May 30, 2019

Kinloch Lake Homeowners Association
Ken Eastwood
706 Milstead Ln.
Manakin-Sabot, VA 23103

RE: Fishery Survey, Kinloch Lake.
ES Project No. 12029

Dear Mr. Eastwood,

On May 1st, 2019, EnviroScience biologists performed lake diagnostic services on Kinloch Lake located in Goochland County, Manakin-Sabot, Virginia.

Electrofishing was conducted in two representative zones. These zones included representative near-shore habitats of the lake to effectively sample the fish population (Att. A, Figure 1). The objective was to assess assemblage and health of the current fish community to aid in making future management decisions.

METHODS

Night-boat electrofishing was used to collect fish community data from representative habitats within Kinloch Lake. Length and weight data were recorded for every fish species collected. The collection methods are summarized in the following paragraphs.

A Smith-Root® 5.0 GPP Electrofisher was used to sample the fish community at two sampling zones. The electrofisher supplied pulsed direct current to anodes mounted to a boom on the front of a 16 ft sampling boat. During electrofishing, the control unit was adjusted according to the conductivity of the water of Kinloch Lake and fish capture effectiveness and response. Approximately 15-20% (4-6 amps at 600 volts) of its available power at 120 pulses per second was used.

Electrofishing was conducted at night because of the well-established tendency of fish to move close to shore to feed. When shocked, the fish became temporarily stunned and floated to the surface where they were netted. To aid in capture, the boom of the boat was also equipped with flood lamps. The boat was maneuvered by directing the bow toward the shore and sampling any shoreline structures while shocking the nearshore area. The boat continued in this manner in one direction down the shoreline. Each sampling zone was approximately 500 m (1640 ft). All available habitats were sampled for approximately 1000 seconds for each sampling zone.

All fish were weighed (g), measured for total length (mm), and examined for the presence of external anomalies. DELT (deformities, erosions, lesions, and tumors) anomalies are defined as externally visible skin or subcutaneous disorders. Anomalies, if present, were recorded. All results were recorded on fish data forms for each sampling zone.

Water quality was analyzed in the field for temperature, pH, conductivity, and dissolved oxygen (DO) using a YSI 556 multi-parameter water quality monitoring device. The device was calibrated

according to the manufacturers' recommendations prior to use. Measurements were taken from the water column at; one meter below the surface, mid depth and one meter above the substrate. Data from these readings will help to determine the location of available oxygen (thermocline) within the water column.

RESULTS

In total, 495 individuals making up five species of fish were collected in the Kinloch Lake study area (Table 1 and Table 2). The two dominant fish species in total abundance were the Bluegill and Largemouth Bass. A total of 337 Bluegill were collected during the survey, contributing to 68.1% of the total fish abundance. A total of 135 Largemouth Bass were collected, contributing to 17.4%_ community abundance.

Table 1. Fish Species List

Common Name	*Species Name*
Bluegill	*Lepomis macrochirus*
Golden Shiner	*Notemigonus crysoleucas*
Largemouth Bass	*Micropterus salmoides*
Redear Sunfish	*Lepomis microlophus*
Warmouth	*Lepomis gulosus*

Table 2. Electrofishing Abundance Results

Species	**Zone 1**	**Zone 2**	**% Total Abundance**	**Total**
Bluegill	210	127	68.1	337
Golden Shiner	1	0	0.2	1
Largemouth Bass	78	57	27.3	135
Redear Sunfish	12	8	4.0	20
Warmouth	1	1	0.4	2
Total #	**302**	**193**	**100.0**	**495**

To gain further insight to the quality of the Largemouth Bass (*Micropterus salmoides*) and Bluegill (*Lepomis macrochirus*) populations, a Proportional Stock Density (PSD) was determined. This value was calculated by dividing the number of quality length fish by the total number of fishes that were longer than the minimum stock length and multiplying the quotient by 100 (Anderson 1979, Murphy and Willis 2000). A quality length fish is the minimum length that most anglers prefer to catch. The length value is dependent upon the species. A stock length fish is a fish at approximate maturity, and/or an individual that is the minimum length of fish that can provide recreational value. The minimum stock and quality lengths for Largemouth Bass are ≥8 inches and ≥12 inches (200 mm and 300 mm), respectively, and the minimum stock and quality minimum

lengths for Bluegill are ≥3 inches and ≥6 inches (80 mm and 150 mm), respectively (Anderson 1979, Murphy and Willis 2000).

