
1820
1800
1780
1760
1740
1720
1700
10
20
30
40
50
105
120
1700
1720
1740
1760
1780
1800
1820
1840
1860
1880

## *LEGEND*

- WATER SAMPLING SITE
- GILL NET
- HABITAT SUITABILITY SAMPLING SITE
- MARSH GRASS
- 50 — DEPTH CONTOUR
- SUBMERGENT/EMERGENT VEGETATION
- SUBMERGED TREE
- 1860 — SURFACE TOPOGRAPHY (FT., AMSL)
- STREAM


**TETHYS Consultants, Inc.**
Specializing in Earth and Environmental Sciences
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717-BED-ROCK 717-233-7625


# SILVER LAKE STUDY AREA

SILVER LAKE TOWNSHIP
SUSQUEHANNA COUNTY
PENNSYLVANIA

| CONTOUR | DRAWN BY | DATE |
|---|---|---|
| N.A. | GCPS | 10/27/92 |
| **SCALE** | **APPROVED BY** | **PROJECT NO.** |
| 1" = 400' | JEG | T-869 |

**TETHYS Consultants, Inc.**
Specializing in Earth and Environmental Sciences
Suite 234, Building 3, 2001 N. Front Street, Harrisburg, PA 17102
717—233-7625 717—BED-ROCK

# BIOLOGICAL SURVEY OF SILVER LAKE

**November 12, 1992**
**TETHYS Project No. T-869**

**Submitted To:**
**SILVER LAKE ASSOCIATION**

**Submitted By:**
**TETHYS CONSULTANTS, INC.**
**ECOLOGICAL SERVICES DIVISION**

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# EXECUTIVE SUMMARY

At the request of Mr. William M. Boyd, of the **SILVER LAKE ASSOCIATION, TETHYS CONSULTANTS, INC. (TCI)** recently completed a biological survey of Silver Lake located in Silver Lake Township, Susquehanna County, Pennsylvania. The survey included water quality and fishery sampling, the use of computer models to evaluate the quality and quantity of existing habitat at the site, and a thorough review of all the available literature, maps and photographs that provided information regarding the past and/or current environmental condition of Silver Lake.

On August 20, 1992, **TCI** personnel conducted a field study of the lake and all of the immediately surrounding properties. Five distinct vegetative cover types, including the lake itself, were identified at the site. These areas, totalling 162 acres, are available as potential fish and wildlife habitat. The habitats of eight different "indicator" species, four terrestrial and four aquatic, were evaluated and given a numerical score for their potential habitat quality.

Based upon the results of this survey, the water quality of the lake is believed to be very good. Temperature and dissolved oxygen were optimum throughout most of the water column. The field pH values ranged from 6.8 to 7.6, and were well within the preferred range necessary to support healthy biological activity. Water clarity was also good. Secchi disk transparency was measured at a depth of 20 feet.

The relatively small amount of total acreage containing palustrine emergent and shrub/scrub wetlands provided the best potential wildlife habitat. The much larger forested area only provided moderate quality habitat for one of the "indicator" species, the red-spotted newt. In addition, the steep drop-offs along the shallow littoral areas further limited the quality of potential habitat available at the site.

Potential smallmouth bass and walleye habitat is very favorable. Calculated habitat suitability Index (HSI) values for these species indicated that the available habitat is capable of maintaining natural populations of these fish. However, the same habitat is not capable of maintaining a self-sustaining trout fishery.

The information provided in this report is intended to be used as baseline information for assessing any potential future impacts on the land and water resources of Silver Lake. Furthermore, the HSI values given represent the quality of the existing habitat. Sudden changes in the quantity and/or quality of this habitat in the future will reflect positive or negative environmental impacts.

# I. INTRODUCTION

At the request of Mr. William M. Boyd, of the **SILVER LAKE ASSOCIATION, TETHYS CONSULTANTS, INC. (TCI)** recently completed a biological survey of Silver Lake and the immediately adjacent properties. These areas exist within a tract of land located along State Route 167 in Silver Lake Township, approximately nine miles north of Montrose (see Site Location Map in Appendix A).

The primary objective of the survey was to collect the necessary baseline biological data required to accurately evaluate the current condition of the lake. This information was carefully documented so that the effects of future environmental impacts on the lake and land resources could be evaluated, and compared with the present-day conditions.

