STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-5

Study No.: 230712 **Title:** Resource inventory support for inland lakes

Period Covered: October 1, 2003 to September 30, 2004

Study Objectives:

1. To oversee the implementation of the status and trends program for inland lakes.
2. To summarize and maintain data collected as part of the status and trends of inland lakes.
3. To evaluate statewide stocking programs in inland lakes.
4. To evaluate the status and trends of inland lakes.

Summary: Analyses were conducted to determine appropriate sample sizes for estimating fish lengths and for characterizing catch per unit effort in inland lake surveys. A comparison of mean lengths for fish measured to the 0.1 inch to fish measured to the inch group indicated that sample sizes of 25 individuals measured to the inch group were adequate to provide reasonably precise (0.2 inch) estimates of mean length. For catch per unit effort, preliminary analysis of precision and power indicated that current sampling effort may not be high enough to adequately characterize catch per unit effort of fishes in most lakes. In working with the 2003 survey data, a number of equipment, procedural, and data management issues that may currently limit the use of survey information became apparent. A series of meetings were held to discuss these sampling issues and a revised set of sampling recommendations was drafted and distributed to all management units. Additional analyses based on data collected from 2004 surveys will be required to better estimate effort required to characterize catch per unit effort.

Findings: Jobs 1, 2, 3, 4, and 5 were scheduled for 2003-04, and progress is reported below.

Job 1. Title: Develop sampling protocols, train field personnel, and develop sample processing procedures for fish and limnological measures collected from inland lakes.–Analyses were conducted to determine appropriate sample sizes for estimating fish lengths and for characterizing catch per unit effort. In the case of fish lengths, total length means for fish measured to 0.1 inch were compared with those for fish measured to the inch group. The goal was to provide sample size estimates for determining when fish should be measured to 0.1 inch and when it is more efficient, and as accurate, to measure fish to the inch group. Three fish length data sets were selected for evaluation. Two of the length data sets were bluegill and one was smallmouth bass. Bluegill were collected by trap net from Horseshoe and Big Seven lakes in 1991 (Schneider and Lockwood 2002). Smallmouth bass were collected by electrofishing from the Huron River 1990-93 (Lockwood et al. 1995). All three data sets were collected in conjunction with previously completed research studies and all fish were measured to 0.1 inch. For each sample the mean length from measures to 0.1 inch (fine measure) were compared with mean lengths derived from inch mid-point lengths. For each measure then, length L was truncated to the inch and 0.5 inch added to each measure. Resampling (with replacement) methods (Efron and Tibshirani 1993, Manly 1997) were used to estimate mean lengths $\overline{L}_{dk}$ derived from mid-point measures:

$$\overline{L}_{dk} = n^{-1}\left[\sum_{j=1}^{n}\left(k^{-1}\left[\sum_{i=1}^{k} L_i + 0.5\right]\right)\right], \quad (1)$$

for dataset d, k=5,10,15,20,25,30,40,60,80,100,140,180 mid-point measures, truncated length L, and n=1,000 iterations. Mid-point means were considered significant when they differed from fine measure means by ≥0.2 inch.

Empirical mean length of bluegill from Horseshoe Lake was 7.1 inches with SD 0.4. Minimum and maximum lengths were 6.3 inches and 8.5 inches, respectively. Empirical mean length of bluegill from Big Seven Lake was 4.6 inches with SD 0.8. Minimum and maximum lengths were 2.2 inches and 5.6 inches, respectively. Empirical mean length of smallmouth bass from Huron River was 5.2 inches with SD 2.5. Minimum and maximum lengths were 2.3 inches and 18.1 inches, respectively.

Greatest reduction in error rate for all three data sets occurred when sample sizes were increased from 3 to 15 measures. With 3 measures means differed by ≥0.2 inch for 29.9% to 38.2% of comparisons. With 15 measures, inch group means differed from fine measure means by ≥0.2 inch for 6.7% (Horseshoe Lake), 1.1% (Big Seven Lake), and 2.4% (Huron River) of 1,000 comparisons. With 25 measures, comparisons differed by <4% and only minor improvements were realized with additional measures.

