Fishery Survey

Hemlock Farms

Blooming Grove Township
Pike County, PA

Fall 2006

Submitted To:

Hemlock Farms Community Association

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Section D. Willow Pond

Willow Pond Fishery Survey

Ecological Solutions, Inc.

The following is a summary of the fishery data collected during field surveys conducted at Willow Pond (see Figure 1D). Data provided in the summary report represents information gathered from fish captured during an electrofishing survey of the lake. A boat-mounted electrofishing unit utilizing 6 amps of DC current was used to capture fish along the shoreline of the lake. The entire shoreline was sampled in a single effort, which lasted 23.1 minutes. Electrofishing began at 12:00 P.M. and was completed at 1:00 P.M. on September 26, 2006. Hoop nets and gill nets were not set in Willow Pond because the sample collected with electrofishing equipment adequately represented the fishery in the lake. All fish captured were weighed and measured to the nearest ounce and 1/8 inch, respectively, and then immediately returned to the lake unharmed.

Sample Results

A. Water Quality

As part of the fishery survey, ECS collected water quality data on each of their sampling visits. A summary of the water quality data collected, along with historical water quality data for Willow Pond has been summarized in Table 1D. A dissolved oxygen/temperature profile was not done for the pond because the water was only several feet deep, and water temperatures at the surface and bottom of the pond indicated that it was thoroughly mixed. Upon review of the data, the following conclusions were made with respect to the water quality in Willow Pond.

- As with the other lakes in the Hemlock Farms Community, neutral to slightly acidic conditions exist throughout the year.
- Dissolved oxygen concentrations throughout the year are above the 5.0 mg/l minimum acceptable level for healthy aquatic systems. However, in comparison to other lakes evaluated during this survey they were on average the lowest.
- Specific conductance fluctuates significantly throughout the season. This may occur in response to the periodic increase in dissolved solids after rain events.
- Alkalinity in the lake is good, and unlike most of the other lakes in the Hemlock Farms Community, this lake is not as susceptible to acidification in response to acidic rain events.
- Nitrate nitrogen and total phosphorous concentrations were high. Nitrate nitrogen is the limiting nutrient, and total phosphorous was present in higher concentrations than what is considered for typical (< 0.01 ppm) in unpolluted freshwater environments.
- Secchi disk measurements indicate good water clarity, with visibility being near the bottom throughout most of the year.

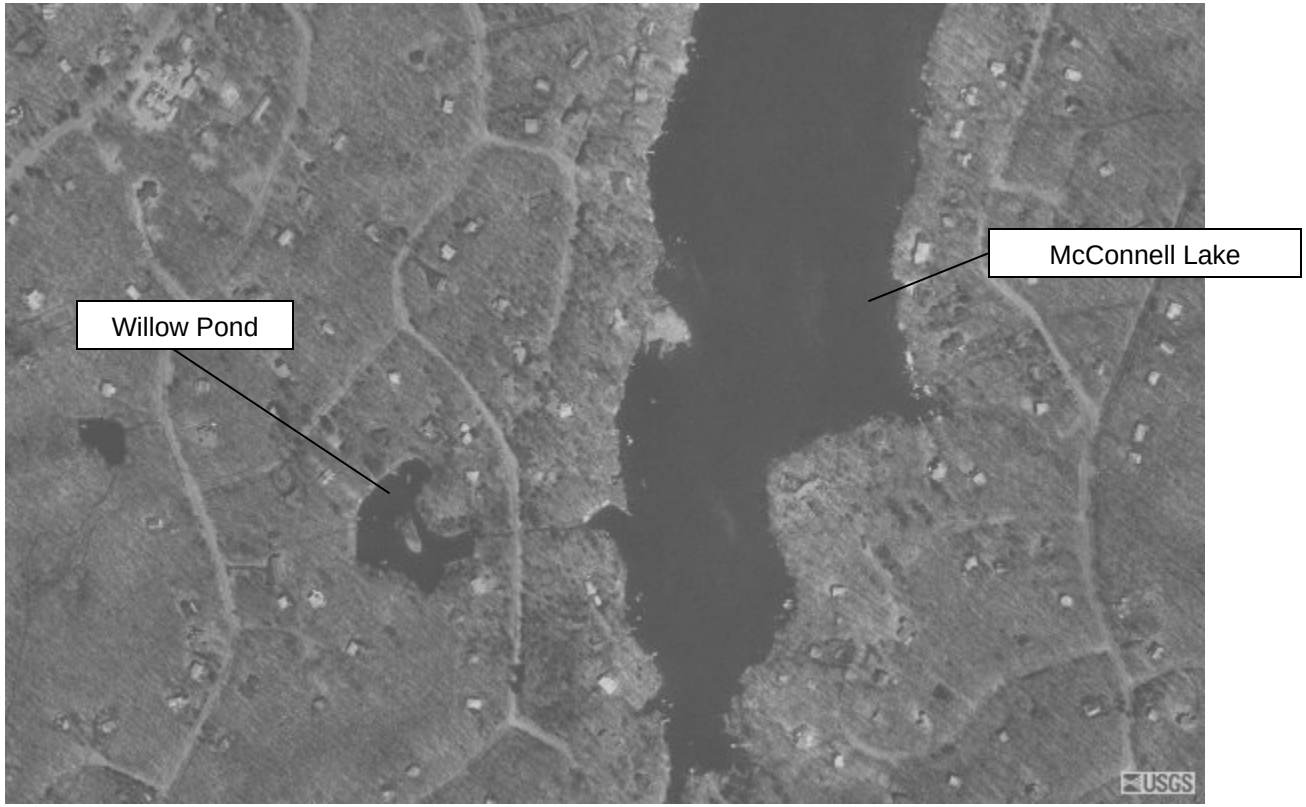


Figure 1D. Aerial map of Willow Pond showing the surrounding landscape.