Section III describes the methodologies used to evaluate the existing biological condition of the lake. Sections IV and V provide the results obtained and conclusions drawn from the on-site habitat assessments, respectively. Recommendations for the maintenance of good water quality and several fishery management alternatives are discussed in Section VI.

## II. SITE DESCRIPTION

Vegetation at the site is typical of climax forests in the Northern Lake States and is composed of highly tolerant, long-lived species such as sugar maple, beech and basswood. Several mid-tolerant species such as yellow birch and white pine exist in the small gaps in canopy cover, while hemlock was found inhabiting the coarser drier soils along the shoreline and roadways. Herbaceous and shrubby vegetation was restricted to small clearings and residential areas.

This primarily rural area contains many small dairy farms that are nestled within the valleys and gently rolling hills of the surrounding countryside. Each of these valleys eventually combines to become part of the Susquehanna River drainage. All of Susquehanna County is drained by the North Branch of the Susquehanna River and its tributaries.

Geologically, Silver Lake is located along the southwestern edge of the Glaciated Low Plateau Section of the Appalachian Plateaus Province. Underlying geology at the site consists of several members of the Catskill Formation and contains a complex of shale, siltstone, sandstone, and conglomerate.

Several different soil types were formed within the glacial till that remains throughout the area (see Soils Map in Appendix A). Volusia flaggy silt loam (VfB) and Mardin channery loam (McB2) dominate on the lower side slopes of the northeast shore. Two types of Morris Series soils, (MoB2, MoC2) channery silt loam and (MrC2) flaggy silt loam, are mapped in the remaining lower hillsides along the lake. Three

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types of Wellsboro Series soils, (Wec2, WeD2) channery silt loam, (WIB2, WIC2) flaggy silt loam and (WsD) very stony silt loam, form the convex lower side slopes farther from the shoreline. All three soil types are listed in Table 1 along with other pertinent soils information.

The sandstones of the Catskill Formation provide moderate supplies of ground water at depths ranging from 50 to 100 feet. Except for a few isolated instances, the water supplied by these wells is sufficient for most purposes. A review of historical records indicates the existence of a hand dug well on the north shore of Silver Lake. Apparently, the well was hand dug to a depth of 25 feet and maintains a static water level of approximately 10 feet below grade throughout most of the year.

Silver Lake was formed by glacial activity and is classified as a kettle lake. Shorelines are steeply banked and the sediments contain only small amounts of organic matter. Categorically, the lake is oligotrophic, a term that refers to its limited supply of nutrients and relatively low productivity. Littoral plants and phytoplankton (photosynthesizing algae) are restricted to a small portion, approximately 36 percent by volume, of the lake's total water column. Several other important physical and morphological features of the lake are summarized in Table 2.

**TABLE 1**
**Summary of Soil Properties Existing on the Silver Lake Association Property**

| SOIL PROPERTIES | SOIL SERIES/PHASE | | | |
|---|---|---|---|---|
| | Volusia (VfB) | Mardin (McB2) | Wellsboro (WeC2, WeD2, WlB2, WlC2, WsD) | Morris (MoB2, MoC2, MrC2) |
| % Slope | 3% to 8% | 3% to 8% | 3% to 25% | 0% to 15% |
| Depth to Seasonal High Water Table | < 1.5 Feet | < 2.5 Feet | < 2.5 Feet | < 1.5 Feet |
| Drainage Classification | Somewhat Poorly Drained | Somewhat Poorly Drained | Somewhat Poorly Drained | Somewhat Poorly Drained |
| Hydric Condition | Inclusions (Norwich) | Inclusions (Chippewa) | Inclusions (Norwich) | Inclusions (Norwich) |



**TABLE 2**
**Summary Chart Showing Several Important Physical and Morphological Features of Silver Lake, Susquehanna County, Pennsylvania**

| PHYSICAL AND MORPHOLOGICAL FEATURES | |
|---|---|
| Surface Elevation (Feet Above Sea Level) | 1680 |
| Surface Area (Acres) | 79.13 |
| Mean Depth (Feet) | 48.3 |
| Total Volume (Gallons) | 1.2 Billion |
| Flush Rate (Years) | 96* |
| Trophic State | Oligotrophic |

*This value obtained from earlier studies.

# III. METHODOLOGIES

A field inspection of Silver Lake was conducted by **TCI** on August 20, 1992 to determine the environmental quality of all properties owned and/or maintained by the Association. Emphasis was placed on habitat availability and quality, rather than identifying existing or potential sources of point and non-point source pollution. The methodologies chosen for this study combined both quantitative and qualitative techniques designed to look at the "broad picture" and not focus on any particular resource.

