog was not detected during the calling survey in 2007, participants did report visual observations of this species of special concern. The northern leopard frog was only reported in one location in Susquehanna County during the Pennsylvania Herpetological Atlas, and has never been confirmed by photograph nor voucher specimen. The location reported in the atlas was southwest of the Silver Lake area, so emphasis was placed on verifying the presence of this frog in the area.

Survey Overview

Teaming up with trained volunteers and a student intern, we kicked off the second year of the frog call survey. Participants learned to recognize the calls of local species before going in the field, and chose one or more sites to survey between the active months of April and August, 2008. Our stated goal was to have each participant visit her/his designated sites once a week throughout the survey season. However, as expected the number of visits varied considerably based on individual availability. Each time a site was visited, the participant listened for a 3-minute period, and recorded all species seen or heard. Calling intensity and weather factors were also recorded. (Appendix A, Frog Call Survey Methodology).

In all, three volunteers and one summer intern monitored a total of 17 sites in 2008 (Figure 1). The surveys were spread over 11 nights from April through July. Six sites were new for 2008, while one previously monitored site was not included this year. Seven species were detected during the survey, including the green frog (*Lithobates clamitans*), pickerel frog (*Lithobates palustris*), bullfrog (*Lithobates catesbeiana*), spring peeper (*Pseudacris crucifer*), American toad (*Anaxyrus americanus*), gray treefrog (*Hyla* sp.), wood frog (*Lithobates sylvatica*) and northern leopard frog (*Lithobates pipiens*). While data collected for some species is probably complete (e.g., green frog, spring peeper, etc.) or nearly so, other species may have been missed at some sites due to timing of survey efforts relative to breeding activity. For example, the wood frog is the earliest breeder of all species in the area, calling in late March to mid-April and only for a brief period of one to two weeks. In our survey, a majority of site visits occurred after the peak of breeding season for this species. Therefore, the expected distribution of the wood frog likely is

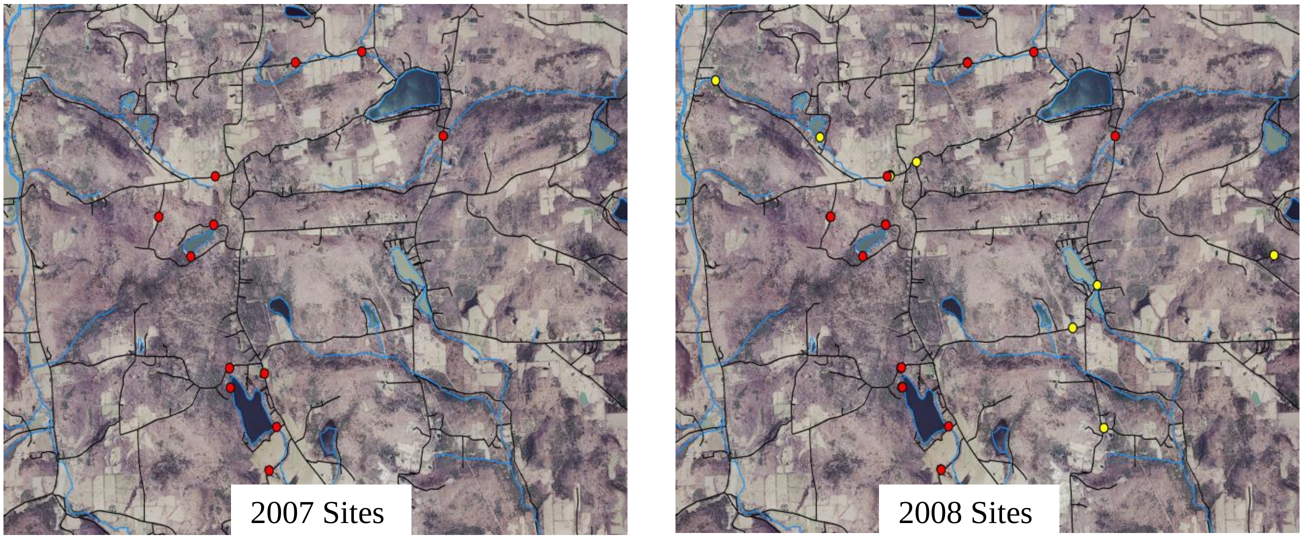
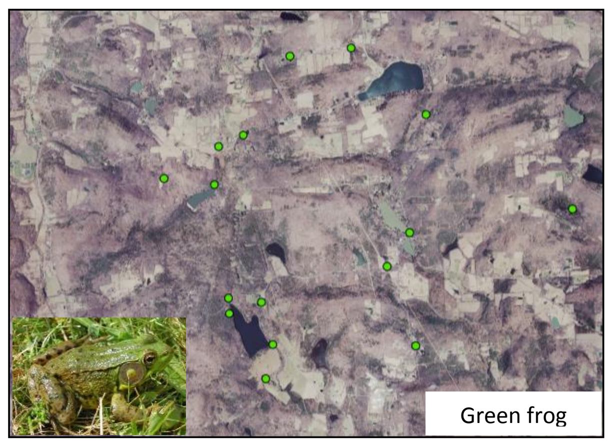


Figure 1. Frog call survey locations for 2007 and 2008. Twelve sites were surveyed in 2007 and 17 were surveyed in 2008, expanding our geographic coverage.

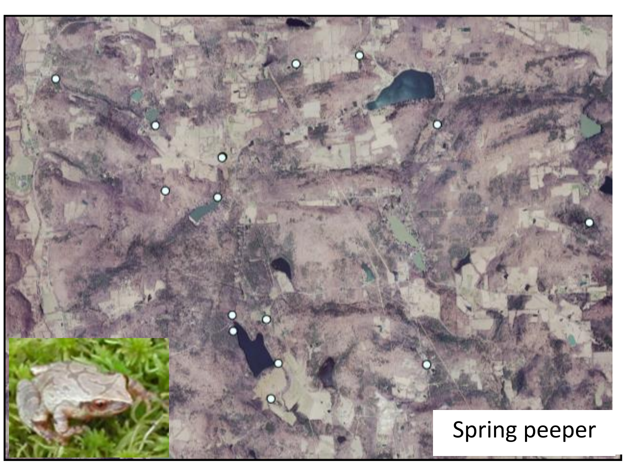
greater than currently represented by our results. Increasing the number of visits to each site early in the season would enhance the validity of our distribution data.

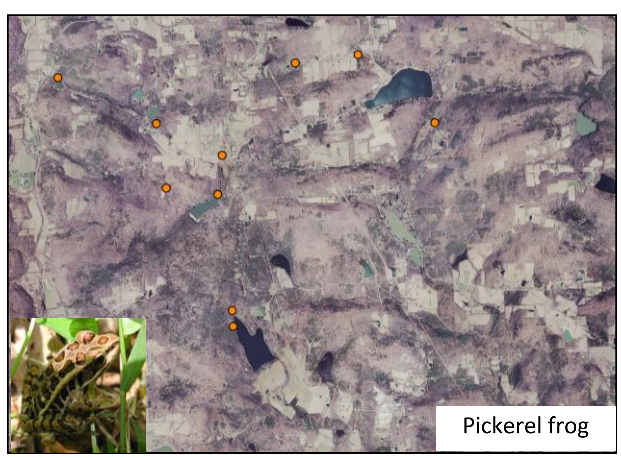
Geographic Distribution of Species

The green frog is common and widespread throughout the Northeast and was the most frequently detected species in the area. This species was heard at all but one of the 17 sites over the two-year period. Green frogs are habitat generalists, though they require permanent standing water to complete their life cycle. Found in ponds, marshes, swamps, along the edge of lakes, and in tiny streams and banks of large rivers, the home ranges of these animals are most often near water. However, they do move into terrestrial areas to feed on rainy nights.



The spring peeper, heard at 15 sites, was the second most widely distributed species in our study. The peeper is the most common tree frog in the Northeast. With the aid of its large toe pads that help it to climb, it is often found in shrubs and herbaceous vegetation. It inhabits deciduous woods and swamps with adjacent open

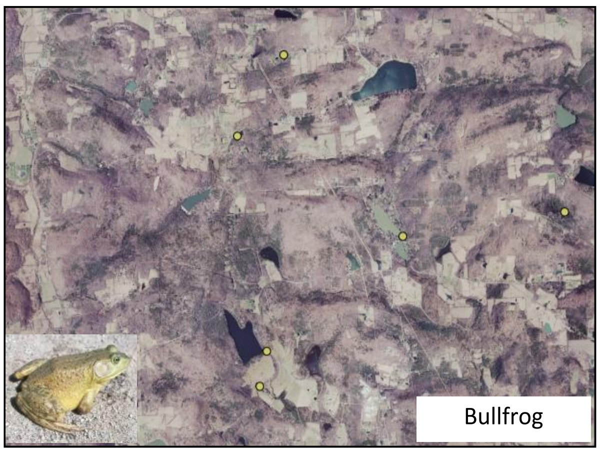




meadows and marshy fields. It moves into the open during the breeding season, but spends most of the remainder of the year in wooded areas.

The pickerel frog was detected at 10 sites during our surveys. Pickerel frogs are semi-aquatic animals found near water during the breeding season, and often occur in moist, sunny, terrestrial openings during other times of the year. Their breeding habitat includes temporary pools and ponds, the borders of streams and rivers, and the shallow weedy areas of ponds and lakes. Interestingly, the pickerel frog produces a distasteful skin secretion thought to be toxic to other frog species. Green frogs and bullfrogs, however, are reportedly unaffected by the skin secretions. In our surveys, pickerel frogs were found mainly near openings and rarely co-occurred with bullfrogs.

The bullfrog was found at only 6 sites, and rarely overlapped with the occurrence of pickerel frogs. Bullfrogs are the largest and most aquatic of Pennsylvania frogs. They require permanent bodies of water such as farm ponds, lakes, and the margins of slow-moving creeks and rivers, to complete their life cycle. Within these habitats, they prefer patches containing emergent, floating, or submerged vegetation which provide cover.



Surveyors detected the gray tree frog at 8 sites. An arboreal species, the gray tree frog has mucous-secreting discs on the tips of its toes which help it cling to tree bark. Although preferred breeding areas include some open water with dense emergent and scrub shrub vegetation, often adjacent to woods, the tree frog is a habitat generalist. They may be found in pasture ponds, roadside ditches, and even in swimming pools. Although their loud calls are easily heard, their cryptic coloration makes them difficult to see, especially when they climb high into a tree.

The wood frog only was recorded at one survey site, but was also visually observed by Cornell researchers at an additional location. Additional surveys during the early weeks of spring

would be useful for expanding information on the geographic distribution of this species in the area. Such earlier surveys would likely yield more wood frogs, which breed in early spring in seasonal woodland pools, and spend the remainder of the year in the forest.

The American toad was detected at seven survey sites. Toads are habitat generalists and do well in all but urban settings. They lay their eggs in shallow water that lasts 4-8 weeks, long enough for their eggs to hatch and metamorphose. This includes places like large puddles, ditches, and tire ruts, as well as lakes, ponds and wet meadows, which explains their ubiquity across the landscape. Outside of the breeding season, toads can be seen moving about in suburban backyards, in agricultural areas, or in the forest. American toads move about freely because they are covered with warts that secrete a liquid deterrent that sickens predators. The secretions are harmless to human skin.

The leopard frog was also heard by two different survey participants at two different locations along Silver Lake, once in 2007 and once again in 2008. Because this species has not been confirmed in the area previously, this is an exciting find.. We will focus on photo-documenting the presence of this species next year.

Overall, adding new survey sites this year and combining two years' data expanded our knowledge of the distribution of frog species in the study area (Table 1). An expansion of geographic coverage, and consistent survey effort at all sites would allow further analysis of species distribution by landscape and habitat characteristics.

Species	# of Sites 2007	# of Sites 2008	Total # of Sites (2007/2008)
Green frog	12	12	16
Spring peeper	10	13	15
Pickerel frog	7	7	10
Gray treefrog	6	5	8
American toad	5	3	7
Bullfrog	3	4	6
Wood frog	1	1	2
Leopard frog	1	1	2

Table 1. Number of survey sites each species was detected at in 2007, 2008, and both years combined.

Frog Calling Phenology

Using survey data from 2007 and 2008, we plotted the calling intensity for each species by date (Figure 2). From these data, we developed a frog call phenology timeline for Susquehanna County, which can guide optimal survey time for individual species in the future. These data are also helping to establish baseline information for long-term monitoring of regional amphibians. For example, temperature strongly influences the breeding activity of frogs. Researchers in New

York State compared frog calling data from the early 1900's to that collected during the New York Herpetological Atlas from 1990-1999 (Gibbs and Breisch 2001). They found that the average first calling date for four species, the wood frog, spring peeper, bullfrog and gray tree frog, was 10-13 days earlier than at the beginning of the century. This suggests that the climate has warmed in central New York over the last century and in turn has affected calling phenology. As the climate continues to warm, amphibians can be a sensitive indicator of change. Our surveys in the Silver Lake area will help us track and document such shifts in phenology in the area.

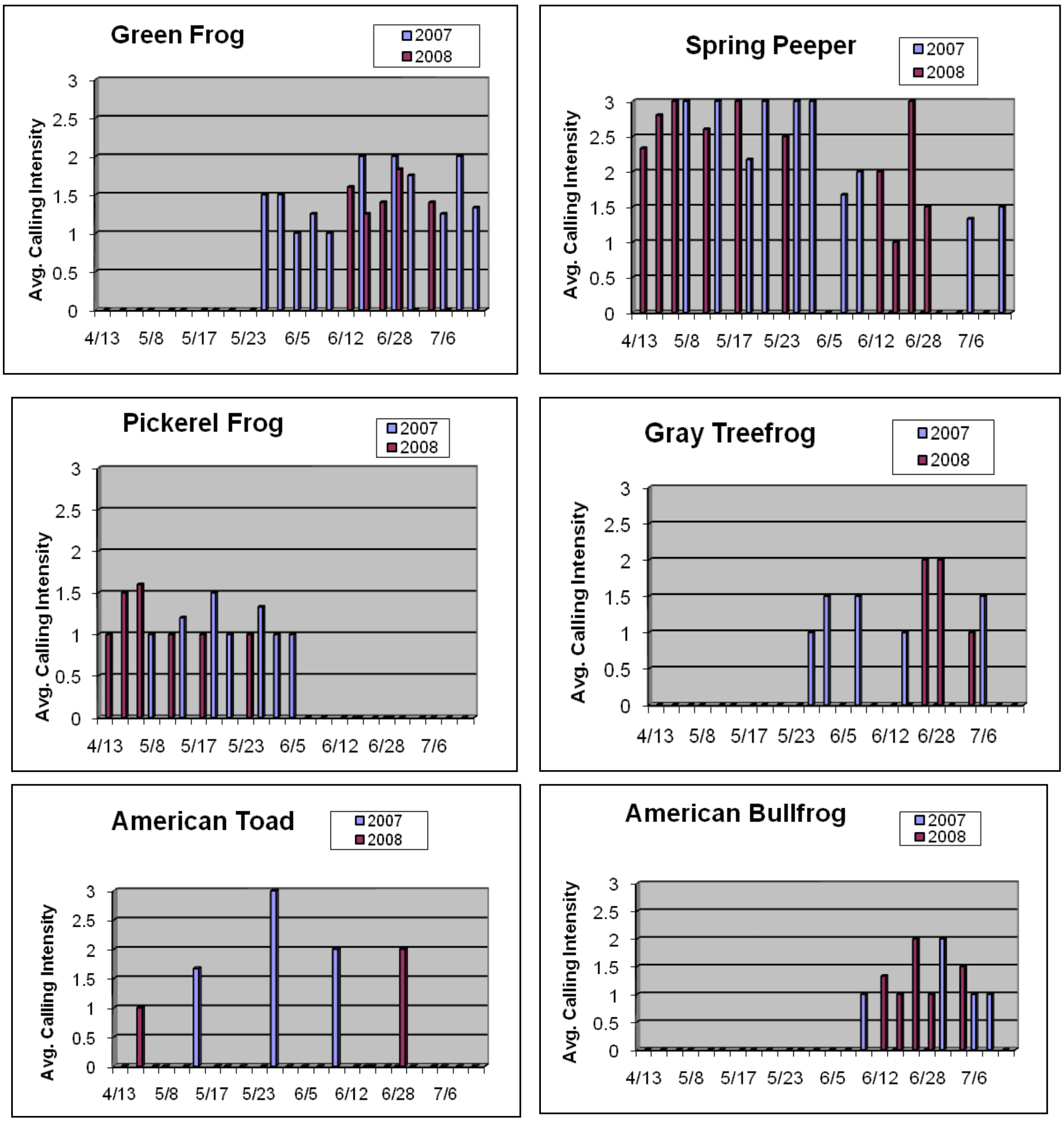


Figure 2. Average calling intensity of six species by date from mid-April through mid-July, 2007 and 2008.