Date	9/23/2002	5/16/2006	6/12/2006	7/12/2006	8/1/2006	8/3/2006	8/14/2006	8/28/2006	9/26/2006
Water Temp (°F)	-	54	63	73	82	97	78	71	62
pH	6.5	7.0	6.3	6.5	7.0	9.5	8.0	6.9	7.6
Conductivity (µS/cm)	-	130	153	148	72	72	-	153	90
Dissolved Oxygen (mg/l)	-	7.6	9.4	7.0	7.0	8.0	7.0	8.0	9.3
Alkalinity (mg/l)	21	34							32
Hardness (mg/l)	32	34							24
Total Phosphorus									0.08
Nitrate/Nitrogen									0.26
Secchi Depth (ft.)	-	3	3	2	2	4	2	3	2.3
Turbidity/clarity (FTU)									11

Table 1D. Summary of historical water quality data and data collected in Willow Pond during the 2006 fishery survey.

Table 2D further summarizes the water quality data according to season. This data provides incite on how water quality may or may not be affecting the specific life stages of fish that inhabit the lake. A discussion of how this data relates to habitat quality in Willow Pond occurs later in the "Physical Habitat" section of the report.

	Spring (Apr 15 - Jun 15)	**Summer** (Jun 16 - Aug 30)	**Fall** (Sept 1 - Nov 15)	**Winter** (Nov 16 - Apr 14)
Water Temp (°C)	59	80	62	-
pH	6.6	7.6	7.6	-
Conductivity (µS/cm)	142	111	90	-
Dissolved Oxygen (mg/l)	8.5	7.4	9.3	-
Alkalinity (mg/l)	34	-	32	-
Hardness (mg/l)	34	-	24	-
Total Phosphorus	-	-	0.08	-
Nitrate Nitrogen	-	-	0.26	-
Secchi Depth (ft.)	3.0	2.6	2.3	-
Turbidity (FTU)	-	-	11	-

Table 2D. Summary of water quality data collected in Willow Pond showing seasonal averages for all parameters analyzed.

B. Fishery Study

Figure 2D shows the species composition of the fishery sampled in Willow Pond. A combined total of 120 fish representing nine different species were collected during the surveys. Bluegill (*Lepomis machrochirus*), pumpkinseed sunfish (*Lepomis gibbosus*) and yellow perch (*Perca flavescens*) comprised 69 percent of the entire sample population, while 31 percent of the population consisted of largemouth bass (*Micropterus salmoides*) and chain pickerel (*Esox niger*). This represents a 3 to 1 prey to predator relationship, indicating that there should be an adequate amount of prey to maintain a balanced fish population. However, 65 percent of the chain pickerel in the population were less than three

inches in length and are not able to consume the abundance of larger prey species.

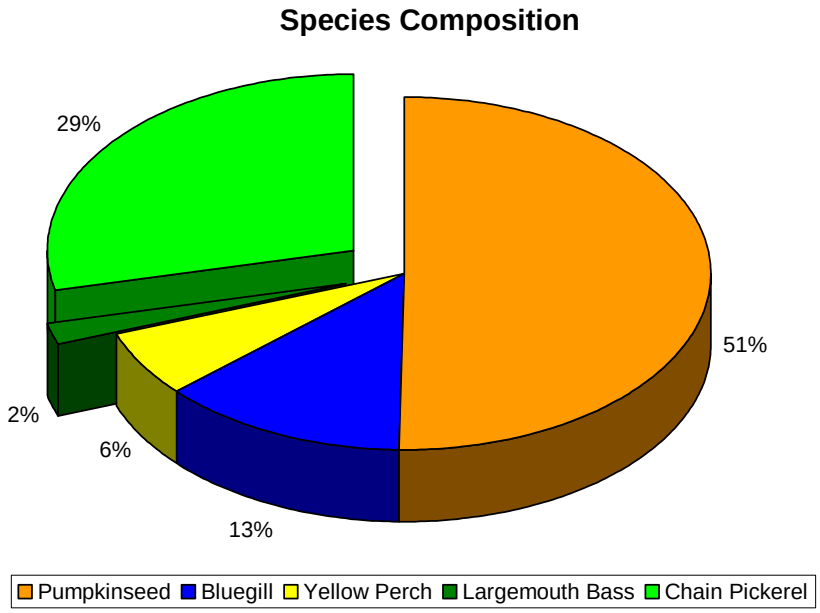


Figure 2D. Pie chart showing the percent contribution of individual fish species captured during the 2006 fishery survey conducted at Willow Pond.This data indicates a population consisting of 31% predators and 69% prey species.

All of the species represented in the sample are typical of what is considered to be a warmwater fishery. The bass and chain pickerel serve as the predator species, while the yellow perch, bluegill, and pumpkinseed are the prey species. In small impoundments with balanced populations the forage species (F) to predators or carnivores (C) is considered desirable when it falls within the range of 3 to 6 (Swingle, 1950). The largemouth bass is the primary species of concern, but chain pickerel were the dominant predator species in the lake. Therefore, chain pickerel were used to calculate the indices, along with bluegill, pumpkinseed, and yellow perch. In Willow Pond the ratio was 1.0 indicating that based solely on the weight of forage species with respect to predators the forage base in Willow Lake is less than desirable.