## A. Water Chemistry

A single mid-lake sampling station was established in the deepest portion of the lake basin (see Site Map in Appendix A). Depth at the station was determined before sampling with a calibrated sounding line and maximum light penetration was measured with a Secchi Disk. A Van Dorn bottle was used to collect water samples at three-foot intervals to an acceptable point beyond the thermocline. Specific conductance, dissolved oxygen, temperature, and pH were measured in the field and recorded at each depth interval. In addition, three surface water samples were collected from random locations along the shoreline and analyzed in the field for the same set of parameters.

Field measurements of temperature and dissolved oxygen concentrations were measured using a Yellow Springs Instrument (YSI) dissolved oxygen/temperature probe. Specific conductance was measured with a LaMotte Chemical conductivity meter and an Orion Research (Model SA250) portable pH meter was used to determine field pH values.

## B. Fishery Sampling

The fishery of Silver Lake was sampled using commercial gill nets and nylon drag seines. Each drag seine had a uniform 1/2-inch stretch mesh webbing and was suspended from cork floats to a depth of 4 feet. They were deployed from a boat parallel to the shoreline and towed to shore with draglines. All fish were carefully removed and quickly processed to minimize the amount of stress caused to each fish.

Gill netting began in the morning when two 100 yard sections of commercial gill netting were deployed throughout the lake. Each commercial net was 6 feet deep and had a uniform 2-1/2-inch stretch mesh webbing. This type of net was used instead of experimental gill nets with varying mesh sizes, because of the size and types of fish species believed to be in the lake. Furthermore, since the goal of the study was to identify the species present, and not population structure, it was not necessary to capture fish from different age classes within the population. Both nets were deployed using a stationary bottom set technique that involved anchoring the bottom corners and suspending the remainder of the net vertically in the water column. All nets were lifted four hours after they were deployed and the catches

processed at that time. Fish processing involved weighing each fish to the nearest ounce and measuring total length to the nearest 1/8-inch.

In the laboratory, the length and weight of each fish were analyzed using standard fisheries techniques (Lagler 1956; Ricker 1971, 1975; Nielsen and Johnson 1983) to evaluate the overall condition of the existing fishery. Proportional stock densities (PSD's) were calculated by comparing the lengths of captured fish to proposed lengths for minimum stock, quality, preferred, memorable, and trophy sizes based on percentages of world record lengths.

## C. Terrestrial/Aquatic Habitat Analyses

The terrestrial and aquatic habitat evaluation procedures (HEP) utilized during this study have been modified for use in Pennsylvania (PAMHEP). Originally, these methods were developed to rate the quality and quantity of habitat in order to quantify the impacts of change over time resulting from land and water development projects. However, in the case of this project, these techniques will be used as a tool to document baseline information on existing habitats.

Prior to the site visit, **TCI** reviewed the following maps, lists and publications to gather the background information necessary to select appropriate terrestrial and aquatic "indicator" species for the habitat analysis.

- U.S.G.S. 7.5 Minute Series Topographic Quadrangle Map of Silver Lake, Pennsylvania (1946).
- Geologic Map of Pennsylvania (1980)
- U.S. Department of Agriculture, Soil Conservation Service (SCS) Soil Survey of Susquehanna County, Pennsylvania (1982).
- Susquehanna County Hydric Soils List (Provided by SCS).
- Engineering Characteristics of the Rocks of Pennsylvania (1982).
- Ground Water in Northeastern Pennsylvania (1957).

After thoroughly reviewing all of the above-referenced information, a list of appropriate "indicator" species was selected for the survey (Table 3). These particular organisms were not necessarily chosen because they are known to exist at the site, but rather because suitable habitat was present. Therefore, the results from the evaluation techniques reflect habitat potential and not species abundance. The four primary vegetative cover types identified at the lake are listed in Table 4, along with a few of the more common woody and herbaceous plant species found in each.

Once the habitat types and "indicator" species were chosen, a combined list of all the habitat variables for both terrestrial and aquatic organisms was generated (Tables 5 and 6). Each of these variables was then measured in the field or calculated using 7.5 minute series topographic maps and aerial photographs. All of these values were then entered into a database and used as input to the computerized Habitat Suitability Index (HSI) Models. The HSI model calculated individual habitat scores and ranked them on a scale of 0.0 to 1.0, with 1.0 being optimum.