Results from the two years of our study indicate that spring peepers and pickerel frogs were most likely to be detected from mid April to early June. Wood frogs only were heard in April. In contrast, green frogs and gray tree frogs were calling at their highest intensity from late May to mid July. Bullfrogs are the latest breeders of the group, and were most vocal from mid-June to late July. The American toad called sporadically from mid-April through June, and preliminary results indicate that toads may call in response to rainfall events. As we gather more data in upcoming years, we can further refine our interpretations of calling phenology and relationships to temperature and precipitation. However, our current Susquehanna County Timeline (Figure 3) provides a useful template for future efforts.

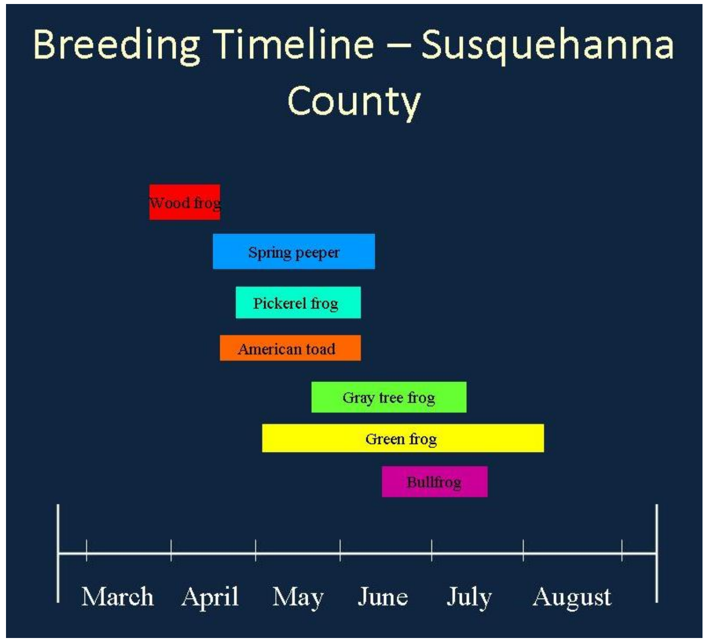


Figure 3. Preliminary frog calling timeline for Susquehanna County, Pennsylvania.

Bird Survey at Highpoint Preserve

Bird counts were conducted once a week from June 13 to July 3, 2008, at 10 surveyed points along a transect that was previously established in 2001 at Highpoint Preserve. The first point is located on the Red Trail, 50 meters north of the Crowley Road entrance at the southern end of the preserve. From there, the plots are located at 200-m intervals along the red trail, the white trail, and the southern portion of the green trail. Each plot previously had been marked with 4-foot-long x ½-inch-diameter iron rebar placed off the trail next to a tree. This year, a student intern visited each plot on three different occasions for a period of 10 minutes, recording all birds heard or seen within a 50-m radius (Appendix A).

Overall, 26 species were detected during the surveys (Table 2). On average, 13.5 species were detected per location (range 11-18). The ovenbird, red-eyed vireo, and black-throated green warbler were the most frequently recorded species at the preserve (Figure 4). Other frequently observed species included the American crow, American robin, black-capped chickadee, and yellow-bellied sapsucker.

Species Name	Abbreviation	Species Name	Abbreviation
American crow (*Corvus brachyrhynchos*)	AMCR	American goldfinch (*Carduelis tristis)*	AMGO
American robin (*Turdus migratorius*)	AMRO	Black-capped chickadee (*Parus atricapillus*)	BCCH
Blue-headed vireo (*Vireo solitarius*)	BHVI	Blue jay (*Cyanocitta cristata*)	BLJA
Brown creeper (*Certhia Americana*)	BRCR	Black-throated green warbler (*Dendroica virens*)	BTNW
Chipping sparrow (*Spizella passerine*)	CHSP	Common yellowthroat (*Geothlypis trichas*)	COYE
Dark-eyed junco (*Junco hyemalis*)	DEJU	Downy woodpecker (*Picoides pubescens)*	DOWO
Eastern towhee (*Pipilo erythrophthalmus*)	EATO	Eastern wood-pewee (*Contopus virens*)	EAWP
Hairy woodpecker (*Picoides villosus*)	HAWO	Hermit thrush (*Catharus guttatus*)	HETH
Mourning dove (*Zenaida macroura*)	MODO	Ovenbird (*Seiurus aurocapillus*)	OVEN
Pileated woodpecker (*Dryocopus pileatus*)	PIWO	Rose-breasted grosbeak (*Pheucticus ludovicianus*)	RBGR
Red-eyed vireo (*Vireo olivaceus*)	REVI	Scarlet tanager (*Piranga olivacea*)	SCTA
Veery (*Catharus fuscescens*)	VEER	White-breasted nuthatch (*Sitta carolinensis*)	WBNU
Wood thrush (*Hylocichla mustelina*)	WOTH	Yellow-bellied sapsucker (*Sphyrapicus varius*)	YBSA

Table 2. Species detected during bird counts at Highpoint Preserve in 2008.

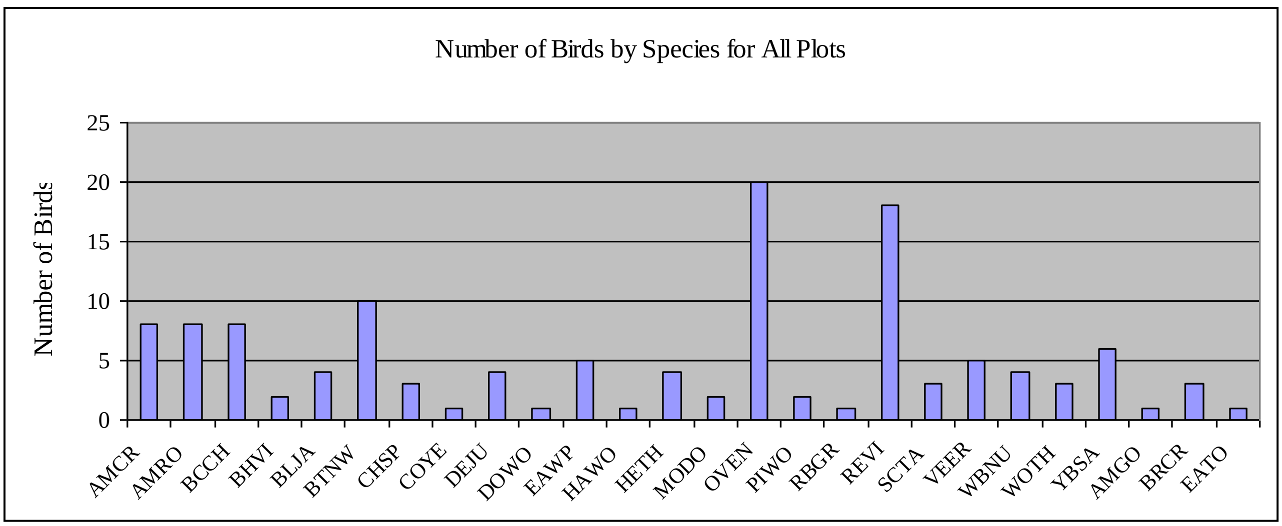


Figure 4. Cumulative number of birds in all plots by species.

Permanent Forest Inventory Plots at Highpoint Preserve

Methodology

Using Geographic Information Systems (GIS), we projected a grid onto a map of Highpoint Preserve, designating 61 potential permanent forest inventory (PFI) plots at 100-m intervals (Figure 5). The PFI plots will be used to monitor short- and long-term changes in forest health and composition. The methodology (Appendix B) is based on protocols developed and implemented at Cornell University's Arnot Teaching and Research Forest.

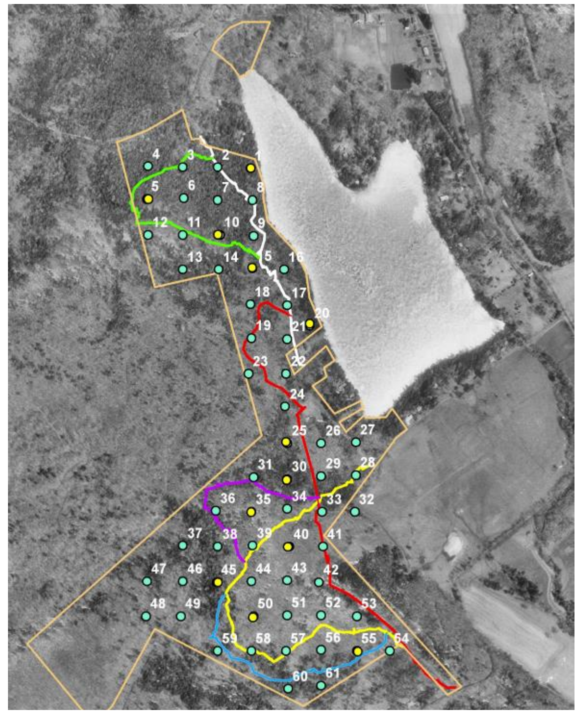
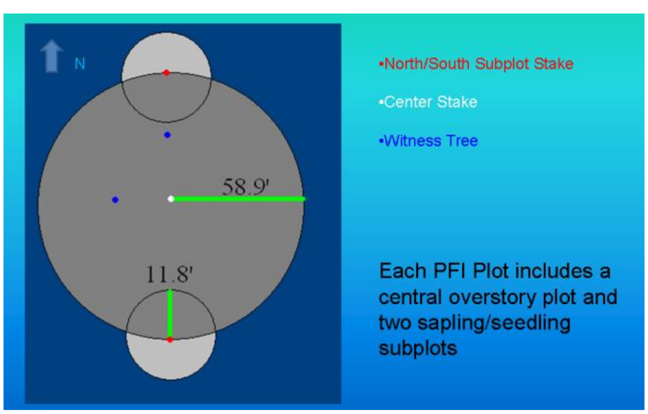


Figure 5. Sixty-one potential PFI plots were designated (light blue) and 12 plots were completed (yellow) in 2008.

During the months of July and August 2008, we inventoried 12 selected PFI plots at High Point Preserve. The sampled plots ranged from the northern end of the Preserve to the southern end, and spanned a variety of elevations. Each quarter-acre PFI plot consists of a circular central plot (58.9' radius) and two subplots (11.8'). The center of the plot was marked with white pvc pipe painted blue at the top for visibility and longevity. The pipe has a tag attached at the top with the plot number on it, which is also written on the pipe in permanent marker. At the north and south ends of each plot there is a short wooden stake, with "N" and "S" in permanent marker and flagging; the subplots form a circle around the stakes. Within the central plot, all the living trees with a diameter at breast height at least 4" were marked one foot off the ground with small, round aluminum tags and aluminum nails. For these trees the species, dbh (diameter at breast height), presence/absence of cavities, and crown class was recorded. The subplots were used to evaluate the number of seedlings and saplings present, as well as other understory characteristics. Additional information recorded for the PFI plots included: geography (elevation, aspect, etc.); measures of coarse woody debris; presence/absence of water, rocks and tree cavities; number of dead standing trees (snags); species and number of salamanders found; and signs of wildlife (Appendix C). For many of the plots, pictures were taken and placed on CD to potentially be used for photo-monitoring in the future.



Results

<u>Overstory trees</u>

In 2008, 742 overstory trees were recorded, measured, classified and tagged in 12 plots. Twelve tree species were identified within the plots, including American beech (*Fagus grandifolia*), eastern hemlock (*Tsuga canadensis*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*), black birch (*Betula lenta*), black cherry (*Prunus serotina*), white pine (*Pinus strobus*), white ash (*Fraxinus americana*), American basswood (*Tilia americana*), hickory (*Carya* spp.), and striped maple (*Acer pensylvanicum*). Species comprising 30% or more of the trees in one or more plots included hemlock (7), sugar maple (5), red maple (2), and beech (1) (Table 3). Red maple and beech were significant components in plots that also supported a high percentage of hemlock trees.

Overstory Tree Species	PFI Plot Number											
	1	5	10	15	20	25	30	35	40	45	50	55
American beech	0.13	0.03	0.00	0.10	0.06	0.22	0.10	0.03	0.28	0.33	0.11	0.02
Black cherry	0.14	0.00	0.00	0.05	0.00	0.02	0.01	0.00	0.02	0.00	0.00	0.07
Red maple	0.06	0.34	0.38	0.03	0.06	0.07	0.08	0.10	0.06	0.14	0.15	0.02
Sugar maple	0.00	0.00	0.00	0.40	0.00	0.24	0.24	0.73	0.37	0.00	0.63	0.66
Eastern hemlock	0.44	0.43	0.35	0.21	0.53	0.41	0.33	0.02	0.02	0.47	0.00	0.02
White ash	0.00	0.00	0.00	0.05	0.00	0.02	0.13	0.07	0.07	0.02	0.00	0.14
White pine	0.00	0.02	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00
Basswood	0.00	0.00	0.00	0.03	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.02
Yellow birch	0.11	0.02	0.23	0.14	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sweet birch/Black birch	0.11	0.15	0.00	0.00	0.13	0.00	0.04	0.03	0.19	0.02	0.00	0.00
Hop hornbeam	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Hickory sp.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.05
Striped maple	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00

Table 3. Overstory tree composition of PFI plots, with species comprising 30 percent or more of the overstory trees in the plot highlighted.