A second index to evaluate the predator/prey relationship is a biomass relationship comparing the total weight of consumable-sized prey (Y) to that of the average-sized predator. In order to make this comparison, the combined weight of all bluegill and pumpkinseed sunfish three inches in total length, plus the weight of yellow perch less than five inches in total length, was divided by the weight of the average total weight of all chain pickerel greater than ten inches in

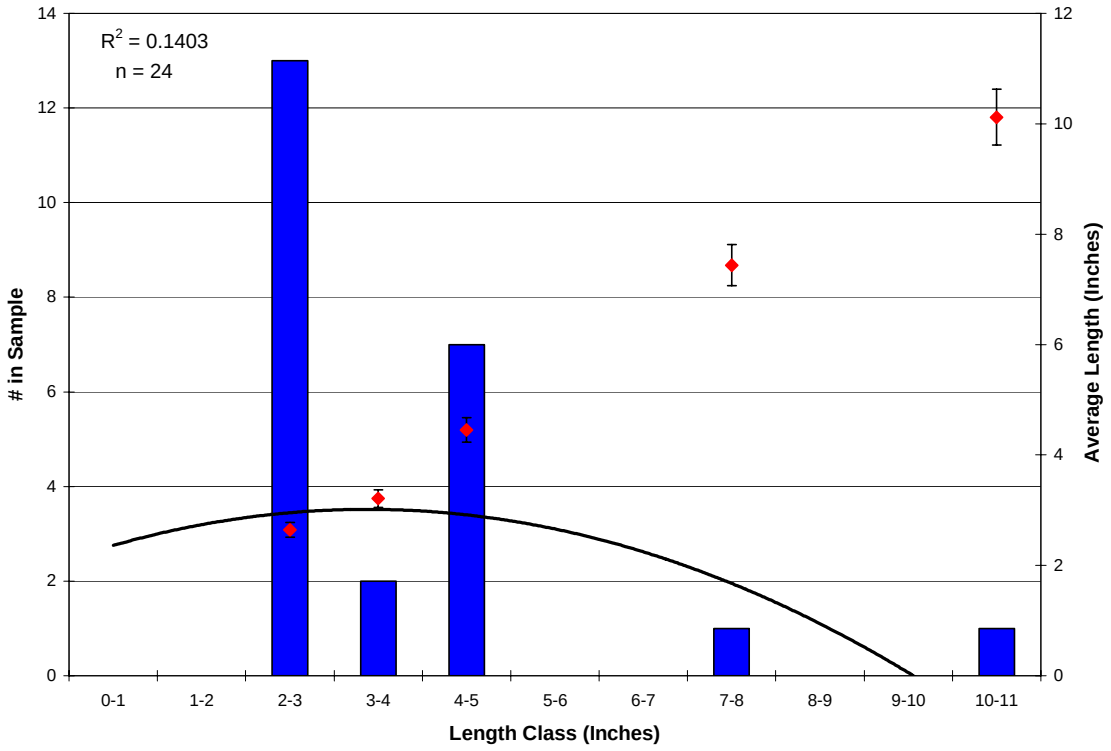
total length. This analysis yielded a ratio of 0.8, which is significantly less than the desirable range of 1 to 3. Therefore, even though prey species are abundant, the population contains mostly larger sized prey species that are too large to be consumed by the average size bass.

A bass/bluegill population is considered to be balanced when 60 to 85 percent of the total weight of the population is represented by fish of harvestable size. Bluegill and pumpkinseed sunfish are typically considered to be of harvestable size when they are greater than four inches in length, whereas largemouth bass and chain pickerel must be greater than 12-inches and 15-inches in total length, respectively. Based upon the data collected in the surveys, only 38 percent of the bass/bluegill population is of harvestable size. Of this total, bass account for 0 percent of the total sample weight of harvestable-size fish. Bluegill and pumpkinseed represent 10 and 6 percent of the harvestable fish, while chain pickerel comprise 20 percent of the harvestable fish in the population. Therefore, since it is considered desirable for bass to represent 14 to 25 percent of the total weight of harvestable fish, the bass fishery in Willow Pond is very poor. Overall, the fishery in Willow Pond is less than desirable and contains very few harvestable or quality size fish of any species.

The proportional stock density (PSD) for a given species is defined as the proportion of fish of quality size in a stock. For largemouth bass, a “quality” size fish is greater than 12-inches in length, while chain pickerel must be greater than 15 inches in length. Bluegill and pumpkinseed sunfish are considered to be of “quality” size after they reach a length of 6-inches, while yellow perch are not considered quality size until they reach a total length of 8-inches. Depending on the fishery, stock sizes can vary. However, in general, largemouth bass are considered to be stock size when they are greater than 8-inches. Bluegill and pumpkinseed sunfish are considered stock size at 3-inches, and yellow perch must be 5-inches. Using these standard values, the PSD for largemouth bass in Willow Pond is 0 because there were no fish in the sample greater than 12 inches in length. For bluegill and pumpkinseed it is 18 and 6, respectively, and for yellow perch the PSD is 0. Chain pickerel have a PSD of 20. This indicates that there are very few “quality” size bluegill and pumpkinseed sunfish, and no “quality” size yellow perch in the population. Proportional stock densities calculated for Willow Pond further indicate the presence of a very poor fishery.

Figures 3D through 7D show length frequency distributions for bluegill, pumpkinseed sunfish, yellow perch, and chain pickerel collected in the 2006 sample. Of significance is the fact that chain pickerel were more abundant than largemouth bass, making them the primary predator in the pond.

The data presented in Figures 3D indicates that most of the bluegill sampled in the lake were small and immature. In addition, not all age classes of bluegill are represented in the population, which suggests poor spawning success and/or high juvenile mortality.