The PSD provides valuable understanding of the current adult population and an estimate of recruitment for the following season. Analysis of PSD values can also identify problems with reproduction, growth and mortality. To sustain a quality fishery, optimum PSD values for largemouth bass are 40-70 and sunfish PSD values are 20-60 (Anderson, 1979, Murphy and Willis 2000).
The PSD value for Largemouth Bass was 27 and Bluegill having a PSD of 28. CPUE was calculated in both zones for Largemouth Bass and Bluegill. In Zone 1, Largemouth Bass CPUE was 273.4 fish/hr, and in zone 2 CPUE was 197.1 fish/hr. The combined CPUE was 235.0 fish/hr for Largemouth Bass. In Zone 1, Bluegill CPUE was 736.1 fish/hr and in zone 2 CPUE was 439.2 fish/hr. The combined CPUE for Bluegill was 586.7 fish/hr for bluegill.

Size class frequency histograms were also generated for Largemouth Bass and Bluegill to illustrate what proportions specific size-classes (Figures 2 and 3).

Figure 2. Largemouth Bass Size Class Frequency

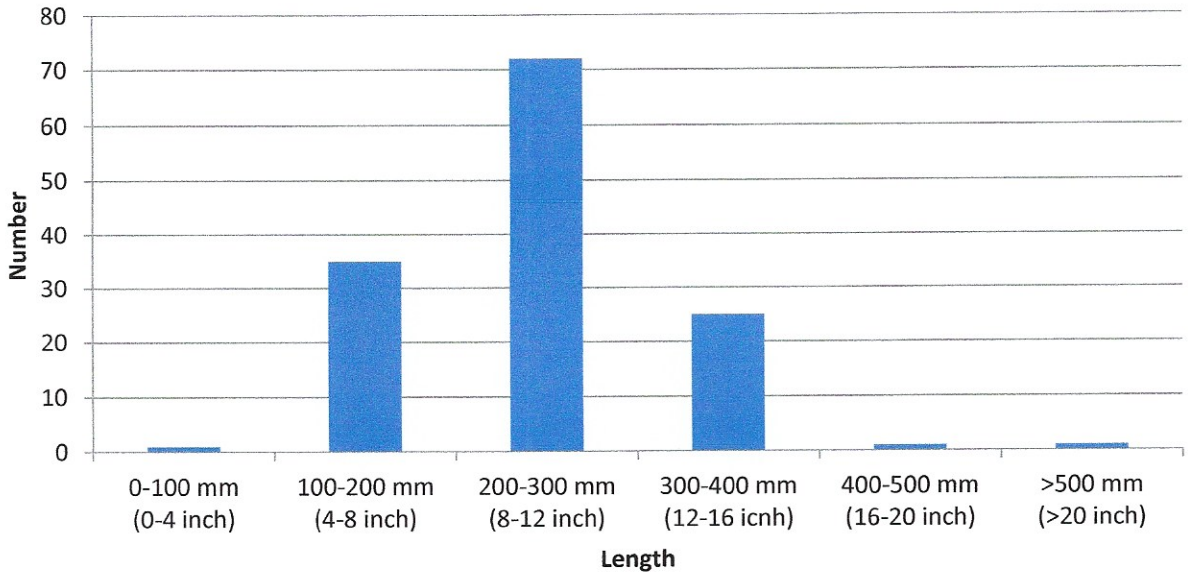
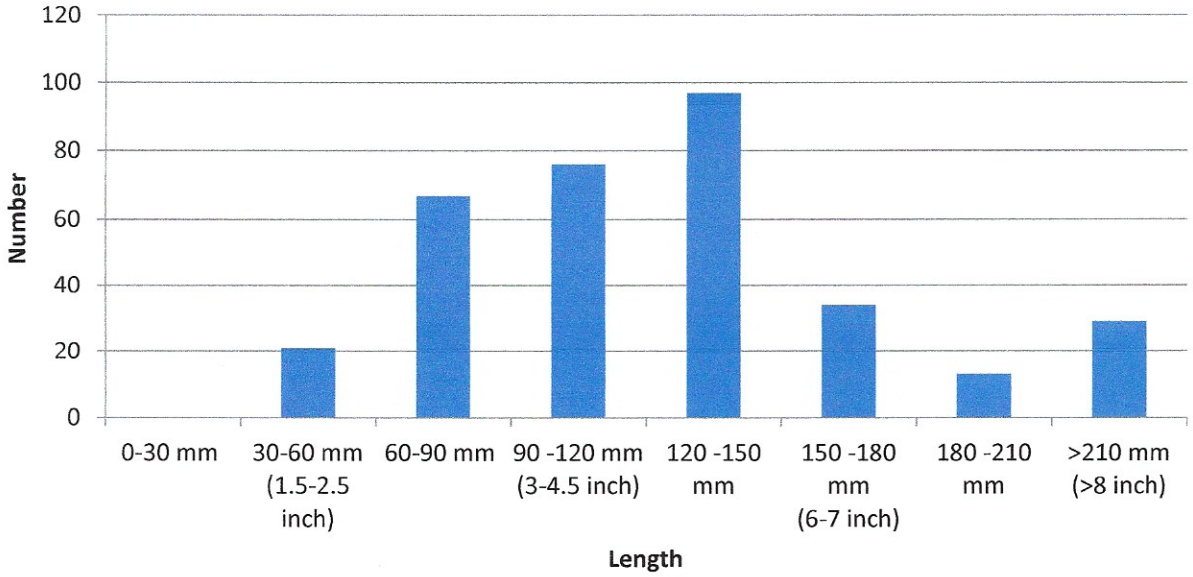