The number of trees per ¼-acre plot ranged from 108 to 508. Not surprisingly, the plots with the greatest number of trees tended to also have the smallest diameter trees, and vice versa. For each plot, we calculated the number of trees per acre, average dbh of all trees, and basal area (Table 4). Basal area is the cross-sectional area of the trunk of a tree at breast height. The basal area of a stand is the sum of the basal area for the individual trees, expressed in square feet per acre. Basal area can be used to describe the stocking

Plot 10 is a heavily stocked mixed hardwood and hemlock stand.

density of a forest. Stocking density commonly is used to guide forest management and harvesting activities, but is also useful for describing the character of the forest and predicting future conditions. For example, an “overstocked” forest can result in slow-growing trees of low vigor. In areas where trees are overstocked, future mortality of trees in that stand may be high, as competition for light and other resources results in some trees being outcompeted by others. Under these conditions, some of the trees in the forest stand may be weakened and of low vigor, making the trees susceptible to disease, or wind-throw due to poorly developed root systems. Figure 6 shows a stocking chart for northern hardwood or mixed hardwood and conifer stands. Stands that fall above line A are considered overstocked; stands between lines A and B are adequately stocked; stands between B and C are on their way to becoming adequately stocked and stands below line C are considered understocked. All of the plots at Highpoint Preserve inventoried in 2008 are either fully stocked, or overstocked, according to the stocking chart below, with a majority falling in the latter category. However, conifers such as the eastern hemlock require less growing space than hardwoods. Hemlock is the most shade tolerant species in Pennsylvania forests, staying suppressed in the understory for as long as 400 years with as little as 5 percent of full sunlight. Therefore, in stands where hemlock is the dominant species, stocking densities can be higher. Plot 5, for example, is dominated by hemlock and supports a high density of relatively small trees. In this plot as well as others, the trees are competing for light and natural mortality is high.

Plot	# Trees/acre	Avg. dbh of trees	Basal area/acre
1	252	9.13	141
5	508	7.64	185
10	208	11.3	174
15	252	9.26	144
20	360	7.31	125
25	164	11.31	139
30	288	9.48	165
35	240	8.53	121
40	216	8.13	89
45	196	10.12	131
50	108	10.42	74
55	176	9.05	93

Table 4. Overstory plot characteristics including basal area and average diameter at breast height (dbh, 4.5 ft).

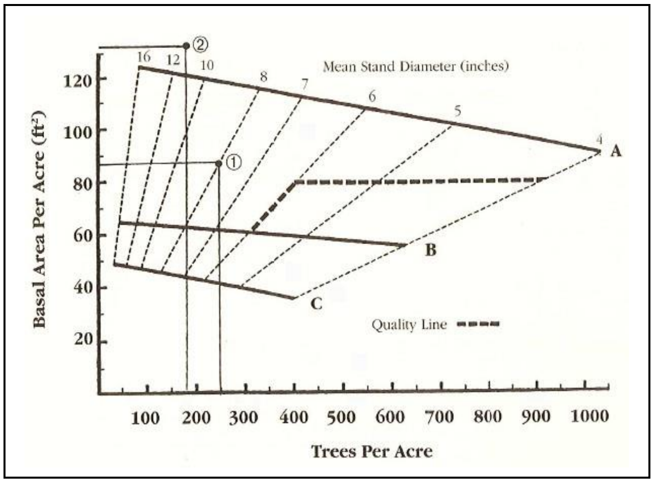


Figure 6. Stocking chart for northern hardwood and mixed forests.

Forest understory

Wthin the understory subplots in the 12 PFI plots, eight different tree species were recorded (Table 5). Six of the species growing in the understory, including American beech, black cherry, red maple, sugar maple, eastern hemlock, white pine, and striped maple, were also observed growing in the overstory. White oak, which occurred in one plot, was the only species recorded in the understory that was absent in the overstory. The most prevalent species of seedlings – red maple, sugar maple, and beech – are all shade tolerant species. Although quite a few seedlings were present in the plots, very few have grown to sapling size in the plots sampled. Beech saplings are growing in 7 of the plots, and hemlock saplings are growing in one plot. With relatively little sunlight reaching the forest floor due to a closed forest canopy, it is not surprising that the understory is not well-developed. However, the presence of seedlings but lack of saplings indicates that other factors are also affecting growth of the understory community. Evidence of deer impacting the forest was recorded on a majority of the PFI plots. Obvious symptoms of deer pressure on the plant community included a visible browse line several feet above the ground, and ferns growing on the forest floor. Ferns are relatively unpalatable to deer and are left to flourish. The composition of the forest saplings is also indicative that deer are affecting the forest vegetation. Although three shade tolerant species are growing to seedling height, only beech has made it to sapling height, out of reach of deer. Beech is a species that is less preferred as a forage species than maples, oaks, and others. These results in the Highpoint Preserve forest mirror what we have seen at the deer exclosure at Longford Lake. There, seedlings planted outside the fenced area are heavily browsed and much shorter than those protected inside the fence.

	Seedling and Sapling Plot Results															
	American beech		Black cherry		Red maple		Sugar maple		Eastern hemlock		White pine		Striped maple		White oak	
Plot	**Seedling**	**Sapling**	**Seedling**	**Sapling**	**Seedling**	**Sapling**	**Seedling**	**Sapling**	**Seedling**	**Sapling**	**Seedling**	**Sapling**	**Seedling**	**Sapling**	**Seedling**	**Sapling**
1N	5	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
1S	10	0	0	0	10	0	0	0	20	0	2	0	0	0	0	0
5N	5	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0
5S	0	1	0	0	0	0	0	0	0	5	2	0	0	0	0	0
10N	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10S	1	0	0	0	40	0	3	0	0	0	2	0	0	0	0	0
15N	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0
15S	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0
20N	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20S	2	0	0	0	0	0	19	0	0	0	0	0	0	0	0	0
25N	10	0	0	0	5	0	5	0	0	0	0	0	0	0	0	0
25S	0	0	0	0	0	0	5	0	0	0	0	0	1	0	0	0
30N	0	1	0	0	0	0	4	0	0	0	0	0	3	0	0	0
30S	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
35N	2	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0
35S	0	0	0	0	0	0	50	0	0	0	0	0	0	0	0	0
40N	1	1	0	0	0	0	0	0	0	0	0	0	300	0	0	0
40S	1	2	0	0	0	0	13	0	0	0	0	0	2	0	0	0
45N	0	0	0	0	4	0	0	0	0	0	0	0	6	0	1	0
45S	5	7	0	0	1	0	2	0	0	0	0	0	8	0	0	0
50N	0	0	0	0	10	0	25	0	0	0	0	0	5	0	0	0
50S	20	5	0	0	10	0	50	0	0	0	0	0	1	0	0	0
55N	0	0	0	0	50	0	50	0	0	0	0	0	0	0	0	0
55S	0	0	0	0	50	0	50	0	0	0	0	0	0	0	0	0

Table 5. Understory seedlings and saplings recorded in the PFI plots.

Invasive species

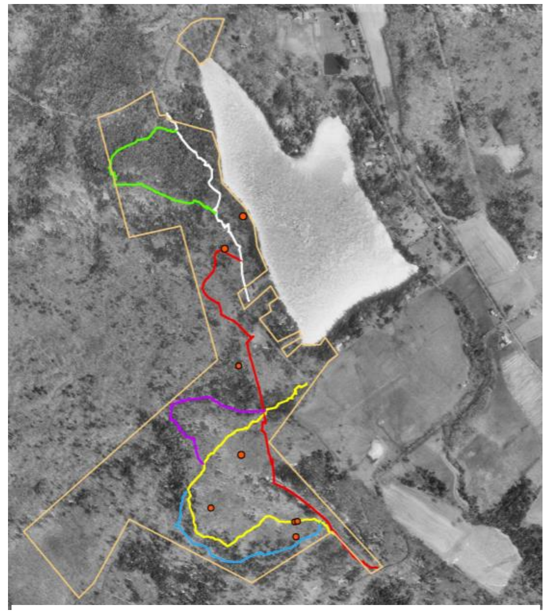
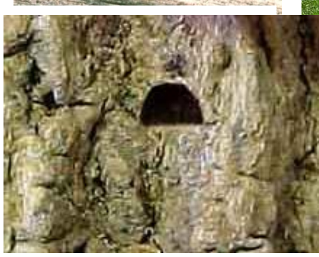


Figure 6. Locations of Japanese barberry documented as of 2008.

Japanese barberry and multiflora rose were 2 invasive species noted during the plot inventories. Barberry occurred at three of the plots, while multiflora rose was found growing in one. Figure 6 shows the locations of barberry noted during the PFI plot inventory, in addition to other noted locations. In general, barberry is most prevalent in the southern half of the preserve, and occurs near trails and other disturbances, and in locations where the canopy is not completely closed.

During the plot inventories, we looked for signs of emerging forest pest issues, notably the emerald ash borer, hemlock woolly adelgid, and beech bark disease. The **emerald ash borer** is a beetle from Asia that was first discovered in 2002 in Michigan and Ontario. Approximately 1/2 inch long and 1/8 inch wide, this insect is dark metallic green in color, with a coppery red or purple abdomen. As of 2008, the emerald ash borer had made its way to Illinois, Indiana, Maryland, Ohio, Pennsylvania, West Virginia, Missouri, and Quebec. Within Pennsylvania, emerald ash borer is known to occur in Butler County. The larval beetle kills all North American ash species by feeding under the bark, cutting off the flow of water and nutrients. Infested trees gradually die over a 2-4 year period. The destruction of an



infested stand is generally complete. Trees decline from the top down and die even if they were healthy before being attacked by the insect. Presence of emerald ash borer can be detected by watching for signs of decline in ash trees, starting at the top of the tree. Distinctive D-shaped exit holes in the outer bark of branches and the trunk is also a key sign of infestation.

We did not see any signs of emerald ash borer during the plot inventories in 2008. Ash was a minor component of most stands, averaging 4 % (range 0-14 %) of the tree composition in our plots. However, more than 10 % of all trees growing in plots 30 and 55 were ash. Thus, we expect emerald ash borer to have a substantial impact on some portions of the preserve when it moves east. The impacts will not be widespread, however, because ash is not a major component throughout the property.

The **hemlock woolly adelgid** is a serious pest of Eastern hemlock in the northeastern states. The hemlock woolly adelgid is tiny, less than 1/16-inch long, and varies from dark reddish-brown to purplish-black in color. As it matures, it produces a covering of wool-like wax filaments to protect itself and its eggs from natural enemies and prevent them from drying out. This "wool" is most conspicuous when the adelgid is mature and laying eggs, and can be readily observed from late fall to early summer on the underside of the outermost branch tips of affected hemlock trees.

This insect was first reported in southeastern Pennsylvania in the late 1960s and has spread to both ornamental and forest hemlocks (Figure 7). Adelgids are small, soft-bodied insects that are closely related to aphids. The hemlock woolly adelgid sucks fluid from the base of hemlock needles. It may also inject toxins into the tree as it feeds, accelerating needle drop and branch dieback. Although some trees die within four years, trees often persist in a weakened state for many years. Hemlocks that have been affected by hemlock woolly adelgid often have a grayish-green appearance (hemlocks naturally have a shiny, dark green color).

Site characteristics are thought to influence the degree of decline and recovery of adelgid infested hemlocks. Some hemlock forests can resist or recover from infestation by the adelgid. For instance, hemlocks on north and northeast facing slopes, and those in valleys or riparian zones, appear to suffer far less damage from the adelgid than those on ridge tops and upper slopes. North-facing slopes are cooler and moister than slopes facing other directions, which may result in healthier hemlocks that are more resistant to stresses caused by the insect. At Highpoint Preserve, a majority of the areas dominated by hemlock face northeast to east. It is possible that these stands may be able to resist the pest should it make its way to the area. The most vulnerable stands could be the stands on the ridge top in the southwestern portion of the preserve.

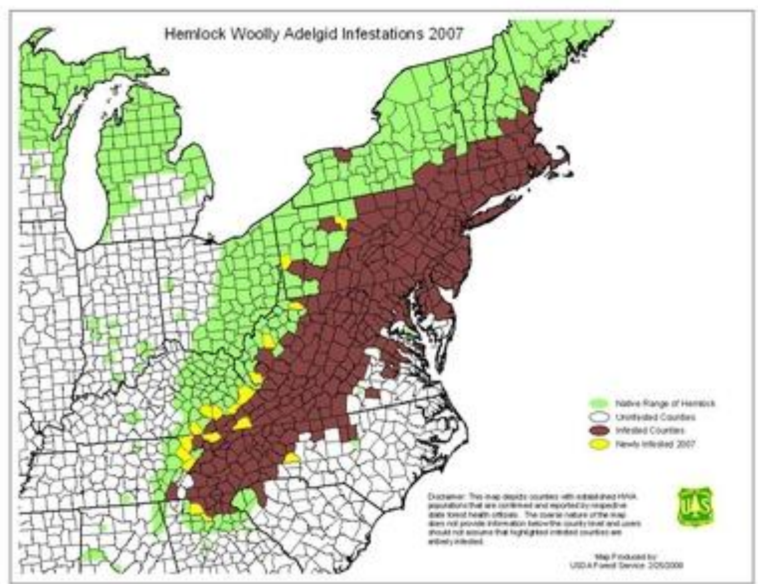


Figure 7. Map of hemlock woolly adelgid infestation as of 2007. Hemlock woolly adelgid was first detected in Susquehanna County, Pennsylvania, in 2006.

Beech bark disease is caused by an interaction between the beech scale (a non-native insect) and either one of two native *Nectria* fungi. This disease began causing widespread destruction of beech trees in Maine during the 1930s and has continued to move southward ever since. The beech scale excretes a white waxy covering while feeding on beech bark. Beech scale causes

heavy mortality of mature beech trees, though some appear to be resistant to the disease. Severely affected trees lose vigor, grow slowly, and then die. Following mortality of the mature trees, thick stands of small trees typically sprout from the roots. These thick stands can inhibit the growth of other seedlings by blocking light from the forest floor, leading to a decrease in the diversity of species in the affected area. We found beech bark disease in 92% of the plots we inventoried this year. Based on these numbers, we predict increased tree mortality in the forest, and the potential for thickets of beech sprouts to further limit seedling growth in the future. Beech trees that are not infected may be resistant and are an important component of the forest, specifically because the cavities that typically form in beech trees provide excellent habitat for wildlife, and because beech is currently the most abundant mast-producing species in the preserve.

Overall, invasive species are currently having a moderate effect on the vegetation community in the preserve. However, that could change with the impending movement of emerald ash borer to the area, and the potential infestation of hemlock woolly adelgid. Large-scale die-off of trees in locations where hemlock or ash are substantial components of the overstory create openings in the forest canopy. These openings have the potential to stimulate seedling growth and result in a greater diversity of age classes within the preserve. However, because Japanese barberry is fairly widespread across the property, any openings or disturbances could promote the growth of this invasive and subsequently prohibit growth of native vegetation. In addition, the prevalence of deer will almost certainly limit the potential for growth of new trees unless measures are taken to prevent browsing.

Salamanders and Other Wildlife

The presence and abundance of salamanders in the forest can indicate forest condition. The eastern red-backed salamander, for example, is the most abundant vertebrate in northeast deciduous forests and plays a key role in ecosystem functioning. Red-backed salamanders reach their greatest abundance in mature forests with a closed canopy, and are less abundant in young forests, or forests with open canopies. Studies have shown the biomass of red-backed salamanders in forests to be twice that of birds and equal to that of small mammals. Because salamanders are small, they are able to consume prey that is too small to be used by mammals or birds. In addition, because salamanders are ectothermic and have the lowest metabolic rates of any terrestrial vertebrates, they are highly efficient at converting the energy that they consume. From 40 – 80% of the energy ingested by salamanders produces new salamander biomass, which subsequently is available for consumption by their predators - birds, mammals, snakes and other salamanders.