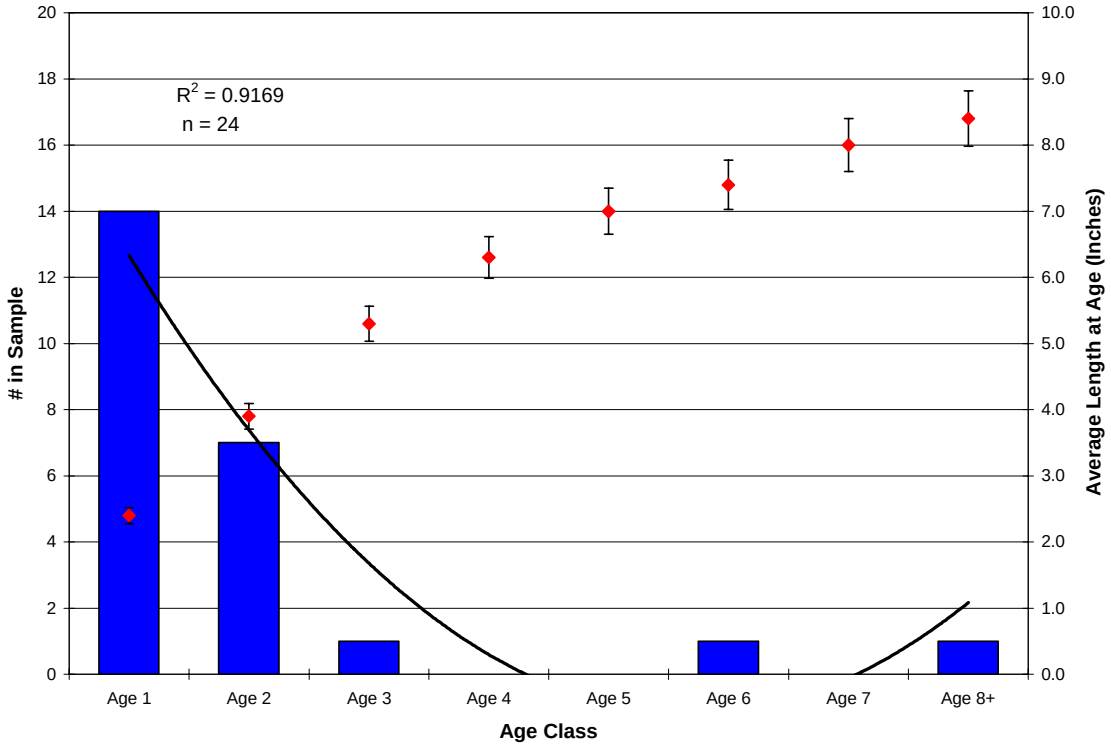


Figure 3D. Length frequencies and age class distributions for bluegill captured during the 2006 Willow Pond fishery survey.

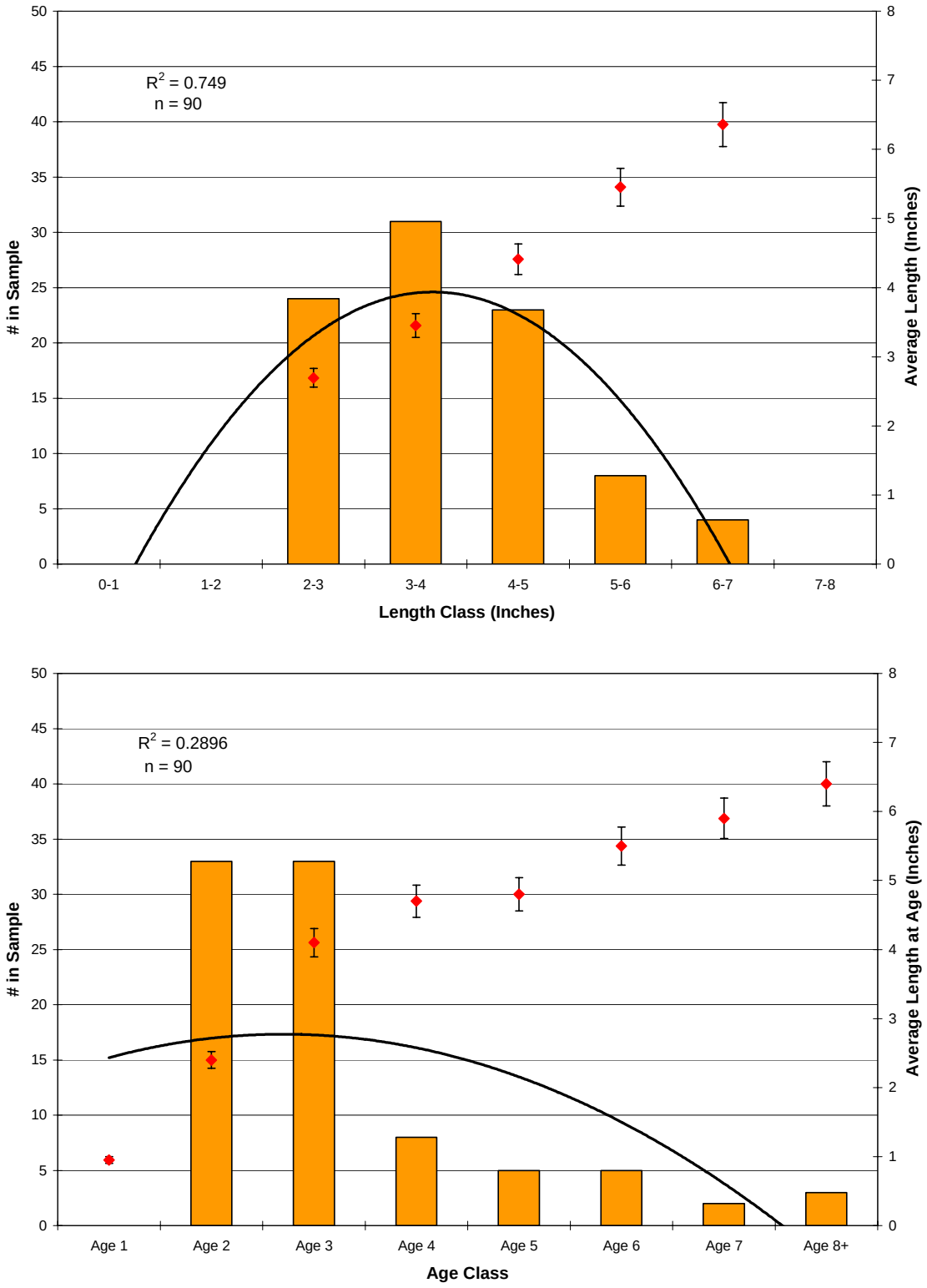


Figure 4D. Length frequencies and age class distribution of pumpkinseed sunfish captured during the 2006 Willow Pond fishery survey.