**TABLE 3**
**A List of Selected Terrestrial and Aquatic "Indicator" Species Used in the Habitat Survey Conducted at Silver Lake on August 20, 1992**

| TERRESTRIAL AND AQUATIC "INDICATOR" SPECIES LIST | |
|---|---|
| **COMMON NAME** | **LATIN NAME** |
| Bullfrog | *Rana catesbeiana* |
| Snapping Turtle | *Cheydra serpentina* |
| Red-Spotted Newt | *Notophthalmus viridescens* |
| Great Blue Heron | *Ardea herodias* |
| Walleye | *Stizostedion vitreum* |
| Smallmouth Bass | *Micropterus dolomieui* |
| Rainbow Trout | *Salmo gairdneri* |
| Brown Trout | *Salmo trutta* |

## TABLE 4

### A Summary of Vegetative Cover Types at the Silver Lake Property Susquehanna County, Pennsylvania

| | | |
|---|---|---|
| 1. | **PALUSTRINE EMERGENT WETLANDS** | |
| | American Burreed | *Sparganium Americanum* |
| | Sweetflag | *Acorus calamus* |
| | Three-Way Sedge | *Dulichium arundinaceum* |
| | Arrow-Leaf Tearthumb | *Polygonum sagittatum* |
| | Sensitive Fern | *Onoclea sensibilis* |
| | Fowl Manna Grass | *Glyceria striata* |
| | Jewelweed | *Impatiens capensis* |
| 2. | **PALUSTRINE SCRUB-SHRUB WETLANDS** | |
| | Speckled Alder | *Alnus rugosa* |
| | Red Maple | *Acer rubrum* |
| | Jewelweed | *Impatiens capensis* |
| | Arrow-leaf Tearthumb | *Polygonum sagittatum* |
| | Sensitive Fern | *Onoclea sensibilis* |
| | Fow Manna Grass | *Glyceria striata* |
| 3. | **DECIDUOUS FOREST** | |
| | Yellow Birch | *Betula alleghaniensis* |
| | American Beech | *Fagus grandifolia* |
| | Mountain Laurel | *Kalmia latifolia* |
| | Eastern Hemlock | *Tsuga canadenis* |
| | Hay-scented Fern | *Dennstaedtia punctilobula* |
| | American Basswood | *Tilia americana* |
| | Cinnamon Fern | *Osmunda cinnamomea* |
| 4. | **LACUSTRINE LITTORAL SUBSYSTEM** | |
| | White Water-Lily | *Nymphaea odorata* |
| | Long-leaf Pondweed | *Potamogeton nodosus* |
| | Broad Water-weed | *Elodea canadensis* |

## TABLE 5
## A Summary of Habitat Variables Evaluated for Selected Terrestrial "Indicator" Species at Silver Lake, Susquehanna County, Pennsylvania

| HABITAT VARIABLE | EVALUATION SPECIES | | | |
|---|---|---|---|---|
| | Bullfrog | Snapping Turtle | Red-Spotted Newt | Great Blue Heron |
| Distance from shoreline to water >1.5 m | X | | | |
| Mean distance to permanent water (m) | | X | | |
| Distance to small stream (m) | | X | | |
| Mean distance to forest cover type (m) | | | X | |
| Distance between potential nest sites and forage areas (Km) | | | | X |
| Distance free zone of 100 m around forage area | | | | X |
| Disturbance free zone (250 m land; 150 m water) | | | | X |
| Water area with suitable prey and forage | | | | X |
| Treeland cover within 250 m of wetland areas | | | | X |
| Percent canopy cover of aquatic vegetation in littoral zone | X | X | X | |
| Percent shoreline cover </= 1 m from shore | X | | | |
| Percent canopy cover of herbaceous species | | | X | |
| Percent canopy cover of trees | | | X | |
| Percent of overstory tree canopy/deciduous species | | | X | |
| Percent of all trees < 19 cm DBH | | | X | |
| Mean Secchi disk transparency | X | | | |
| Mean surface pH | X | | | |
| Mean water temperature (C) at Mid-depth (summer) | X | X | | |
| % silt and clay in the top 10 cm of substrate | X | X | | |
| % of water area < 2 m deep | | | X | |