In addition to being important as both predators and prey, recent research has suggested that the red-backed salamander may be a keystone species that controls leaf litter decomposition. By feeding on detritivores, salamanders may slow the rate of decomposition of leaf litter on the forest floor. As a result, salamanders may enhance carbon sequestration, allowing nutrients to be made available to vegetation at a slower, more consistent rate.

Four species of salamander were found during our plot searches at Highpoint Preserve, including the red-backed salamander (*Plethodon cinereus*), eastern newt (*Notophthalmus viridescens*), slimy salamander (*Plethodon glutinosus*), and Allegheny mountain dusky salamander (*Desmognathus ocrophaeus*). Red-backed salamanders occurred most commonly (every plot except # 35), ranging from 0 to 7 individuals and averaging 3 animals per ¼-acre plot. In addition, we found one Allegheny mountain dusky salamander and one slimy salamander in plots 50 and 45, respectively. Four Eastern newts, in their terrestrial or red eft stage, were recorded from plots 35 and 50.

The number and distribution of red-backed salamanders at Highpoint Preserve is indicative of a mature forest with a closed canopy. The red-backed salamander is a generalist salamander of northeast forests, tolerating a wide range of conditions, but faring best in the cool, moist conditions created when the forest floor is shaded by overstory vegetation. As such, the Highpoint Preserve forest ecosystem is highly favorable for the species. The slimy salamander likewise prefers mature woodlands with abundant rocks and logs for cover, and will retreat underground during periods of drought. This secretive species hibernates in areas of shale or rock with crevices extending underground below the frost line. This probably explains why we found the slimy salamander in a plot containing abundant rock cover. The mountain dusky salamander also is found in moist deciduous or mixed hardwood-coniferous forests, often under rocks, logs, bark, and other cover objects. However, this species tends to favor moist or wet substrates.

All tolled, we found 0.19 salamanders per cover object overturned at Highpoint Preserve. During a similar survey at the Arnot Forest in July, 2008, we counted 0.25 salamanders per cover object. These numbers are fairly comparable, and the higher numbers at the Arnot are most likely due to differences in habitat characteristics and the greater age of the forest there.

Habitat Characteristics

As part of the PFI plots, we recorded many different habitat characteristics, including a rough estimate of coarse woody debris (logs) on the forest floor. High levels of coarse woody debris increases distribution and abundance of both amphibian and small mammal populations. Decomposing wood protects woodland salamanders from predators and desiccation. Debris also provides favorable moisture and temperature conditions that allow salamanders to survive and move freely across the landscape. Besides providing habitat for wildlife, the presence of woody debris microhabitats has positive effects on numerous invertebrates and bryophytes. While beetles, mites, and mosses may not be the most noticeable of organisms, these beneficiaries also contribute to the functioning ecosystem. Tree tops and other new woody debris can also protect growing seedlings from being browsed by deer, acting as a natural barrier to movement. Therefore, the density of woody debris can greatly influence the health and biodiversity of a forest. Preferably, the forest floor should include a diverse range of debris sizes and stages of decay to maximize the short- and long-term benefits for wildlife and the regenerating forest. In addition, standing dead trees should be maintained as a significant habitat component themselves, and to provide for future coarse woody debris down on the forest floor. In the 12 plots we inventoried, there was a substantial amount of smaller-diameter coarse woody debris however, coarse woody debris greater than 6 inches in diameter was minimal (Figure 7). The diversity and quality of the habitat at Highpoint Preserve could be enhanced by providing for larger woody debris down on the forest floor.

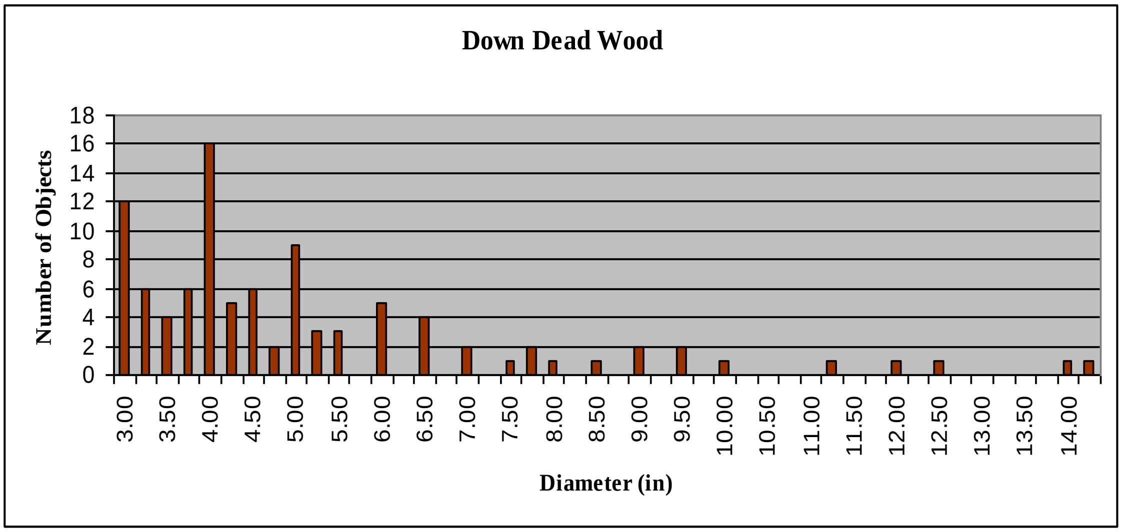


Figure 7. Sum of dead wood documented on the forest floor for all plots by diameter.

One way to project future amounts of woody debris on the forest floor is to examine the number of standing dead trees, or snags, in the plots (Figure 8). This can be useful for targeting management actions for habitat enhancement. For example, of the plots we inventoried, 9 contained more standing snags than woody debris on the ground. The snags in these plots will provide a future source of woody debris on the ground as they decay further and fall to the ground. However, plots with 5 or fewer logs on the ground provide an opportunity for habitat enhancement by creating snags or dropping a few trees onto the ground.

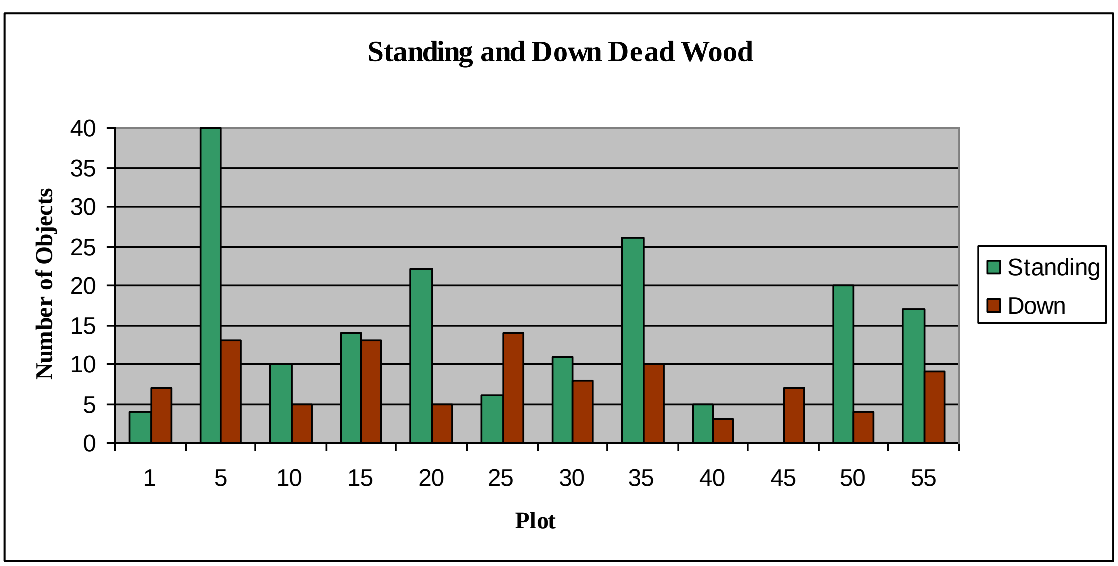


Figure 8. Number of standing snags and down logs on the forest floor by plot.

Another key feature adding to the complexity and quality of the habitats are rocks, rocky crevices and cave areas that are common habitats on the preserve. An impressive 50% of the plots contained one or more of these features, providing habitat for all sorts of wildlife such as, porcupines, raccoons, opossums, and small mammals.

Outreach Activities 2008

Throughout 2008, we came together with Conservancy members and the public around a number of important conservation issues. The first was the frog call survey and associated educational training programs. The second was a presentation of preliminary results from our summer work, given at the Conservancy's annual meeting. And, finally, we delivered an educational program highlighting current threats to bats, their natural history and conservation, and how to keep them out of places where they are not wanted. Following an indoor presentation, we went outside and used an Anabat detector to hear the otherwise inaudible ultrasonic calls of bats. These events provided the opportunity to share the results of our on-the-ground activities, but perhaps more importantly they enable us to receive valuable input from the local community.

Appendix A. Bird Count Methodology and Data Form

E.L. Rose Conservancy Breeding Bird Survey Data Sheet

Location: ________________________ Bird Point: _______________________

GPS Coordinates: ____

Date: _________________ Name of Surveyor: __________________________

Time of Start: _________________ Time of Finish: _______________________

Weather Conditions:

Approx. Temperature(ºF)	
Wind	
Sky Code	
% Cloud Cover	

Birds:

	Species	Seen (y/n)	Heard (y/n)	Within 50 m (y/n)	First 3 minutes (y/n)	Confidence level
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						

18						
19						
20						
21						
22						
23						
24						
25						

Totals:

Species	#

Comments:

Confidence Scale

1) Virtually no doubt in accuracy of identification
2) Reasonably confident, but some doubt
3) Semi-sure (this may be the result of knowing what small group the bird belongs to, ie. Thrushes, but lacking confidence in correct identification of exact species)
4) Educated guess, with much doubt
5) Severe doubt (this may be a result of uncertainty when believing to have heard a bird in the far distance)

Common Names and Codes for Birds in the Silver Lake Township

Alder Flycatcher (ALFL)
American Crow (AMCR)
American Goldfinch (AMGO)
American Kestrel (AMKE)
American Redstart (AMRE)
American Robin (AMRO)
American Woodcock (AMWO)
Baltimore Oriole (BAOR)
Barn Swallow (BARS)
Barred Owl (BDOW)
Belted Kingfisher (BEKI)
Black-and-white Warbler (BAWW)
Blackburnian Warbler (BLBW)
Black-capped Chickadee (BCCH)
Black-throated Blue Warbler (BTBW)
Black-throated Green " (BTNW)
Blue Jay (BLJA)
Blue-gray Gnatcatcher (BGGN)
Blue-headed Vireo (BHVI)
Bobolink (BOBO)
Broad-winged Hawk (BWHA)
Brown Creeper (BRCR)
Brown-headed Cowbird (BHCO)
Canada Goose (CAGO)
Canada Warbler (CAWA)
Carolina Wren (CARW)
Cedar Waxwing (CEDW)
Chestnut-sided Warbler (CSWA)
Chimney Swift (CHSW)
Chipping Sparrow (CHSP)
Cliff Swallow (CLSW)
Common Grackle (COGR)
Common Loon (COLO)
Common Raven (CORA)
Common Yellowthroat (COYE)
Dark-eyed Junco (DEJU)
Downy Woodpecker (DOWO)
Eastern Bluebird (EABL)
Eastern Kingbird (EAKI)
Eastern Meadowlark (EAME)
Eastern Phoebe (EAPH)
Eastern Screech Owl (EASO)
Eastern Towhee (EATO)
Eastern Wood-Pewee (EAWP)
European Starling (EUST)
Field Sparrow (FISP)
Gray Catbird (GRCA)
Great Blue Heron (GBHE)
Great Horned Owl (GHOW)
Great-crested Flycatcher (GCFL)
Hairy Woodpecker (HAWO)
Hermit Thrush (HETH)
House Finch (HOFI)
House Sparrow (HOSP)
House Wren (HOWR)
Indigo Bunting (INBU)
Killdeer (KILL)
Least Flycatcher (LEFL)
Magnolia Warbler (MAWA)
Mallard (MALL)
Mourning Dove (MODO)
Northern Cardinal (NOCA)
Northern Flicker (NOFL)
Northern Mockingbird (NOMO)
Northern Rough-winged Sw. (NRWS)
Ovenbird (OVEN)
Pileated Woodpecker (PIWO)
Prairie Warbler (PRAW)
Purple Finch (PUFI)
Red-bellied Woodpecker (RBWO)
Red-eyed Vireo (REVI)
Red-tailed Hawk (RTHA)
Red-winged Blackbird (RWBI)
Rock Pigeon (ROPI)
Rose-breasted Grosbeak (RBGR)
Ruby-throated Hummingbird (RTHU)
Ruffed Grouse (RUGR)
Savannah Sparrow (SAVS)
Scarlet Tanager (SCTA)
Sharp-shinned Hawk (SSHA)
Song Sparrow (SOSP)
Spotted Sandpiper (SPSA)
Swamp Sparrow (SWSP)
Tree Swallow (TRES)
Tufted Titmouse (TUTI)
Turkey Vulture (TUVU)
Veery (VEER)
Warbling Vireo (WAVI)
White-breasted Nuthatch (WBNU)
Wild Turkey (WITU)
Winter Wren (WIWR)
Wood Duck (WODU)
Wood Thrush (WOTH)
Yellow Warbler (YWAR)
Yellow-bellied Sapsucker (YBSA)
Yellow-billed Cuckoo (YBCU)

Bird Count Methodology

The following bird count methodology was described by Charles Smith in 2003. The methodology was repeated in 2008.

High Point Preserve Breeding Bird Transect

To help the ELRC achieve its goal of long-term breeding bird surveys on the High Point Preserve, we set up a 2,000 meter-long (2 km) breeding bird count transect. The transect follows existing trails on a South to North line through the eastern part of the preserve. The transect consists of 10 points spaced 200 meters apart. The first is located on the Red Trail, 50 meters north of the Crowley Road entrance at the southern end of the preserve. They were marked with 4-foot-long x ½-inch-diameter iron rebar on 15 November 2003. Each bar was driven into the ground 18–24 inches and marked with orange surveyor's flagging. They were labeled consecutively from 1 to 10 with the words "Bird Point 1, Bird Point 2 . . . Bird Point 10." The markers were placed off the trail next to a tree to minimize the chance of a hiker tripping over them. Table 7 lists the geographic coordinates and elevations associated with each point. The coordinates were recorded on 15 November 2003, at the time the rebar was installed, using a Trimble GeoExplorer GPS unit.

The transect counts were started between 04:45 and 04:50 a.m. EDT and lasted approximately 2 hours and ten minutes. A ten-minute count was made at each stop. Each ten-minute count was divided at the three-minute mark. Counts of all individuals were recorded. If an individual was observed or heard singing in the first three minutes of the stop, it was noted as such. If a bird was observed or heard singing after three minutes, it was noted in a different category. If a bird was observed or heard singing in the first three minutes and again after the three minute division, it was only recorded in the first category. The three-minute division was made to coincide with standard three-minute Breeding Bird Survey (BBS) counts. Therefore, the High Point Preserve transect data is directly comparable to the BBS data (one only has to ignore the remaining seven-minute count). The High Point transect also had a spatial component. Every bird's distance relative to the center of the count circle (i.e. where the observer stood) was estimated. For each timed division, birds were recorded within 50 meters, as well as beyond 50 meters. Three identical transect counts were conducted on 17 and 24 June, and 1 July 2003, with one-week intervals between the counts.