Figure 4D shows that the pumpkinseed sunfish population in the pond is more stable. Fish from seven different age classes were identified in the sample, and it appears that spawning success is good. The presence of two strong year classes (Age 2 and Age 3) indicates that juvenile mortality is low. Overall, it seems like environmental conditions in Willow Pond favor pumpkinseed sunfish over bluegill.

Figure 5D shows the length frequency distribution for yellow perch in the sample. Fish representing only two different length classes were identified in the sample. Three to four inch fish were most abundant representing two year old fish. No fish greater than seven inches in length or older than three years of age were found in Willow Pond. This data is indicative of a very poor perch fishery.

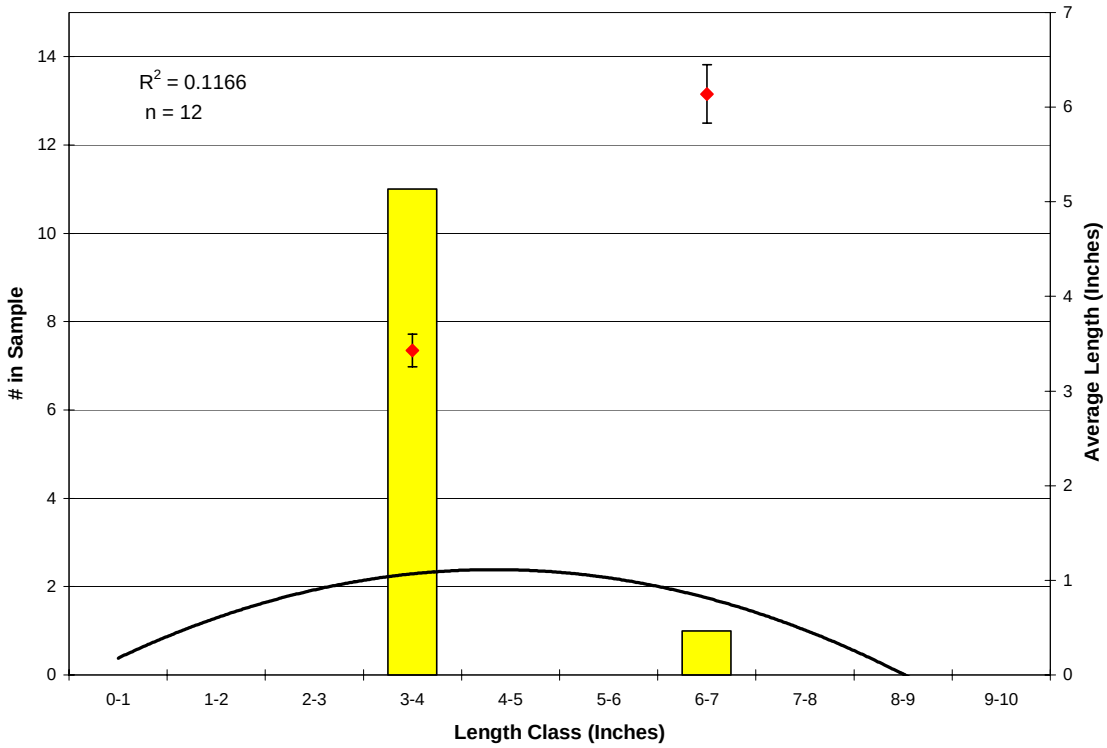
As shown on the graph in Figure 6D, there is an abundance of very small pickerel, representing the 2006 year class. Fish from three of the four preceding years were also represented in the sample, indicating that chain pickerel successfully spawn in the pond. Although a few juvenile bass were present in the sample, chain pickerel appear to thrive in Willow Pond.

Very few of the bass in Willow Pond have reached sexual maturity or breeding size. Typically, bass reach maturity when they are three to four years old. Based upon national averages, a three to four year old bass will be 10 to 11-inches in length. Using this as a basis for comparison, the relative stock density (RSD) or proportion of bass in the Willow Pond stock greater than 10-inches in length is 0 (RSD-10). This indicates that the bass population sampled in the lake consists entirely of small immature fish. In fact, none of the bass in the sample were greater than 10 inches in length.

C. Physical Habitat

As part of the fishery survey, a physical habitat assessment was performed for largemouth bass, bluegill, and yellow perch. To conduct this assessment, specific habitat features (life requisites) considered essential for the management of these species were evaluated in the field and the results run through computer models to calculate a habitat suitability index (HSI) for that particular fish species. The field data sheets and a summary table showing the results of the computer modeling have been provided in Appendix D.