## TABLE 6
## A Summary of Aquatic Habitat Variables Measured for Selected "Indicator" Species at Silver Lake, Susquehanna County, Pennsylvania

| HABITAT VARIABLE | EVALUATION SPECIES | | | |
|---|---|---|---|---|
| | Walleye | Smallmouth Bass | Rainbow Trout | Brown Trout |
| Maximum and minimum pH | X | X | X | X |
| Minimum dissolved oxygen (mg/l) | X | X | X | X |
| Maximum water temperature (C) | X | X | X | X |
| Minimum water temperature above the thermocline (C) | X | X | | |
| Minimum dissolved oxygen (ppm) during the late growing season | | | X | X |
| Average Secchi disk transparency | X | | | |
| Average depth of lake (m) | | X | | |
| Dominant substrate type in shoal areas | | X | | |
| Percent cover in the form of boulders, stumps, trees, crevices, vegetation and rocks | X | X | | |
| Spring water level fluctuations | | X | | |
| Trophic status of the lake | X | | | |

# IV. RESULTS

## A. Water Chemistry

The results of TCI's field sampling, as summarized in Table 7, did not indicate any significant problem with the quality of the lake water. Secchi disk transparency extended to a depth of 20 feet. Mean surface water pH was 7.5 and reached a minimum value of 6.8 at 50 feet. Historically, pH values have been slightly lower (6.0 to 6.5), but well within biologically acceptable levels.

Specific conductance was low, ranging from 60 to 80 uS/cm throughout most of the water column. However, this is not uncommon in oligotrophic or nutrient poor lakes.

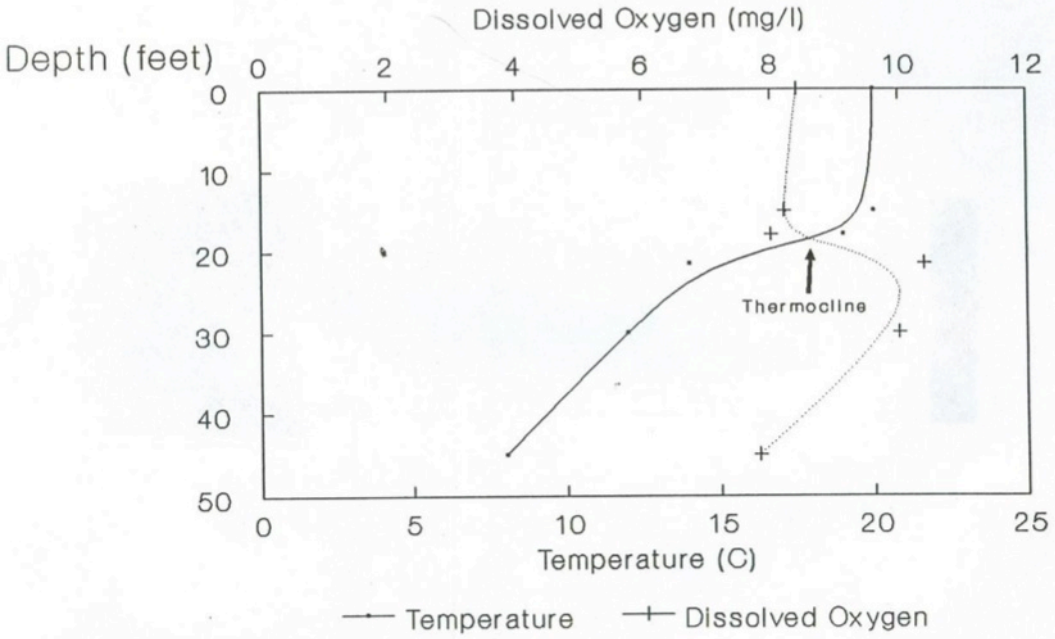
Dissolved oxygen content was well above the 5 mg/l minimum acceptable level required for fish to survive and grow. In fact, oxygen values did not begin to drop below acceptable limits until well below the thermocline. The sudden increase in dissolved oxygen near the thermocline shown in Figure 1 was most likely caused by a dense layer of blue-green algae that thrives in the dim layer of light near the thermocline.

The lake was thermally stratified at the time of sampling. Successive water temperature measurements indicated the formation of a thermocline at a depth of approximately 20 feet. Summer mid-epilimnion temperatures remained below 22 degrees and above 14 degrees Celsius providing optimum growth conditions for all of the salmonid (trout) and cool water species.