Appendix B – Permanent Forest Inventory Plot Methodology (for 2008) and Data Sheets

PFI Herp Search Data and Wildlife Sign

PFI Plot Number ________________________ Tally Date _____/ _____/ _________

Tallied By ____ Page ________ of ________

Time of day			
Days since significant rain			
Litter moisture rating	Dry	Moist	Wet
Number of turn-overs (minimum 10)			

Species Name **Number Found**

1. ____ _______________
2. ____ _______________
3. ____ _______________
4. ____ _______________
5. ____ ________________

Wildlife Sign / Special Features

____

____

____

____

____

____

____

____

____

____

High Point Preserve Permanent Plot Location Sheet

PFI Plot Number ________________________ Tally date: ____/ ____/ ________
Tallied by ____ Page ________ of _________
Pictures __________ -___________

Plot Habitat Description	
Deer Impact	

Comments/ Travel Description:

____
____
____
____

Map / Directions

PFI Seedling-Sapling Samples

PFI Plot Number ____________________________ Tally Date _____/ _____/ _________

Tallied by ____ Page ________ of __________

Subplot : 11.8’ radius
Seedlings: 4”-- 54” tall
Saplings: 54.1” tall -- 3.99” dbh

North Subplot			North (cont.)			South Subplot			South (cont.)		
SPP	**#SDL**	**#SPL**	**SPP**	**#SDL**	**#SPL**	**SPP**	**#SDL**	**#SPL**	**SPP**	**#SDL**	**#SPL**

Trees > 4" dbh

PFI Plot Number ______________________ Tally Date _____/ _____/ ________

Tallied By _____________________________________ Page __________ of ___________

Tree #	Species	dbh	Cavity (y/n)	Crown class

Tree #	Species	dbh	Cavity (y/n)	Crown class

Permanent Forest Inventory Plot Methodology

(Adapted in 2008 from methodology developed for Cornell's Arnot Forest)

Objective: Establish permanent plot samples throughout the forest to measure the change in various forest characteristics through time. Be able to describe changes in forest species composition, structure, health and habitat availability that result from natural forest dynamics and management practices.

Assumptions/Constraints: Plots will be established annually. Each point will be re-sampled every 5 to 8 years and allow an analysis of change through time. Some plots may be sampled more frequently to assess short-term forest dynamics.

Methods: Establish 10-15 plots per year, distributed among properties owned or managed by the E.L. Rose Conservancy in Susquehanna County, Pennsylvania. Plots will be numbered sequentially. Plot center is marked with a white 2.5" PVC pipe 5' long. A GPS unit will be used to record UTM coordinates. A "Permanent Plot Location Sheet" will be completed for each plot. This sheet will include written directions/map to the plot, a general description, and information about deer impact. Each plot will include:

- A fixed radius overstory plot (0.25 acres, 58.9 ft. radius) where all live trees ≥ 4" dbh will be tagged with aluminum numbered tags and aluminum nails at 12" above ground, and tallied by species, dbh, presence of cavities > 1" diameter, and crown class. DBH will be measured to the nearest 0.1 inch using a diameter tape located at the top of a 3.5' stick placed on the nail. Nails should face plot center. All dead trees will be tallied and diameter will be recorded.
- Within each overstory plot record elevation, aspect, % slope, slope shape, percent fern cover, and presence or absence of grass, seeps or wet areas, trails or roads, logs in water, perches, soft or hard mast species, rock piles, rock crevices, caves, and cavities in living or dead trees. Also make note of the presence or absence of accumulate litter on the forest floor, and note the presence or absence of forest pests including beech blight, hemlock woolly adelgid, and emerald ash borer.
- Within each plot, N/S and E/W lines transecting the diameter of the plot will be established to record the percent cover of coarse woody debris > 3" diameter at the point of their intersection with the transect. Record diameter at the intersection, condition, and whether bark is present.
- At the north and south cardinal directions on the edge of the overstory plot, establish sapling/ground layer plots having an 11.8' radius to equal 0.01 acres each. Subplot centers should be marked with a 30" wooden stake and flagged. Record the number of woody stems by species in the ground layer (height of 4" – 54") and sapling/shrub layer (height > 54" up to 3.99" dbh) using decadal increments (1-10 by one; 11 to 100 by tens; 101+ by hundreds).
- Within each sapling subplot (11.8' radius), record presence or absence of the following herbs: sensitive fern, maiden-hair fern, Christmas fern, true ginseng, dwarf ginseng, blue cohosh, jack-in-the-pulpit, or trillium. Also record presence or absence of invasive species including garlic mustard, barberry, multi-flora rose, honeysuckle, or autumn olive, and the percent of inhibiting fern cover, percent of other fern cover, and percent grass and sedge cover.

List of Equipment Needed

1. PVC Pipe: preferably white 2.5” PVC pipe 5’ long
2. Short wooden stakes
3. Blue spray paint (for the top of the PVC)
4. Tags for the pipe (the soft etch-able aluminum one work)
5. Round aluminum tree tags from Forestry Suppliers Co.
6. Multiple tape measures
7. Data sheets, pencils, and permanent marker
8. DBH tape
9. Hammer
10. Aluminum nails (aluminum makes it safe for loggers)
11. Small sledge hammer (to pound in stakes)
12. Flagging
13. Field guides if necessary

Definitions of Variables Recorded at High Point Permanent Forest Inventory (PFI) Plots

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Deer Impact: An estimate of the browsing pressure that deer are having on tree seedlings in the area of the sample plot. Code is as follows:

1= low pressure; 2= low/medium; 3= medium; 4=medium/high; 5= high

Travel Description: A narrative description of travel from the nearest permanent location or landmark.

Map: A hand sketch of the travel description.

Overstory Plot Size: The length of the plot's radius in feet. Typically 58.9' unless otherwise noted.

Sapling Plot Size: The length of the subplot's radius in feet. Typically 11.8' unless otherwise noted.

Seedling Plot Size: The length of the subplot's radius in feet. Typically 11.8' unless otherwise noted.

Aspect: The direction of the downward slope coded as: North, Northeast, East, Southeast, South, Southwest, West, or Northwest.

Slope: The calculated percent slope. Can be calculated in the field or from a topographic map.

Slope Shape: An visual estimation coded as: 1=convex; 2=linear; 3=concave

Topographic Position: Coded as: 1=Upland Plateau; 2=Upland Bottom; 3=Ridge Top; 4=Upper Slope or Shoulder; 5=Mid-slope; 6=Bench; 7=Lower Slope; 8=Bottomland/Flatland.

Riparian %: The percentage of the plot that characterized by stream channels, wetlands, floodplains, and immediately adjacent terrestrial ecosystems.

Seep: Enter either "present" or "absent" as to the presence of seeps or springs within or adjacent to the plot. A seep is a source of surface ground water without a well defined point of origin. A spring has a well defined point of origin. Seeps and springs may or may not have vegetation around them.

Streams: Enter "present" if perennial streams are within the stand or immediately adjacent to the stand.

Temporary Ponds: Enter "present" if any temporary or vernal pools are within or adjacent to the plot. Temporary ponds must be greater than 6 inches deep and greater than 1 square yard; water must be present for at least two months during the growing season. The exact month differs for each species that uses temporary ponds. Areas covered by a fine layer of silt and depressions filled with blackened leaves me serve as dry season indicators of temporary ponds.

Permanent Ponds: Enter "present" if any permanent ponds of lakes are within or adjacent to the plot. Permanent ponds are any size of depth, but larger is generally better; water must be present year-round, although the top layer can freeze.

Logs in water: Enter "present" if any downed logs are partially or wholly in a permanent water source.

High Perch: Enter "present" if any high exposed perches occur in the plot. A high perch is any live or dead tree that clearly towers above the canopy such as a supracanopy white pine, or a single tree or group of trees standing above ground vegetation such as a lone elm in a pasture or a snag in a clearcut.

Hard mast: Enter "present" if there are any plant species in or near the plot that provide hard mast such as acorns or hickory.

Loose soils: Enter "present" if there is soil that can be easily burrowed into.

Rock Piles: Enter "present" if there are any natural or man-made piles (rock walls), as long as they provide hiding places for small mammals, amphibians, or reptiles.
Rock crevices: Enter "present" if there are openings in the rocks that lead below the frost line.
Caves: Enter "present" if there are any caves or larger rock openings that lead below the frost line.
Live cavities: Enter "present" if there are any live trees in or near the plot with cavities at least 1" in diameter. This is collected in the overstory plot and may be determined from field data.
Dead cavities: Enter "present" if there are any dead trees in or near the plot with cavities at least 1" in diameter. This is collected in the overstory plot and may be determined from field data.
Coarse Woody Debris: Any fallen logs or trees that are longer than three feet and greater than three inches in diameter.
Condition: Coded as: 1=solid/good; 2=rotten/ poor
Species: For every tallied tree, enter the tree species using either the 3-digit forest survey code or the mnemonic abbreviation.
DBH: The diameter at breast height (typically four feet above the ground).
Crown Class: Determine the position of the tree crown using the following codes:

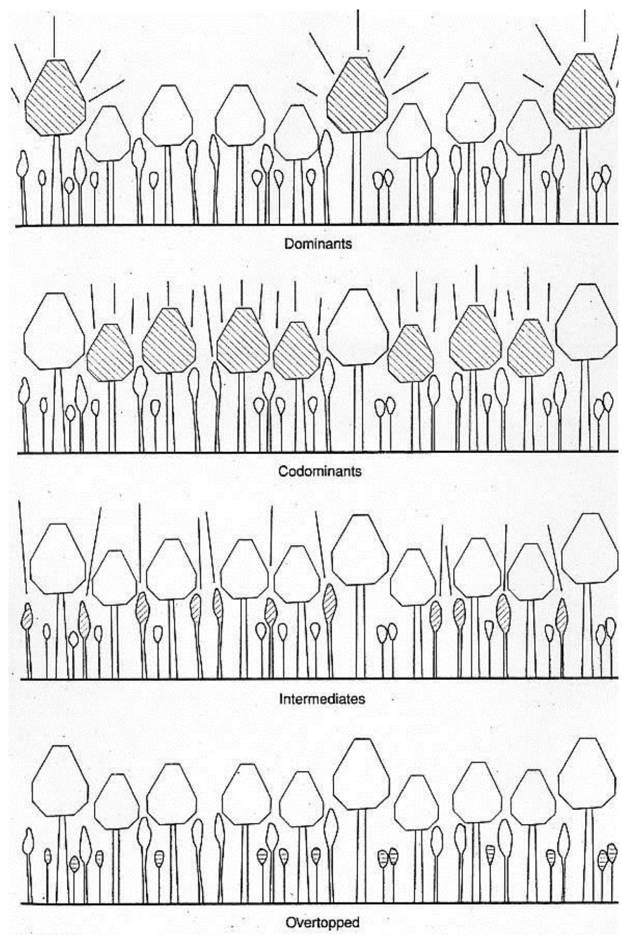
1= open grown- a tree that is free of competition and receives light on top and all sides of the crown as a result of a very heavy thinning or being in an isolated, open-grown position.

2= dominant- a tree with the crown extending above the general level of the main crown canopy and receiving full light from above and partly from the sides.

3=codominant-a tree with a crown forming the general level of the main canopy, receiving full light from above but little from the sides.

4=intermediate- a tree with a crown extending into the lower portions of the main crown canopy, but shorter than the codominants and receiving little direct light from above and none from the sides.

5=suppressed- a tree whose crown is entirely below the general level of the canopy and receives no direct light from either above or the sides.



Appendix C – Permanent Forest Inventory Plot Results

Permanent Forest Inventory Plot Descriptions

Plot	Central plot radius (ft)	Subplot radius (ft)	Elevation (m)	Aspect	Slope Shape	Topo Position	UTM Coordinates
1	58.9	11.8	518	NE	Concave	Lower slope	18T 0420686; 4643179
5	58.9	11.8	560	E	Convex	Upper slope	18T 0420399; 4643111
10	58.9	11.8	583	E	Linear	Hillside	18T 0420601; 4643002
15	58.9	11.8	576	N	Concave	N/A	18T 0420693; 4642916
20	58.9	11.8	540	E	Concave	N/A	18T 0420861; 4642770
25	55.9	8.8	579	E	Convex	Mid-slope	18T 0420797; 4642403
30	58.9	11.8	546	W	Concave	N/A	18T 0420817; 4642277
35	58.9	11.8	589	W	Concave	N/A	18T 0420706; 4642195
40	55.9	8.8	566	ESE	Linear	Mid-slope	18T 0420802; 4642100
45	58.9	11.8	600	SW	Convex	N/A	18T 0420603; 4641984
50	55.9	8.8	581	W	Convex	Ridgetop	?
55	55.9	8.8	577	E	Convex	Ridgetop	?

Plot	Trail or road (y/n)	Riparian %	Wetland %	Adjacent water (y/n)	Seep (p/a)	Stream (p/a)	Temp. pond (p/a)	Perm. Pond (p/a)	Logs in water (p/a)	High Perch (p/a)	Low Perch (p/a)	Soft mast (p/a)	Hard mast (p/a)	Rock pile (p/a)	Rock crevice (p/a)	Cave (p/a)	Live cavity (p/a)	Dead cavity (p/a)	Number snags	Accumulate litter (p/a)	Beech blight (p/a)	Hemlock Woolly Adelgid (p/a)	Emerald Ash Borer (p/a)
1	y	0	0	y	a	a	a	a	a	p	p	a	p	a	a	a	p	p	4	p	p	a	a
5	n	0	0	n	a	a	a	a	a	a	p	a	a	a	a	a	a	p	40	p	p	a	a
10	n	0	0	n	p	p	a	a	p	a	p	a	a	a	a	a	p	p	10	p	p	a	a
15	n	0	40	n	p	p	a	a	p	p	p	a	p	p	p	p	p	p	14	a	p	a	a
20	y	0	0	y	a	a	a	a	a	a	p	a	a	a	a	a	p	p	22	p	p	a	a
25	n	0	0	n	a	a	a	a	a	p	p	a	p	a	a	a	p	p	6	p	p	a	a
30	n	0	0	n	a	a	a	a	a	p	p	a	p	p	p	p	p	p	11	p	p	a	a
35	n	0	0	n	a	a	a	a	a	p	p	a	p	p	p	p	p	p	26	a	p	a	a
40	n	0	0	n	a	a	a	a	a	a	p	a	p	p	a	a	a	a	5	p	p	a	a
45	y	0	0	n	a	a	a	a	a	p	p	a	p	p	p	p	p	p	N/A	p	p	a	a
50	n	0	0	n	a	a	a	a	a	p	p	a	a	p	a	a	p	a	20	p	a	a	a
55	y	0	0	n	a	a	a	a	a	a	p	p	p	p	a	a	a	p	17	p	p	a	a

Biological Assessment of Silver Lake: 2008

Department of Natural Resources
Cornell University

Kurt J. Jirka, Lars G. Rudstam, and Clifford E. Kraft

January 2009

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Cover Photo: Adult alewife captured from Silver Lake, October 14, 2008.

Acknowledgements

We thank the E.L. Rose Conservancy for sponsorship of this study and continued support of Cornell research on Silver Lake. The efforts of the Conservancy in cooperation with Cornell University have enhanced our collective understanding of the biological dynamics of Silver Lake. Furthering this understanding contributes to the stewardship of the unique resources of Silver Lake and provides information applicable to protection and management of other lakes in the region. We would also like to personally thank Patty and Billy Bloomer for the use of their boat, trolling motor, and property and their extra efforts to make Cornell researchers feel comfortable while conducting sampling efforts. Their hospitality and concern for Silver Lake are greatly appreciated.