Of all the lakes in the survey, Willow Pond received the lowest HSI score for bass (0.7). This indicates that the habitat in the lake is average. The primary factors influencing the score where: the lack of deeper areas (> 18 feet) for over-wintering; lack of adequate bottom cover; high water temperatures; and poor substrate. In northern latitudes, lakes that provide optimum habitat have extensive shallow areas (> 25 % < 18 feet deep), but also provide a significant area (40% to 60%) that is deep enough (> 10 feet) for over-wintering. Research has also shown that lakes with high turbidity had lower reproductive success,



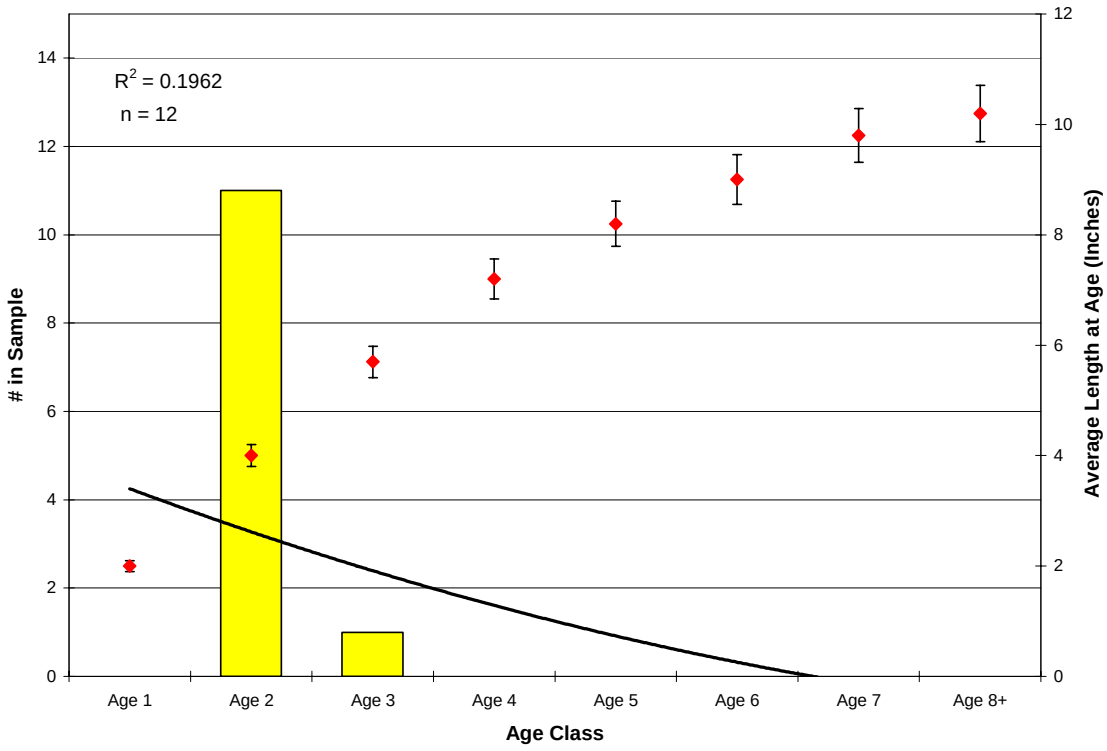
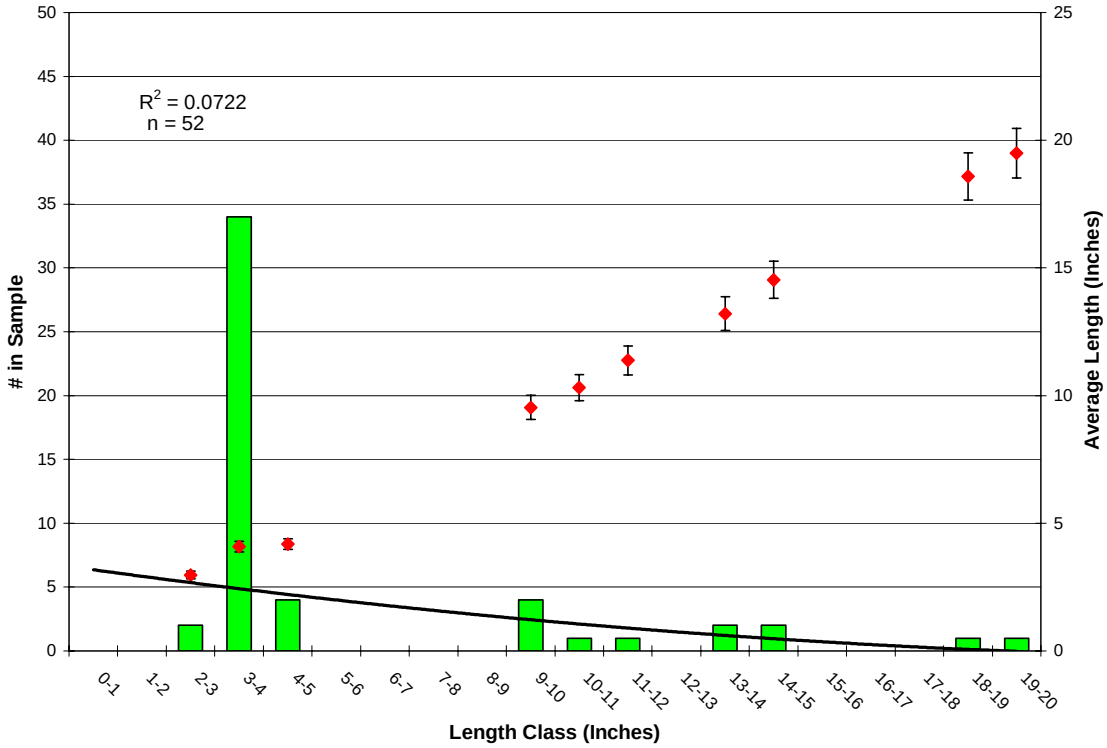


Figure 5D. Length frequencies and age class distributions for yellow perch captured during the 2006 Willow Pond fishery survey.