Figure 3: Bluegill Size Class Frequency



Water Quality was measured in the southeast end of the lake (Figure 1). The lake was thermally stratified during the May 1st sampling event in which surface water was recorded at 69.8°F (21.0°C) and near bottom depth temperature was 53.96°F (12.2°C) (Figure 4). This temperature placement is typical during warm months when warmer, less-dense surface water does not mix with cooler, denser, deeper water. These conditions change naturally during the fall and spring seasons when air temperatures reach approximately 50°F and turnover occurs. The air temperature cools the surface water and allows mixing, resulting in uniform temperature and dissolved oxygen (DO) throughout the water column.

At the time of sampling, DO readings from 1.0m (3ft) to depths of 5.7m (17ft) ranged from 10.71mg/L to 0.33mg/L. Values decreased dramatically to 0.13mg/L at 3.3m (10ft), another indication of thermal stratification. Anoxic conditions of depleted of dissolved oxygen could potentially be occurring between 2m- 3m. Based on this depth profile, approximately 50 percent of the upper water column at the sampling site is useable to aquatic life when the lake is stratified.

In-field pH values were similar from near surface (8.01) measurement and slowly increasing to near bottom (8.21) measurement, of which are within the range of 6.0 to 9.0 in which most freshwater aquatic life occurs.

Conductivity provides an estimate of dissolved matter such as solids and minerals in the water column. Kinloch Lake values of specific conductance ranged from 144 to 182 µS/cm which are well below the threshold of 900 µS/cm in which aquatic life is affected. Higher conductivity values are observed in productive, cloudy eutrophic lakes whereas lower-producing, clear oligotrophic lakes tend to contain less dissolved matter and lower conductivity values.

Figure 4. Water Quality Parameters

Time	Depth (ft.)	Temp (*C)	DO (mg/l)	Spec Cond (µS/cm)	pH
2250	3.0	21.0	10.71	144.0	8.01
2254	10.0	17.0	0.19	152.8	8.17
2252	17.0	12.2	0.33	182.7	8.21

CONCLUSSIONS AND RECOMMENDATIONS

The dominant fish species present during the evaluation of Kinloch Lake was the Bluegill and Largemouth Bass. Combined these species comprised 95.4% of the fish abundance in the survey. Other species encountered were Golden Shiner (*Notemigonus crysoleucas*), Redear Sunfish *(Lepomis microlophus*), and Warmouth (*Lepomis gulosus*); no carp species (Common or Grass) were found during the evaluation.

The data collected from this survey, water quality and fishery, serves as baseline information for the Kinloch Lake Association and future management. It appears that the Largemouth Bass population is stunted and are unable to forage sufficiently on the Bluegill due to the larger size class available. There are a few options when trying to achieve a better balance between species. EnviroScience recommends an approach such as enforcing a catch and release policy of Bass while catching larger Bluegill in 90mm-150mm range. This management decision will protect these top predators as well as promote a balanced bluegill population.

Should you have any other questions or require additional information, please do not hesitate to contact by phone or by email at JRose@EnviroScienceInc.com.

Sincerely,

Jason M. Rose

Fisheries Biologist

LITERATURE CITED

Anderson, R. O. 1979. New approaches to recreational fishery management. Missouri Cooperative Fishery Research Unit.

Murphy, B.R. and D.W. Willis. 2000. Fisheries Techniques, Second Edition. American Fisheries Society. Maryland, USA.