Executive Summary

The primary focus of Cornell researchers in 2008 was developing an estimate of alewife abundance in Silver Lake. Alewife is a non-native fish species believed to have been introduced to Silver Lake sometime after 1992, and this has subsequently caused a decrease in water clarity as a result of overgrazing of large zooplankton. A trout stocking program was initiated in September 2006 with the goal of reducing alewife abundance through predation by trout and subsequently increasing water clarity. The 2008 research effort focused on estimating the abundance of alewife in the lake in order to better understand the dynamics of the alewife population and gauge the effectiveness of the trout stocking program to control this population.

Dissolved oxygen and water temperature were measured on August 18 and October 14, 2008 to assess conditions for supporting trout during the summer and gain a better understanding of the physical condition of the lake. Water clarity and zooplankton community composition were evaluated to measure changes in these measures since inception of the trout stocking program. Alewife density in the lake was estimated based on the results of a hydroacoustic (sonar) survey conducted on October 14, 2008. The open-water fish community was sampled by gill nets concurrent with the hydroacoustic survey.

Results of investigations conducted in 2008 indicate that Silver Lake continues to be capable of supporting long-term survival of trout, and the trout stocking program appears to be having the desired effect of reducing alewife abundance and the impact of alewife on water clarity. Water temperature and dissolved oxygen levels during summer indicate a large zone of cool, well-oxygenated water capable of supporting trout during the warmest time of the year. Summer water clarity as measured by secchi depth readings has continued to improve since the stocking of trout, with the August 18, 2008 value of 16.0 ft being the highest recorded since the introduction of alewife in the early 1990s. Desirable changes in the zooplankton community, most notably increasing abundance and variety of large zooplankton, indicate that alewife abundance has been reduced enough to allow populations of large zooplankton to begin recovery in Silver Lake.

The hydroacoustic survey resulted in an estimate of alewife density in Silver Lake of 2,850-2,909 fish/ha (7,042-7188 fish/acre). These alewife densities are in the lower range of those observed in other lakes in New York State, which range from 4,000 to almost 20,000 fish/acre. Only alewife were captured in the gill nets, and young (age-0) fish represented 53%

the alewife caught. The growth rate of alewife in Silver Lake appears to be relatively low, consistent with the relatively limited abundance of large zooplankton in the lake. Findings from the 2008 investigation support a recommendation to continue trout stocking as a means of controlling undesirable impacts of alewife within Silver Lake.

Introduction

The E. L. Rose Conservancy of Susquehanna County has supported environmental conservation with a philosophy of stewardship and a desire for contemporary knowledge of the area's natural resources. This desire has led to the cooperative relationship between the Conservancy and Cornell University in an effort to understand and improve the water quality, fisheries and aquatic ecosystem associated with Silver Lake. The 2008 field season marked the fifth year of the cooperative relationship between the E.L. Rose Conservancy and Cornell University in an effort to monitor and manage Silver Lake. The initial focus of Cornell researchers was to review available historical information on the aquatic resources of Silver Lake and assess the biological integrity and fish community of Silver Lake through a variety of field sampling efforts. Four annual (2004-2007) reports summarizing the findings of these investigations have been prepared.

Items of concern raised by initial work conducted in 2004 included low oxygen levels in the hypolimnion (water below the thermocline) of Silver Lake and the possibility that nutrient loading may be a problem within the Silver Lake watershed. Based on these findings Cornell researchers focused their 2005 effort on assessing the offshore fish community and further characterizing the water quality of Silver Lake, with an emphasis on evaluating phosphorus levels, the limiting nutrient in most freshwater systems. During 2006 the Cornell research team focused on: (1) assessing the impacts of the introduced rock bass and alewife in the system, and (2) measuring mercury levels in tissue from several fish species within Silver Lake. Secondary goals included conducting a littoral zone survey for available prey items and additional evaluations of thermal and oxygen conditions within Silver Lake. The 2007 research effort primarily focused on evaluating the effectiveness of stocking trout to control alewife and their associated impact on water clarity.

Alewife are a non-native fish species believed to have been introduced to Silver Lake sometime after 1992, and subsequently caused a decrease in water clarity as a result of overgrazing of large zooplankton. With support from the E.L. Rose Conservancy and the Silver Lake Lake Association, a trout-stocking program was implemented in 2006 with the goal of reducing alewife abundance through predation by trout and subsequently increasing water clarity. Results of investigations conducted in 2007 indicated that stocking of trout is having the desired effect of reducing alewife abundance and the impact of alewife on water clarity and other aquatic resources of Silver Lake. The primary focus of Cornell researchers in 2008 was developing an estimate of alewife abundance in Silver Lake. The following activities were conducted by Cornell researchers in 2008.

- A dissolved oxygen and water temperature profile of the lake was measured on August 18, 2008 to assess conditions for supporting trout during the summer when dissolved oxygen and water temperature conditions are most stressful to trout. A second profile was measured on October 14, 2008 in conjunction with a hydroacoustic survey.
- Water clarity was measured using a secchi disk on August 18, 2008.

- The zooplankton community was sampled near mid-lake on August 18 and October 14, 2008 to evaluate community structure and make inferences regarding impacts to zooplankton due to predation by alewife.
- Hydroacoustic sampling (using sonar) of the open-water portion of the lake was conducted on October 14, 2008 to develop estimates of the density and biomass of alewife in Silver Lake.
- Gill-net surveys were conducted concurrently with hydroacoustic sampling to sample the fish community in open-water portions of the lake and provide supporting data for the hydroacoustics analysis.

Dissolved Oxygen/Water Temperature

Rainbow and brown trout require cool, well-oxygenated water year-round. These species prefer water temperatures below 72 ºF and dissolved oxygen levels above 5 mg/L. Dissolved oxygen and water temperature profiles were measured near mid-lake on August 18, 2008 to further assess the suitability of Silver Lake for long-term survival of trout. Similar profiles were measured by Cornell researchers in 2005-2007, and some historic data from 1946, 1992, and 2002 are also available from Silver Lake.

Data collected on August 18, 2008 were consistent with similar data collected in recent years (Figures 1 and 2) and indicate thermal stratification in this lake is fairly consistent during late summer (i.e., a layer of warm, less dense water overlays a dense, colder water layer). The transition area between these water layers is known as the thermocline. Typically, trout are limited to waters below the thermocline (known as the hypolimnion) during summer, since waters shallower than the thermocline are unsuitably warm. However, dissolved oxygen levels can sometimes be depressed within the hypolimnion due to minimal mixing with more oxygenated surface waters and biological oxygen demand associated with bottom sediments. If a lake is to sustain trout year-round, there must be a great enough volume of cool, well-oxygenated water within the hypolimnion to allow trout to survive throughout the summer. Past data and the data collected in 2008 indicate that a sufficiently large volume of the hypolimnion in Silver Lake remains well oxygenated during the warmest time of the year to support cold-water species such as trout (Figures 1 and 2). On August 18, 2008, the zone of the lake ranging in depth from about 14 to 41 ft contained water cooler than 72 ºF with dissolved oxygen greater than 5 mg/L.

The dissolved oxygen/water temperature profile measured on October 14 indicated that the lake was still stratified at this time, but the pattern of change in dissolved oxygen and temperature with increasing depth differed from that in August (Figures 3 and 4). In October, dissolved oxygen and temperature were relatively stable within the upper 30 ft of the water column and showed a marked decrease below this depth (marking the thermocline). The zone of the lake ranging from the surface to about 41 ft deep contained water less than 72 ºF with dissolved oxygen greater than 5 mg/L.

Water Clarity

Water clarity was measured on August 18, 2008 with a secchi disk, a weighted, 8-inch diameter disk with four alternately colored black-and-white sections. The depth to which the disk can be viewed provides a standardized measure of water clarity. Secchi depths for Silver Lake prior to the establishment of alewife were high, ranging from 15 to 20 ft (Figure 5). Following the introduction of alewife sometime after 1992, secchi depths remained relatively high

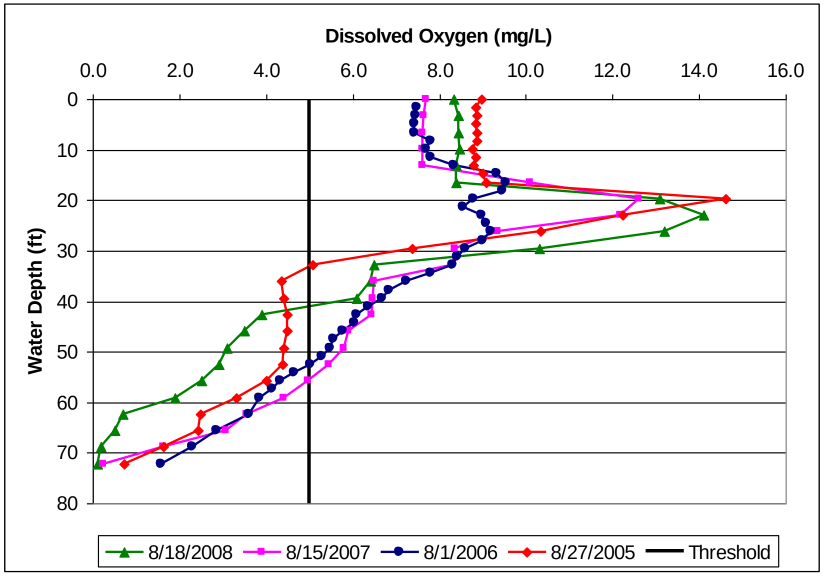

Figure 1. Dissolved oxygen profiles for Silver Lake on August 18, 2008, August 15, 2007, August 1, 2006, and August 27, 2005.

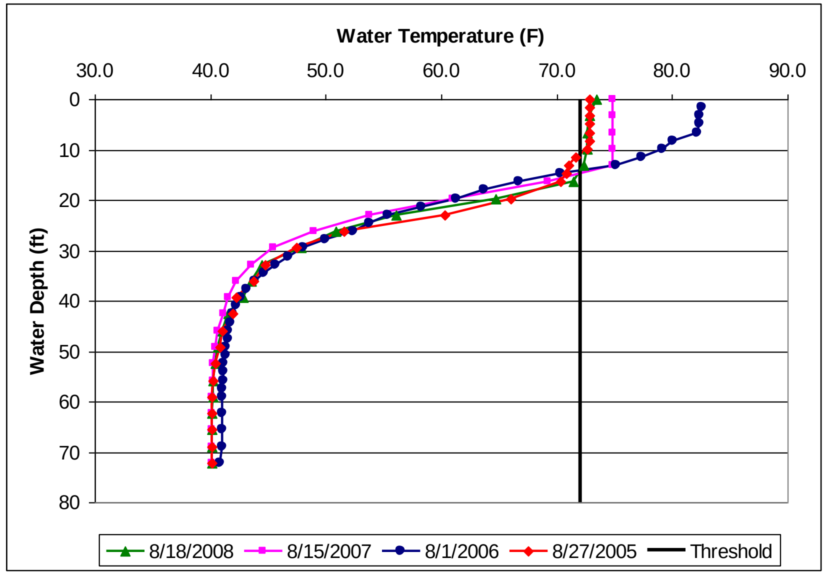

Figure 2. Water temperature profiles for Silver Lake on August 18, 2008, August 15, 2007, August 1, 2006, and August 27, 2005.

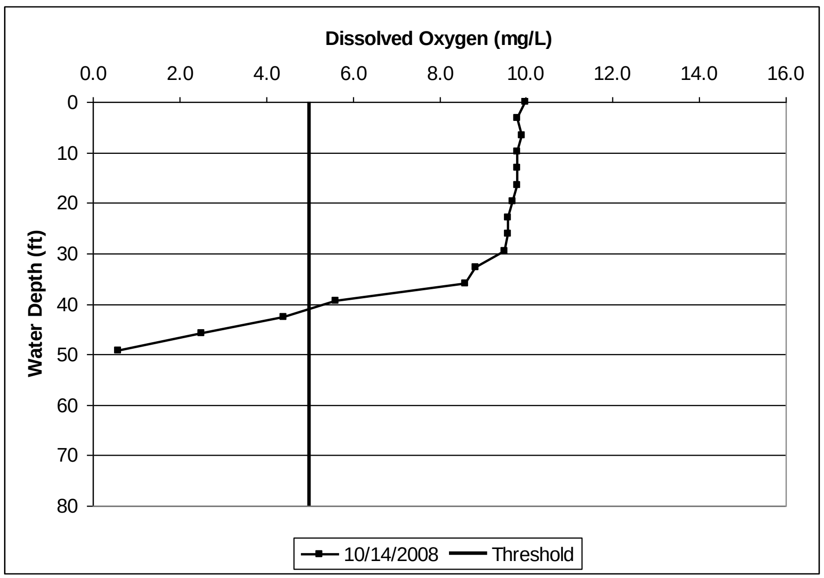

Figure 3. Dissolved oxygen profile for Silver Lake, October 14, 2008.

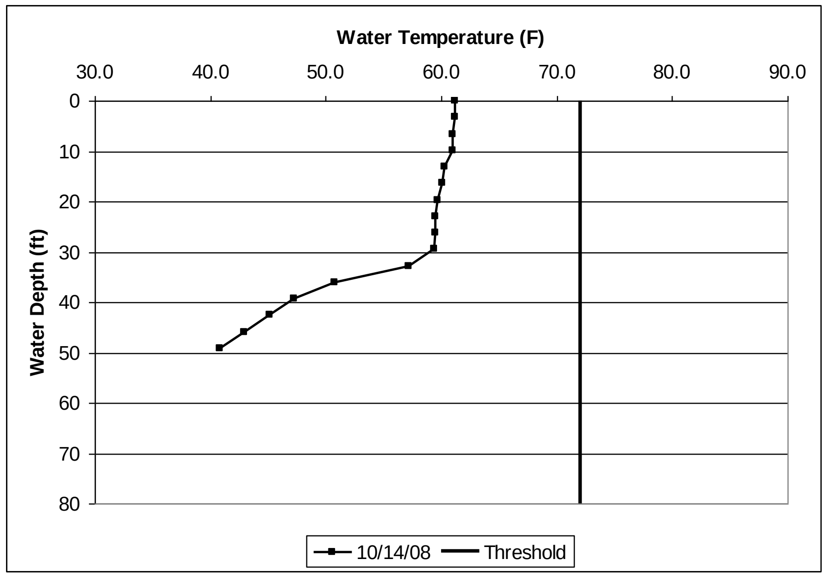

Figure 4. Water temperature profile for Silver Lake, October 14, 2008.