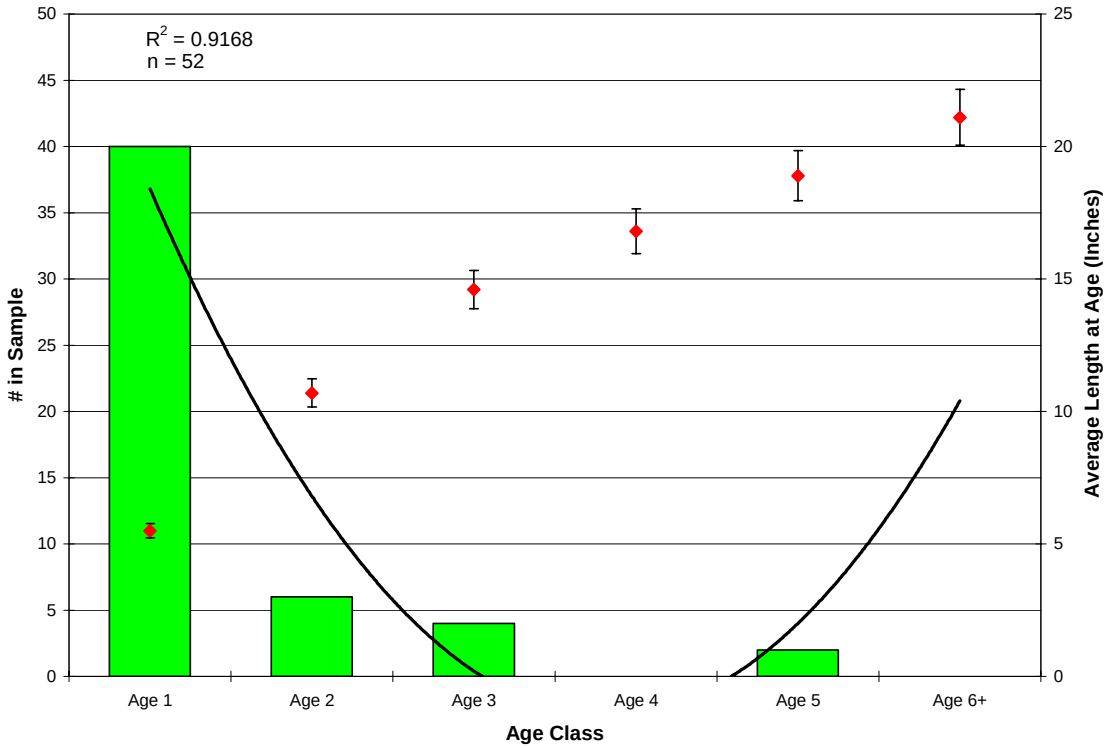


Figure 6D. Length frequencies and age class distributions for chain pickerel sampled during the 2006 Willow Pond fishery survey.

with optimum suspended solid levels being in the range of 5 to 22 parts per million. Substrate in the lake is dominated by silt and hard sand. Gravel is the preferred spawning substrate. Bass will spawn on a variety of different substrates, with the type of substrate influencing the rate of reproductive success.

Water temperature is the primary limiting factor identified during the habitat survey. Because Willow Pond is so shallow, water temperatures fluctuate significantly during the spawning season and warmer summer months. From the historical data collected, water temperatures fluctuate considerably providing poor habitat conditions for all life stages of this fish.

Yellow perch habitat is limited by the lack of deeper water. In lakes that provide good perch habitat, only 20 to 30 percent of the lake is within the littoral zone. Of this small percentage, 25 to 50 percent should contain an abundance of aquatic vegetation. All of Willow pond provides littoral habitat, and much of it does not contain aquatic vegetation.

Conclusions

Based upon the sample results discussed above, the following conclusions can be made regarding the current condition of the Willow Pond fishery.

1. The ratio of forage species (F) to carnivores (C) (i.e. bluegill, pumpkinseed, yellow perch to chain pickerel) is considered desirable when it falls within the range of 3 to 6. This ratio was 1.0 indicating a less than desirable number of prey species are available in the Willow Pond fishery.
2. A comparison of the total weight of consumable-sized prey (Y) to that of the average-sized predator (F) yielded a ratio of 0.8, which is below the desirable range of between 1 and 3. Therefore, the prey that is available is not capable of being consumed.
3. Thirty-eight percent of the population is comprised of harvestable-size fish. Of this value, none of the harvestable size fish were bass. In most lakes bass represent between 15 and 25 percent of the harvestable-size fish in the population. This value indicates that Willow Pond maintains a very poor bass fishery.
4. Based upon PSD's calculated from the survey data, there is a very small percentage of "quality" size fish in Willow Pond.
5. None of the bass caught during the survey were representative of mature fish.
6. Based upon the length and age class distribution for bass collected in the 2006, the reproductive success of largemouth bass was calculated to be 0.

7. Based upon the results of a habitat assessment, it was concluded that poor spawning success and the lack of deeper water limit the quality of this fishery.

Recommendations

Willow Pond maintains a very poor bass/bluegill population. Bass represent a very small proportion of the population, and bluegill seem to be struggling to survive. Therefore, ECS would like to make the following recommendations to help improve the quality of this fishery.

1. *Supplement the existing bass population through stocking.*

   In an effort to jump start the recovery of the bass fishery in Willow Pond, 25 (8 to 10-inch) and 5 (10 to 12-inch) largemouth bass should be stocked in the lake. In addition, 3 to 4 lbs of fathead minnows should be stocked as a supplementary prey species in the spring and fall. This will establish a bass population in the lake with a PSD of 20; replace the 3 and 4 year old fish that were missing from the sample; and within the first year potentially see an increase in reproductive success.