**TABLE 7**
**Summary of Field Water Chemistry Data**
**Collected at Silver Lake**
**Susquehanna County, Pennsylvania**
**August 20, 1992**

| CHEMICAL AND PHYSICAL PARAMETERS | | | | |
|---|---|---|---|---|
| WATER DEPTH (Ft) | TEMPERATURE (C) | pH | SPECIFIC CONDUCTANCE (µS/cm) | DISSOLVED OXYGEN (mg/l $O_2$) |
| 0 | 20 | 7.60 | 60 | 8.4 |
| 3 | 20 | 7.58 | 60 | 8.4 |
| 6 | 20 | 7.61 | 60 | 8.3 |
| 9 | 20 | 7.56 | 60 | 8.3 |
| 12 | 20 | 7.52 | 60 | 8.3 |
| 15 | 20 | 7.51 | 60 | 8.2 |
| 18 | 19 | 7.44 | 100 | 8.0 |
| 21 | 16 | 7.30 | 100 | 9.5 |
| 24 | 14 | 7.15 | 80 | 10.4 |
| 27 | 12 | 7.09 | 80 | 10.2 |
| 30 | 10 | 7.05 | 80 | 10.0 |
| 33 | 9 | 7.01 | 75 | 9.1 |
| 36 | 9 | 6.94 | 70 | 8.3 |
| 39 | 8 | 6.87 | 70 | 8.0 |
| 42 | 8 | 6.85 | 60 | 8.0 |
| 45 | 8 | 6.80 | 60 | 7.8 |

Figure 1. Temperature/Dissolved Oxygen Profile for Silver Lake (8/20/92)



A review of some previously collected water quality data revealed the existence of small concentrations of fecal coliform bacteria at several locations around the lake. This is usually an indication of a failing on-lot septic system. However, small concentrations of fecal coliforms can be flushed from working systems when they are located in poorly drained soils, and are exposed to excessive amounts of rainfall. Most of the reported coliform levels were not high enough (> 200 colonies/100 ml sample) to warrant immediate concern. These levels should be closely monitored throughout the swimming season.

## B. Lake Fishery

Silver Lake is a moderately large, fairly unproductive lake that has a limited amount of food and cover. Visible cover is provided by several shallow emergent areas scattered along the shoreline, and a few submerged trees on the western shore. Some additional cover is provided by the steep drop-offs and rocky substrates along most of the remaining shoreline (see Site Map in Appendix A).

The food web is believed to be delicately balanced on an abundant supply of crayfish that inhabit the shallow littoral areas, and the pelagic (open-water) plankton community. Several different orders of zooplankton were observed in the water samples, but not taxonomically identified.

Biotic diversity within the benthic macroinvertebrate community is poor. Chironomidae (midges), Tipulidae (Craneflies) and Oligochaeta (aquatic earthworms) were the only identified benthic macroinvertebrate in the three (bottom) samples.

A total of nine different species of fish were captured during the sampling visit or are known to exist in Silver Lake (Table 8). Three species of trout are stocked annually and the remaining six species are self-sustaining. Most of these species are considered to be insectivores (insect-eating), but have adapted to eating a wide variety of prey species.

Proportional stock densities (PSD's) are given in Table 9 for the fish species sampled. PSD's represent the number of fish in the population greater than minimum stock length that have a minimum length greater than the proposed quality length shown in Table 10. Usually, these values indicate whether or not the fishery is within a preferred range or size class. However, the values given in this report do not have much meaning because of the relatively small sample size captured.

## C. Terrestrial/Aquatic Habitat Analyses

Results from the habitat analysis indicate the existence of 162 acres of combined wetland, forest and open-water habitat (Table 11). Palustrine emergent and shrub/scrub wetlands provide good to moderate habitat for the bullfrog, snapping turtle and great blue heron. Deciduous forests comprise 27 percent of the available habitat, but are only moderately suitable for the terrestrial life stage of the red-spotted newt. Steep drop-offs account for the poor habitat suitability indexes calculated for species found in lacustrine littoral areas. HSI values for the lacustrine open-water indicate that these habitats are at least moderately suitable for the fish species evaluated.