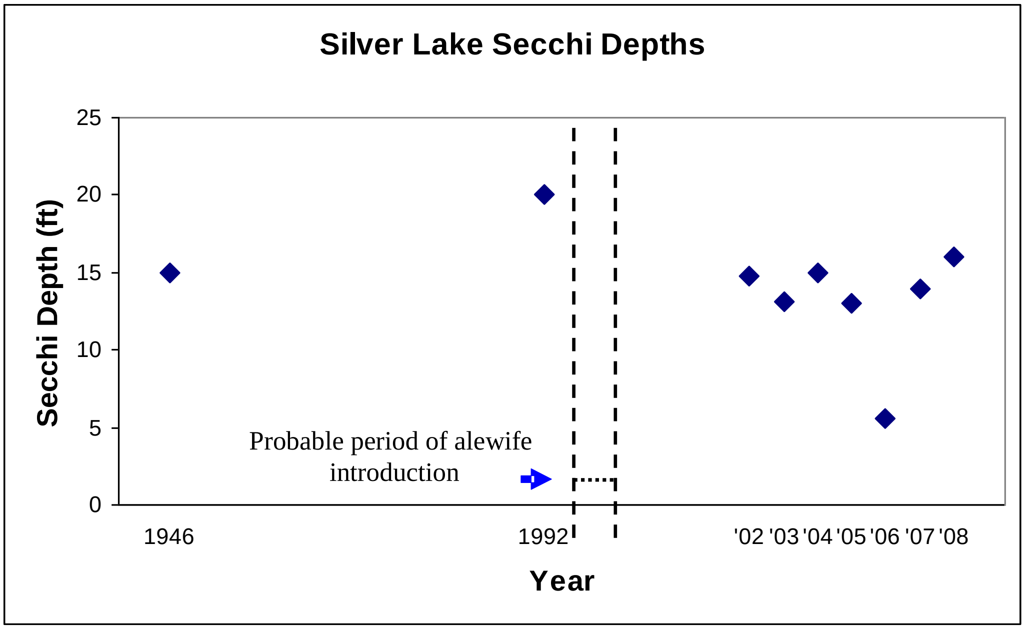

Figure 5. Secchi depths for Silver Lake, 1946, 1992, and 2002 through 2008. Points represent data collected on the nearest date to June 30th to minimize seasonal differences. Data collected in 2006 were associated with a flood event.

(13-15 ft) until 2006, when they declined to as low as 5.6 ft (Figure 5). Values measured in 2006 ranged from 5.6 ft on June 30 to 11.9 ft on October 12. The 5.6-ft value was measured during a flood event and therefore likely reflects a worst-case scenario, but the values for August 1 (9.6 ft) and October 12, 2006 (11.9 ft) were still lower than any previous measurements.

The secchi depth measured on August 15, 2007 was 13.9 ft, well within the range of values recorded prior to 2006 and very near values recorded before the establishment of alewife in the lake. Furthermore, while conducting fish sampling on October 16, 2007, Cornell researchers anecdotally noted that the water clarity appeared even better than during their August 15, 2007 visit to the lake. Unfortunately, no secchi depth was measured on October 16 to confirm this observation. Secchi depth measured on August 18, 2008 was 16.0 ft. This is the second highest secchi depth recorded for Silver Lake and the highest recorded since the introduction of alewife in the early 1990s. This also represents the second consecutive year in which secchi depth has increased since trout stocking began in 2006.

Zooplankton Community

The zooplankton (micro-crustaceans and other animals living within the water column) community of Silver Lake was first investigated by Cornell researchers in 2006 (sampled on June 30, August 1, and October 12) and was sampled once again in 2007 (August 15) and twice in 2008 (August 18 and October 14). Samples were collected near mid-lake using a Wisconsin-style plankton net that was lowered to a depth of 20 meters (~66 ft) and slowly lifted vertically to the surface. Preliminary analysis of the 2006 samples found that large-bodied zooplankton were scarce or absent. This finding strongly supported the hypothesis that alewife were the cause of decreasing water clarity in Silver Lake. Alewife preferentially consume large zooplankton that graze upon the phytoplankton (microscopic algae) responsible for algal blooms in lakes. When large-bodied zooplankton are reduced or eliminated by heavy predation, the density of phytoplankton in the water column increases and water clarity decreases due to reduced light penetration.

The 2006 zooplankton samples contained relatively low numbers of zooplankton overall and were dominated by small-bodied zooplankton, primarily *Bosmina* and small rotifers, that are ineffective in controlling phytoplankton abundance (Table 1). In contrast, the 2007 zooplankton samples contained relatively high numbers of zooplankton overall, a greater variety of zooplankton, and, most importantly, greater numbers and variety of large-bodied zooplankton than in 2006.

Table 1. Estimated densities of various zooplankton groups in Silver Lake based on preliminary analysis of samples collected in 2006 through 2008.

Zooplankton Group	**Size (mm)**	**Estimated Density (No./Liter)**					
		6/30/06	**8/1/06**	**10/12/06**	**8/15/07**	**8/18/08**	**10/14/08**
Small Cladocera	<0.5	9.6	93.1	10.2	324.0	12.5	13.1
Large Cladocera	>0.5	0.0	0.0	0.0	0.9	2.8	3.0
Small Copepoda	<0.7	3.8	0.2	5.5	11.5	2.7	12.9
Large Copepoda	>0.7	0.4	0.0	0.9	13.0	8.4	0.4

Analysis of the zooplankton samples collected on August 18, 2008 showed reduced numbers of small zooplankton and a greater than three-fold increase in large Cladocera, which are highly effective consumers of phytoplankton, in comparison to August 2007. Large zooplankton were not numerous, but their abundance is increasing after being absent in past samples. Zooplankton samples collected on October 14, 2008 showed a similar trend, with large Cladocera present in even slightly greater numbers in October 2008 than in August 2008. No large Cladocera were found in samples collected in October 2006. These findings strongly suggest that the stocking of trout since October 2006 is having a positive impact on the zooplankton community by reducing the abundance of alewife and consequently the level of predation on large-bodied zooplankton.

Hydroacoustic Survey

Alewife are an effective planktivore, and abundant alewife populations cause declines in large, efficient zooplankton grazers (Brooks and Dodson 1965). Therefore, abundant alewife populations are usually associated with high chlorophyll levels (due to abundant phytoplankton) that result in decreased water clarity (Harman et al. 2002, Wang et al. submitted). Understanding water clarity changes in Silver Lake therefore requires an understanding of the dynamics of the alewife population. A hydroacoustic survey of Silver Lake was conducted on October 14, 2008 to estimate the density and biomass of the lake's alewife population.

Silver Lake was surveyed at night using a 123 kHz split beam echo sounder mounted off the side of a flat-bottom motor boat. Within a two-hour period between about 9 and 11 p.m., a total of

1,348 m of acoustic transects (lines along which data were collected) were surveyed in eight sections corresponding to roughly parallel SE to NW transects (Figure 6). Acoustic data were recorded directly to a laptop computer in the boat from which the sonar gear was deployed. Data from each transect were analyzed to determine the number of alewife present at two ranges of depth: 2-6 m and 6 m to the lake bottom. The acoustic equipment and methods used in this survey were not able to detect fish in the top 2 m of water, so fish densities in the top 2 m were assumed be the same as in water from 2 to 6 m deep. Lake-wide averages were calculated using the average fish density from each transect.

Fish were also captured using vertical gill nets set at six locations concurrent with hydroacoustic sampling (Figure 7, Table 2). The nets were set at three lake locations from the surface to 6 m depth, at two locations from 6 m to 12 m depth, and at one location from 14 m to 20 m depth. Nets were retrieved after being set for approximately four hours, after which fish were identified to species and the depth at which they were caught was recorded in 2-m intervals. A random subsample of 30 alewife captured per net was measured for total length in millimeters (mm) and total weight in grams (g).

Gill net data. A total of 150 fish were caught in the gill nets (Table 2, 0.3 to 12.8 fish/hr), and alewife was the only species caught. Fish were found from the surface to 12 m deep. Only one fish was caught in the deep net, corresponding to low acoustic density observed at that depth. In general, alewife were distributed at depths above the thermocline, which had higher dissolved oxygen levels than water depths below the thermocline.

Three distinct modes were observed in the alewife size distribution: fish smaller than 85 mm, fish 85 to 100 mm, and fish larger than 100 mm (Figure 8). The smaller length mode most likely consisted of age-0 fish hatched in 2008. These young fish represented slightly over half of the fish caught (80 out of 150), and a subsample of these fish will be aged to confirm this assumption. For now, it is assumed that the larger fish were all age 1 and older fish. Average length and weight was 67.6 mm and 2.5 g for the age-0 fish and 109.2 mm and 10.7 g for the older fish. Alewives typically reach lengths of 60-90 mm by September of their first year of life in New York inland lakes (Rudstam and Brooking 2005) but can get larger, up to 140 mm, in productive lakes with large zooplankton (e.g., Oneida Lake and Canadarago Lake, Rudstam unpubl. data). Therefore, the observed growth rate of alewives in Silver Lake appears to be relatively low, consistent with relatively small zooplankton sizes.

Acoustic data. Fish density calculated from both transect-specific hydroacoustic signal data and data from all transects combined was 2,850 fish/ha (7,042 fish/acre) and 2,909 fish/ha (7,188 fish/acre), respectively (Table 3, Figure 9). Fish densities for individual transects ranged from 76 to 4,758 fish/ha (188 to 11,757 fish/acre). The fewest fish were found along transect 1 at the northern end of the lake. All fish densities were calculated as the sum of densities for two depth ranges: 0-6 m and 6 m to the bottom. The densities obtained for the 0-6 m water depth assumed that the density of alewife at depths from 2-6 m was the same as at depths from 0-2 m that were not surveyed by the sonar gear. This seems reasonable because almost exactly 1/3 (33.1%) of the fish caught in our 0-6 m nets were indeed caught at depths of 0-2 m. By further assuming all of these fish were alewife and using an average alewife weight of 7.2 g (Table 1), the average Silver Lake alewife biomass was calculated as 20 kg/ha (17.8 lb/acre; Table 3).

Figure 6. Approximate track taken during hydroacoustic survey and locations of transects 1 through 8 surveyed in Silver Lake on October 14, 2008.

Figure 7. Location of gill net sets in Silver Lake on October 14, 2008.

Table 2. Summary of fish catches in gill nets set in Silver Lake on October 14, 2008.
Note: All fish captured were alewife.

Measure	**Net 1**	**Net 2**	**Net 3**	**Net 4**	**Net 5**	**Net 6**
Set time (h)	1836	1845	1856	1902	1909	1918
Retrieve time (h)	2245	2235	2301	2308	2316	2316
Time fished (h)	4.15	3.83	4.08	4.07	4.12	3.97
Depth fished (m)	0-6	6-12	0-6	14-20	0-6	6-12
No. of fish	25	49	29	1	25	21
Catch/hour	6.02	12.79	7.11	0.25	6.07	5.29
% in upper1/3	20	51	66	0	8	38
% in middle 1/3	52	39	21	100	48	43
% in lower 1/3	28	10	14	0	44	19
Mean length (mm)	70.6	107.4	72.8	96	72.8	116.6
Length range (mm)	65-76	82-152	53-135		52-108	92-145
Mean weight (g)	2.8	10.3	4.5	6.1	3.5	12.4
Weight range (g)	2.2-3.4	4-27.9	1.3-19		1.0-10.4	5.2-23.9
% <85mm (age 0)	100	0	86	0	92	41

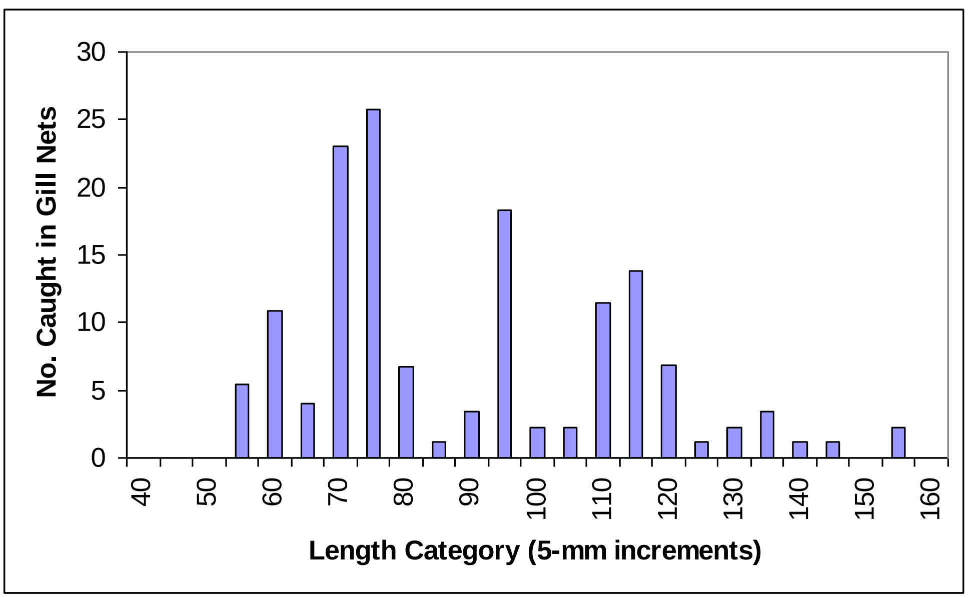

Figure 8. Size distribution of alewife captured in gill nets set in Silver Lake, October 14, 2008.

Table 3. Estimates of alewife density in Silver Lake based on hydroacoustic data collected October 14, 2008. Density[1] is calculated using transect-specific data. Density[2] is calculated using lake-wide average data. Biomass is the density multiplied by the average weight of all alewife caught in gill nets. Mean density and biomass is weighted by length of the transect.

Transect	Transect Length (m)	Density[1] (fish/ha)	Density[2] (fish/ha)
1	131	76	78
2	94	4557	2417
3	110	518	555
4	117	4345	2845
5	270	2261	2244
6	224	3574	3901
7	189	4758	6927
8	213	2483	2355
Mean	**168**	**2850**	**2909**
Biomass (kg/ha)		20.2	20.6

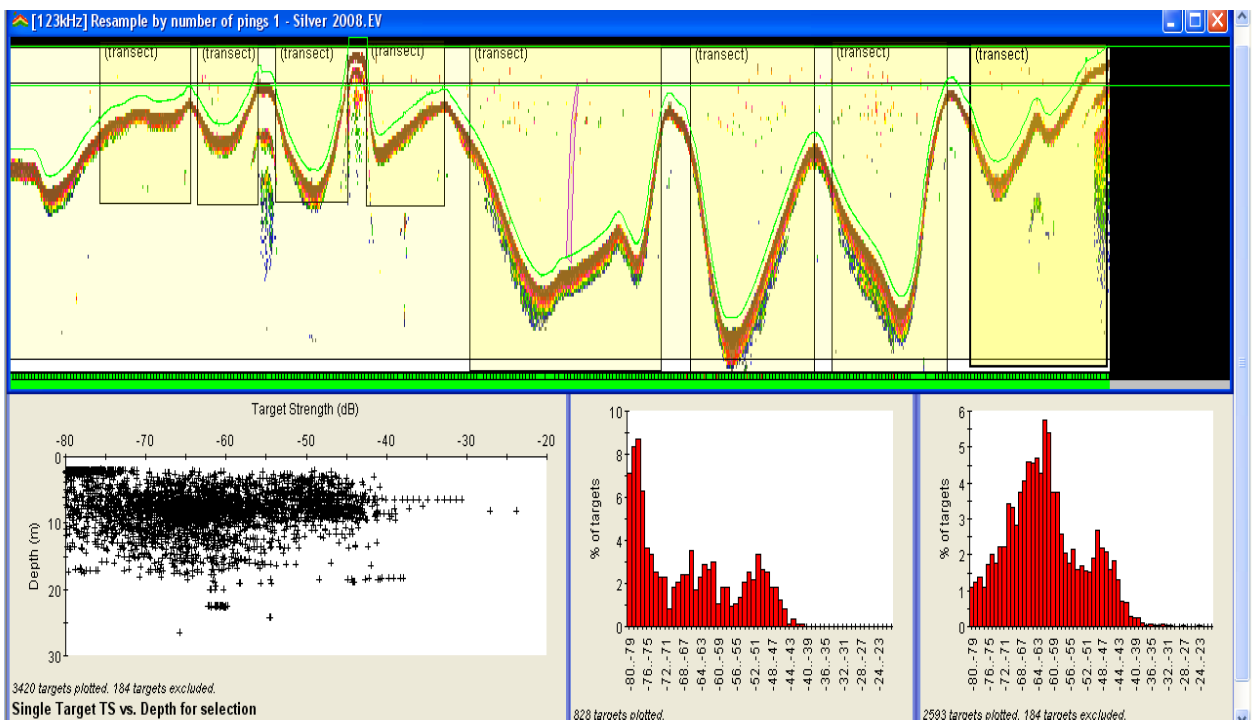

Figure 9. Hydroacoustic software output for data collected during survey of Silver Lake on October 14, 2008. Top panel shows distribution of transects along sampling track; undulating band represents lake bottom; colored marks above lake bottom indicate targets (primarily fish) detected by sonar.