2. *Continue to monitor the PSD's of both the bass and bluegill populations in the lake to ensure that the fishery remains balanced.*

   Figure 7D provides a "target" range for establishing and/or maintaining a balanced bass/bluegill fishery based upon PSD's. Ideally, 15 to 25 percent of both the bass and panfish (bluegill and pumpkinseed) within the stock should be of harvestable size (12 and 6-inches, respectively). The Association should manage the lake as a "catch and release" fishery to ensure that the fish have the opportunity to become established before any are removed from the population.

   Along with the bass population, the bluegill population should be monitored. Just like with the bass, only 15 to 25 percent of bluegill in the lake should be considered "harvestable" or greater than six inches in total length. By maintaining this stock density, an adequate number of prey-size bluegill will be maintained as a food source for the larger bass. In general, bluegills are much more prolific and will spawn several times in a single season. Therefore, it is essential that the bluegill population be controlled through harvesting. A "healthy" bluegill fishery cannot be maintained with a "catch and release" management strategy

   Once this ideal range has been established, the quality of the fishery should be periodically monitored by calculating the PSD's for both bass and panfish to determine where the population falls within the chart.

Determining where in relation to the "target" range the population falls provides valuable information on how the fishery should be managed in the future (e.g. should more fish be harvested to maintain PSD's within the "target" range; should "slot limits" be established rather than "catch and release" restrictions to reduce the number of certain size class fish in the population so that fish of a more desirable length class (i.e. trophy-size) become more abundant; or establish a "maximum" size restriction to improve catch rates by removing only the larger fish so that the abundance of "quality-size" fish in the population increase). Regardless of the management technique used, by maintaining the population within the "target" range the fishery will remain healthy and capable of sustaining itself in the future.

3. *Collect seine and cast net samples in the summer and early fall to monitor spawning success.*

   Although electrofishing and net sampling provide valuable data on the overall "health" of the fishery, this type of sampling does not specifically provide information relating to spawning success. Therefore, it is recommended that additional studies aimed at specifically evaluating spawning success be performed in the future. This would involve collecting samples once in the summer and then again in the fall to determine spawning success and estimate juvenile mortality. The study should be conducted using beach seines and/or cast nets in the shallow littoral areas to collect juvenile fish that tend to congregate in these areas in the summer and early fall. Results from this type of survey will provide information on the need for habitat improvements, and help determine whether additional fish need to be stocked.

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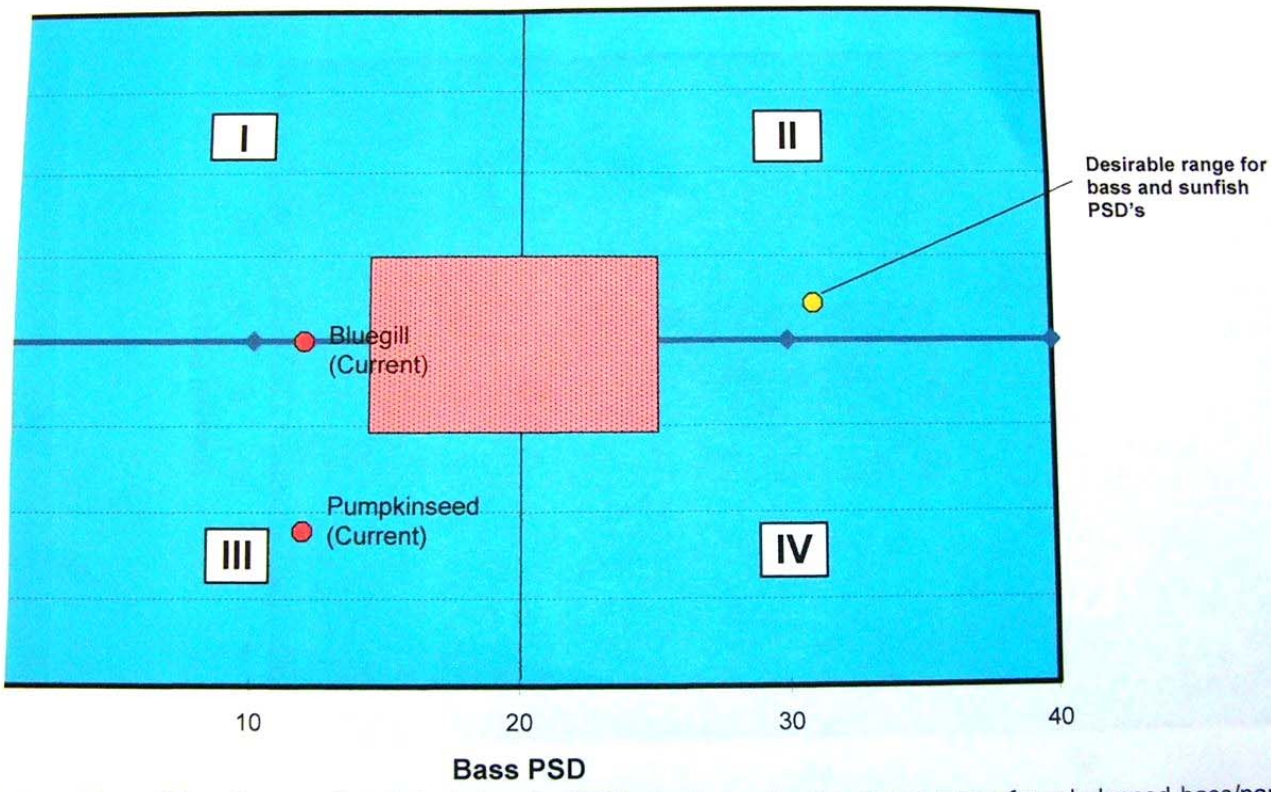

Figure 7D. A proportional stock density (PSD) chart showing the target range for a balanced bass/panfish population. In a balanced population, the bass/panfish population should contain between 15% to 25 "harvestable" size fish, which for bass and bluegill is 12 inches and 6 inches, respectively.