## TABLE 8
## Fish Species List for Silver Lake
## Susquehanna County, Pennsylvania

| COMMON NAME | LATIN NAME |
|---|---|
| Largemouth Bass | *Micropterus salmoides* |
| Rainbow Trout* | *Salmo gairdneri* |
| Brown Trout* | *Salmo trutta* |
| Brook Trout* | *Salvelinus fontinalis* |
| Pumpkinseed | *Lepomis gibbosus* |
| Bluegill | *Lepomis macrochirus* |
| Yellow Perch | *Perca flavescens* |
| Brown Bullhead* | *Ictalurus nebulosus* |
| Chain Pickerel | *Esox nigra* |

***These species were not collected during sampling visits, but they are known to exist in the lake.**

## TABLE 9
## Summary of Important Morphological Information and Proportional Stock Densities (PSD's) for Fish Sampled at Silver Lake on August 20, 1992

| SPECIES | AVERAGE LENGTH (Inches) | AVERAGE WEIGHT (Oz.) | LARGEST FISH SAMPLED (Length/Weight) | PROPORTIONAL STOCK DENSITY | SAMPLE SIZE |
|---|---|---|---|---|---|
| Largemouth Bass | 11.8 | 14 | 12.8/19 | 25% | 8 |
| Bluegill | 2 | 1.5 | 2.5/2 | 0% | 3 |
| Pumpkinseed | 7.3 | 5 | 7.9/6 | 0% | 3 |
| Yellow Perch | 12.8 | 13.5 | 14.7/19.5 | 50% | 2 |
| Chain Pickerel | 16.9 | 17 | 16.9/17 | 100% | 1 |

## TABLE 10
## Proposed Maximum Total Length (inches) for Minimum Stock, Preferred, Quality, Memorable, and Trophy Sizes Based on Percentages of World Record Lengths (Adapted from Gabelhouse, 1983)

| SPECIES | SIZE DESIGNATION (Inches) | | | | |
|---|---|---|---|---|---|
| | Stock | Quality | Preferred | Memorable | Trophy |
| Largemouth Bass | 8 | 12 | 15 | 20 | 25 |
| Bluegill | 3 | 6 | 8 | 9 | 12 |
| Pumpkinseed | 3 | 6 | 8 | 9 | 12 |
| Yellow Perch | 5 | 8 | 10 | 12 | 15 |
| Chain Pickerel | 10 | 15 | 20 | 25 | 30 |

## TABLE 11
## A Summary of Cover Types Evaluated and Their Calculated HSI's for Selected Terrestrial and Aquatic "Indicator" Species at Silver Lake for August 20, 1992

| | HSI VALUE FOR INDIVIDUAL COVER TYPE EVALUATED | | | | |
|---|---|---|---|---|---|
| | Palustrine Emergent Wetland | Palustrine Shrub/Scrub Wetland | Deciduous Forest | Lacustrine Littoral Subsystem | Lacustrine Open-Water Subsystem |
| AMOUNT OF AVAILABLE HABITAT (Acres) | 6.0 | 12.8 | 44.1 | 20.0 | 79.1 |
| INDICATOR SPECIES: | | | | | |
| Bullfrog | 0.847 | 0.428 | - | - | - |
| Snapping Turtle | 0.645 | 0.380 | - | 0.126 | - |
| Red-Spotted Newt | - | - | 0.454 | 0.013 | - |
| Great Blue Heron | 0.755 | 0.757 | - | 0 | - |
| Walleye | - | - | - | - | 0.450 |
| Smallmouth Bass | - | - | - | - | 0.872 |
| Rainbow Trout | - | - | - | - | 0.6* |
| Brown Trout | - | - | - | - | 0.83* |

- Cover types not evaluated.

*HSI reflects water quality requirements only.

Water transparency and percent (%) of silt in the substrate limit the amount of potential habitat available for bullfrogs. Both of these habitat variables affect the frog's ability to conceal itself from predators, and successfully forage for insects. In addition, the amount of area with sufficient substrate and water depth, especially in the shrub/scrub wetlands, was very limited.

Winter cover was the most limiting factor for snapping turtles. In emergent areas, the small amount of silt in the substrate prevents the turtle from burrowing and shrub/scrub areas did not contain a sufficient amount of water to prevent them from freezing to the bottom. In addition, the lack of water in the shrub/scrub areas reduced the size of the littoral zone, thereby limiting the amount of summer foraging areas.

Both the aquatic and terrestrial habitats of the red-spotted newt were evaluated. The HSI value for the lacustrine littoral subsystem reflects the lack of shallow areas with sufficient vegetation. Habitat for the terrestrial stage or eft is limited by the abundance of large diameter trees and lack of herbaceous vegetation on the forest floor.