Alewife densities obtained from the 2008 Silver Lake survey were comparable to alewife densities in larger New York lakes (Fitzsimons et al. 2005) and Onondaga and Cayuta lakes (Brooking and Rudstam 2009, Wang et al. submitted). They were lower than observed densities from some other New York lakes such as Otsego Lake, Otisco Lake, and Conesus Lake, which had average densities of 4,000 to 8,000 fish/ha (9,884 to 19,768 fish/acre). We will continue to evaluate alewife density data from Silver Lake in more detail once fish age determinations are completed. This will allow us to estimate alewife mortality rates and the density of trout needed to reduce the 2008 alewife population to a specific level, if that is of interest to the Silver Lake community.

Trout Stocking in 2008

Following a recommendation by Cornell researchers, the Silver Lake Lake Association stocked an additional 150 rainbow trout and 150 brown trout into Silver Lake on November 20, 2008. These fish were stocked at the same density (~3 fish/acre, both species combined) as were stocked in September 2006 and November 2007. The purpose of the stocking was to supplement the existing trout populations in the lake, further increasing predation of alewife in order to reduce the impact of alewife on water clarity and the aquatic food web in Silver Lake. Periodic stocking of trout will be necessary in order to maintain trout populations at a level capable of controlling alewife abundance, since neither brown nor rainbow trout are likely to be able to reproduce within Silver Lake due to the lack of appropriate spawning habitat.

Conclusions and Recommendations

Results of investigations conducted in 2008 indicate that Silver Lake is capable of supporting long-term survival of trout, and the stocking of trout since September 2006 is having the desired effect of reducing alewife abundance and the impact of alewife on water clarity and other aquatic resources of Silver Lake. Water temperature and dissolved oxygen levels during summer indicate a large zone of cool, well-oxygenated water capable of supporting trout during the warmest time of the year. Water clarity as measured by secchi depth readings has continued to improve since the stocking of trout. Desirable changes in the zooplankton community, most notably increasing abundance and variety of large zooplankton (especially large Cladocera) indicate that alewife abundance has been reduced enough to allow some recovery of large zooplankton. Estimates of alewife density based on hydroacoustic sampling indicate that alewife density in Silver Lake is similar to densities in several lakes in New York State but not nearly as high as measured in some New York lakes. This further suggests that trout stocking is serving to control alewife numbers.

Past reports prepared by Cornell University regarding Silver Lake have included several recommendations that are still relevant. These include continuing efforts to minimize inputs of nutrients and pollutants to preserve lake water quality and conducting periodic monitoring of total phosphorus, chloride, alkalinity, pH, water temperature, and dissolved oxygen in order to characterize any changes that may occur through time. Preserving the integrity of undeveloped shoreline and the large amount of wood present along that shoreline should be continued to support native fish populations by providing habitat for forage and refuge. A small evaluation was conducted on Silver Lake fish in 2006 to explore potential concerns regarding mercury contamination in fish. As previously recommended, anglers harvesting fish for consumption should be aware of fish consumption advisory limits published by the Pennsylvania Division of Water Quality Assessment and Standards.

Finally, results of the 2008 investigation of Silver Lake support a recommendation to continue trout stocking as a means of controlling undesirable impacts of alewife within Silver Lake, and this recommendation has already been heeded with the stocking of an additional 300 trout in November 2008. Future monitoring of water clarity, the zooplankton community, and aspects of the fish community (species composition, trout abundance and growth, piscivore diet composition, alewife density) can be used to measure the long-term effectiveness of the stocking program and potentially identify ways to more effectively implement this effort.

Silver Lake is highly valued for a variety of reasons by watershed residents as evidenced through the efforts sponsored by the E.L. Rose Conservancy to understand, protect, and enhance the Silver Lake ecosystem. These efforts continue to improve our knowledge of the lake and identify means by which the valued resources of the lake can be sustained or improved. In addition, lessons learned from studying and managing Silver Lake are applicable to the management and protection of aquatic resources associated with other lakes in the region.

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E. L. ROSE CONSERVANCY of SUSQUEHANNA COUNTY, PENNSYLVANIA 2008 ANNUAL REPORT

THE PEOPLE AND LANDSCAPES OF SUSQUEHANNA COUNTY

James P. Lassoie
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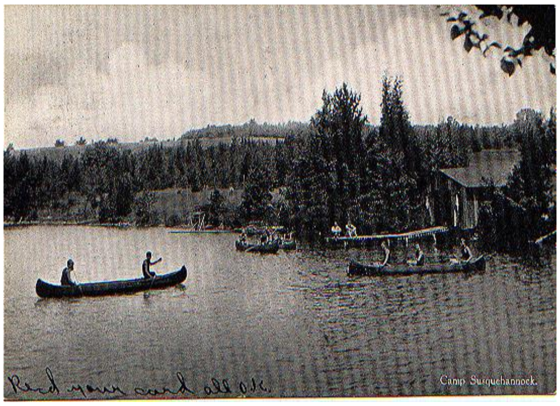
This project finished its fourth year of building a visual record of the people and landscapes of Susquehanna County, PA. Project Year 2008 saw the completion of a video documentary, expansion of the historical repeat photo-database, and archiving of all photographs associated with this project, including their referencing within Google Earth. A new project was initiated during 2008 focused on conducting audio interviews of landowners reflecting on their relationships with the land and rich natural resources of Susquehanna County. These are illustrated with still photography, including old family photos, to tell a personal story of the importance of maintaining the ecological integrity of natural landscapes across the county. Next year will see the expansion of the number of interviews as well as the addition of more historical repeat photographs to the database.

THE E.L. ROSE CONSERVANCY of SUSQUEHANNA COUNTY

Cornell University
Department of Natural Resources

E.L. Rose Conservancy
2008 Annual Report

GROUND BASED PHOTOMONITORING OF ECOLOGICAL CHANGE PROJECT



~1900s **Camp Susquehannock** **2008**

Lindsay A. Myron
Department of Natural Resources
Cornell University

Abstract:

In the fourth year of the photomonitoring project, the ground-based transect component of the project was completed and the historical repeat photography component was expanded. The final photographs of the tenth transect were shot over the summer and the transect database was completed, organizing over 800 images and cataloging each of them with characteristic keywords. In addition, 27 new repeat images were taken throughout the county. GPS coordinates and historical repeat images have been compiled into Google Earth. Currently, GPS coordinates and data for the ground-based transect component are being compiled into Google Earth. The database of transect and repeat images have been transferred to an external hard drive and will be ready this spring for distribution to the Conservancy once the transect data has been incorporated into the Google Earth collection.

The major ecological indicators visible in the photomonitoring project have remained the same, including hilltop clearings, lakeshore and rural development, and unsustainable agriculture. Increased activity in gas-drilling has proved to have drastic visible effects in the landscapes, however, few site-specific images have recorded their effects. As this is of growing concern for the conservancy and residents, the selection of historical photographs for prospective repeats will reflect that concern. More images for the historical repeat photography component will continue to be added to the database.

Project Purpose:

-Assess and monitor changes in the landscape over time
-Ongoing conservation planning in collaboration with DNR and ELRC
-Photo database to be archived with the ELRC

Historical Repeat Methods:

-Obtain historical images

-Scan and digitally archive original

-Identify the original aspect with the help of community members and the Historical Society staff

-Pursue the location and replicate the image

-Record:

-ID Number
-Date
-Time
-Weather
-Location
-Elevation
-Latitude/Longitude
-Description
-Source
-Waypoint
-Views
-Angles

-Catalogue images in library and compile image and data into GoogleEarth

Visibly Changing Characteristics:

-Stonewalls
-Cemeteries
-Agricultural land
-Businesses
-Gas drilling platforms
-Buildings and Schools

Church Street, Franklin Forks

~1900s

2008

Same:
-White house
-Trees alongside road

New:
-Residential development
-Road development

Lord's Pond

1912

2008

Same:
-Mixed deciduous forest

New:
-Shoreline vegetative growth
-Residential development along shoreline

Snake Creek Valley

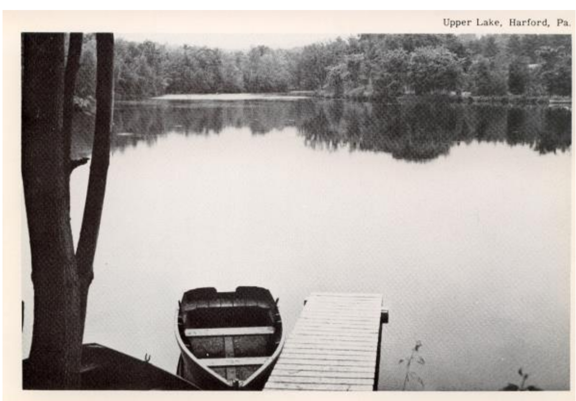
1920

2008

Same:
-Agricultural land

New:
-Forest and vegetative re-growth

Upper Lake



~1900s

2008

Same:
-Marsh and forest land

New:
-Residential Development

Lackawanna Trail


~1900s


2008

Same:
-Mixed deciduous forest

New:
-Paved highway
-Vegetative growth along roadside

Lackawanna Trail, North of Alford

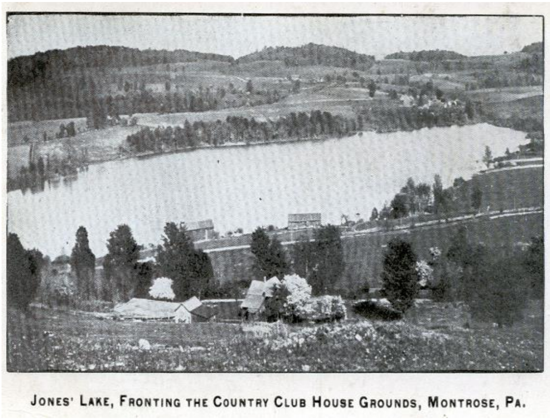

~1900s


2008

Same:
-Railroad
-Mixed deciduous forest

New:
-Paved highway
-Vegetative growth alongside river

Country Club, Lake Montrose



~1900s

2008

Same:

-Country Club
-Lakeshore housing

New:

-Residential development
-Forest and vegetative re-growth

Progress and Future Plans:

<u>Completed:</u>

-Collection and organization of the transect photomonitoring image database (Summer 2008)
-Key-wording the transect photomonitoring image database with cultural and ecological characteristics. (Spring 2008)
-48 historical repeat images (Summer 2008)
-Compilation of historical repeat images and data into Google Earth (Fall 2008)

<u>Continuing:</u>

-Historical repeat photography (Summer 2009)
-Compilation of transect photomonitoring images and data into Google Earth (Spring2009)
-Give ELRC hard drive with all original and edited image files, the organized and catalogued database and other project materials. (Spring 2009)

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THE LANDSCAPES AND FUTURE OF SUSQUEHANNA COUNTY: DOCUMENTARY VIDEO PROJECT

R. Jamie Herring
Department of Natural Resources
Cornell University

This project produced a 20-minute documentary introducing landowners in Susquehanna County to the benefits of conservation easements with hopes of stimulating their thinking about what kind of natural legacy they would like to leave behind. The project utilized a form of participatory video where several local landowners explained the reasons for why their land is important and what it means to them personally. The goal is to have other landowners begin thinking about why their land is important to them and why they should conserve it now and into the future.

Filming of the project took place between May 2007 and June 2007. A 15-minute draft version of the video was shown at the E.L Rose year-end meeting in the fall of the 2007. Additional filming and editing was needed during 2008 based on reviews by Conservancy Board members and others. A final version of the video was submitted at the end of the year for DVD production and distribution during the first half of 2009.

Funding for the documentary allowed us to explore some of the deeper themes of conservation in the county. It allowed me to get to know the area, the people, and the reasons why Susquehanna County's landscapes are so important to protect. This opportunity also allowed me to hone my documentary video-making skills and to learn important lessons about how to produce a video, including scoring it with music, that will be widely distributed.

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2008 Annual Report

A PHOTO-AUDIO PERSPECTIVE OF THE PEOPLE AND PLACES OF SUSQUEHANNA COUNTY, PENNSYLVANIA PROJECT

Lindsay A. Myron
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Cornell University

Abstract:

Overwhelming support and interest in Jamie Herring's documentary video with Susquehanna County's critical landowners has prompted the start of a similar project. This oral history project, though still under development, is in its first steps of production. The project aims to develop an interactive, educational website regarding the history and importance of Susquehanna County's landscapes and residents. Individual interviews with landowners and residents will focus on personal stories, histories and land values. The collection of unique chronicles will build a comprehensive history of the area and its inhabitants.

Over the summer, board member Patty Bloomer was interviewed for practice and her recording was used to demonstrate the final production format. After receiving approval in late September, prospective interviewees have been sought-after. Last fall, Conservancy board members agreed to initiate the project with a history of the Fox School House in Silver Lake Township. Susan Barnes, the new owner of the schoolhouse, was interviewed in November and this spring interviews with alumni from the school will add new perspectives and stories to the topic. Photographs collected from the historical society and interviewees will provide the visual medium to be used in the final web-based presentation.

Following the Fox School House, the project will expand to incorporate residents from all townships and backgrounds.

Project Purpose:

-Directly involve residents in the perpetuation of the county's history

-Provide ELRC with an outreach tool for educating members of the Conservancy

-Create in educational and interactive web-page regarding Susquehanna County's history, residents, and landscapes through a combination photo-audio medium

Methods:

-Meet residents of all backgrounds and ask for participation in the project

-Conduct approximately 30-minute interviews regarding their history and land values

-Record interviews with digital audio recording equipment

-Transcribe interviews have interviewee review transcript for accuracy

-Condense and edit interviews into shorter clips

-Organize library of audio clips and photographs in MemoryMiner

-Upload library to final web-page production

-Archive original audio file, transcript and other related documents

Progress and Plans:

<u>Completed:</u>

-Patty Bloomer Interview

-Initial focus on Fox School House, Silver Lake: Interviewed owner, Susan Barnes (Fall)

-Met several prospective interviewees and received confirmation of participation (Fall)

<u>Continuing:</u>

-Interview alumni of Fox School House (Spring 2009)

-Initiate web-page production with Fox School House focus (Spring 2009)

-Expand focus to include more residents and topics of interest (Summer 2009)