The lack of disturbance-free zones necessary for successful nesting limit the quality of habitat available to the great blue heron. These zones must be free of houses, roads, commercial operations and any form of mechanized agriculture. In addition, suitable nesting sites should be within 275 yards of water, and require a minimum area of one acre free from human disturbance.

The HSI value obtained from the model indicates that the lake is only moderately suited for walleye. However, the model does not take into account the cover provided by the depth of the lake. Walleye prefer slightly turbid conditions when foraging for prey in the shallows. The unsuitable habitat in the shallows is compensated for by more favorable habitat in the deeper portions of the lake.

Smallmouth bass habitat received the highest HSI value of any "indicator" species. This species prefers relatively deep, coolwater lakes with plenty of rock and gravel substrates. Silver Lake meets all of these habitat requirements.

HSI values for rainbow and brown trout indicate that sufficient habitat is available for these species to survive. However, the models used to calculate these values did not include habitat requirements for reproductive success. Both trout species require tributary streams for spawning. Therefore, since there are no tributary streams entering Silver Lake, natural trout recruitment is limited or nonexistent.

## V. SUMMARY/CONCLUSIONS

Water quality at Silver lake appears to be quite adequate. However, the presence of fecal coliform bacteria should not be presently over-looked, it should be monitored very closely in the future. The small number of fish that were sampled were in good condition. In fact, proportional stock densities indicate that at least 25 percent of the major predator species sampled, largemouth bass and chain pickerel, were greater than the minimum preferred stock length for their species. HSI values

show that palustrine emergent and shrub/scrub wetlands provide the best quality habitat, while lacustrine littoral areas were the least desirable, for the terrestrial species evaluated. Lacustrine open-water areas provide suitable potential habitat for natural populations of walleye and smallmouth bass. In addition, these areas are well-suited for a put-and-take trout program, but are not capable of maintaining a natural trout population.

# VI. RECOMMENDATIONS

## A. Water Quality

Currently, the water quality of Silver Lake is above average. However, in order to more closely monitor changes in future water quality, Silver Lake Association should develop a citizen-based monitoring group. This group would monitor on a weekly basis pH, specific conductance, total alkalinity and temperature. Dissolved oxygen, nitrate-nitrogen and total phosphorous should be monitored at least monthly throughout the growing season. In addition, since fecal coliform bacteria have been found in water samples, coliform levels should be checked periodically during the warmer summer months. Especially, if it has been an exceptionally rainy season.

## B. Fishery Management

As stated earlier, the existing fishery at Silver Lake appears to be very healthy. The lake is currently supporting many different species of fish, but most of them are not self-sustaining. Therefore, maintaining a superior sport fishery can be very costly and time consuming. This problem could possibly be eliminated by introducing a fish species that is capable of successfully spawning in deep cold or cool water lakes.

HSI values indicate that the potential habitat for smallmouth bass and walleye is very favorable. These two species do very well in lakes with habitats similar to those present at Silver Lake. However, with the introduction of any species, there are many different factors which must be considered.

First of all, determining the correct stocking density is critical to the success of the introduction and the maintenance of the existing fishery. For example, if adult walleye are stocked only 2 or 3 fish are required per acre. However, when fingerlings are used, no more than ten 2-inch to 3-inch fish should be stocked per acre. If smallmouth bass are going to be introduced, the initial stocking densities should be the same.

Timing is also critical when fingerlings are being stocked. The fingerlings that are stocked must be larger at the time of stocking than the juvenile fish that are naturally present. This helps minimize interspecies competition and improve the success of the stocking.

Yearly samples should be taken to monitor the success or failure of the stocking efforts. A minimum of three to five years may be required before the population structure stabilizes and becomes self-sustaining. During this time, growth and recruitment of the stocked fish should be monitored to determine if the introduction has been successful.

The crayfish and yellow perch already in the lake should provide an adequate supply of prey for either or both the smallmouth bass and walleye. However, if a put-and-take trout fishery is going to be maintained, an additional forage species could be beneficial. One of the pelagic minnows such as the Cisco may be suitable for Silver Lake. This species is the primary forage fish of lake trout in the Great Lakes and was introduced as a forage species in Harveys Lake (Luzerne County, Pennsylvania) by the Pennsylvania Fish and Boat Commission. However, when forage species are stocked the same factors apply as when stocking prey species, i.e., how this "intermediate" member of the food chain will fit into the existing biological community.