For the catch per unit effort analysis, fish survey data from 27 lakes collected in 2002 were analyzed to determine appropriate sample sizes (number of nets and nights). Preliminary analysis of precision and power indicated that current sampling effort may not be high enough to adequately characterize catch per unit effort of fishes in most lakes. In working with the 2003 survey data, a number of equipment, procedural, and data management issues that may currently limit the use of survey information became apparent. These issues along with preliminary sampling recommendations were presented to the Management Team on March 11, 2004. Following that meeting, potential lake survey changes were discussed with the Technician Supervisors on March 30, 2004. The purpose of this discussion was to get feedback on the feasibility of potential changes based on survey logistics, the distribution of different gear types, and workloads. The following sampling recommendations were distributed to all personnel and feedback was requested on proposed survey changes:

Data recording: Net inventory numbers must be recorded for each net lift. Currently, mesh sizes (for both trap and fyke nets) vary widely across the Division and we need to be able to evaluate the influence of mesh size differences on catch data. Include the net number the Fish Collection System database when recording data from every lake survey. Also, information on lead length and mesh size needs to be reported. Catch data still need to be recorded by net lift, and most importantly, individual nets that do not catch any fish need to be recorded as an effort in the Fish Collection System.

A number of questions have been raised regarding the definition of net lifts and net nights. Differences in interpretation have been especially problematic in trying to enter and understand historical surveys in Fish Collection System. The following definitions should be used in place of those found in the Fisheries Survey Manual. A net lift refers to any time a net is lifted and fish removed. A net night refers to the number of nights a net fishes between lifts. For example, effort for a net set on Monday and lifted on Tuesday equals 1 net lift and 1 net night. In contrast, effort for a net set on Monday and lifted on Wednesday equals 1 net lift and 2 net nights. Recording both net lifts and net nights provides the most information and allows others to piece together how the survey was conducted. Fish Collection System will be modified so that, for future surveys, both net lifts and net nights can be recorded.

Effort: For trap and fyke nets, the minimum number of days sampled should be increased to at least 3 on all lake surveys. Ideally, 4 days of netting would be the minimum. The minimum

number of nets should also be increased to 3 nets per survey. Again, 4 is better than 3. These minimums (9 net nights) based on our analysis are in agreement with guidelines found in the literature. For those of you that set a combination of fyke and trap nets, try to balance the number of each gear type set. So in short, sample more days, with more nets, and sample fewer lakes. We also recommend reducing some of the effort put into large lakes (in terms of number of nets) and placing the difference on small and medium sized lakes. Also, consider using the 9-net-night minimum for your discretionary sampling especially if you intend to look at population characteristics other than age and growth.

Design: The goal of netting is to collect a non-biased random sample of the fish population in a lake. Random sampling is also used by Fisheries Division to estimate angler hours and fish harvest, and by Wildlife Division to estimate deer populations and harvest rates. Our goal should not be to catch as many fish as possible. Setting nets to catch as many fish as possible is analogous to interviewing only the best anglers during a creel survey. Maximizing catch will lead to biased estimates of the fish populations and can result in erroneous management decisions.

At the start of a survey, nets should be placed in random locations. Ideally, nets would be moved to new random locations daily. We recognize that moving all nets every day increases the daily work load and may not be feasible. We recommend letting the workday dictate the number of nets that can be moved. On days when catch rates are low it may be easy to move most of the nets to new locations. Conversely, when catch rates are high, none or only a few of the nets may be moved. Whenever a net is moved, be sure to include the new location information as well as the net inventory number. Lastly, no nets should be moved in order to increase catch rates. Additional gear can be added to increase sample sizes for age and growth, and this action should be clearly reported in Fish Collection System. Any catch from a net not set randomly should not be used in the calculation of catch per effort.

Gear: It is well established that net specifications (e.g., mesh size, lead length, and throat opening) can significantly affect catch rates and species and size composition. The Net Inventory Database indicates that net specifications for fyke and trap nets vary dramatically across the Division. These differences contribute to the variability in catch both within and among lakes making it difficult to show differences in fish populations through time and across water bodies. Although it is cost prohibitive to standardize all of our nets to a similar mesh size, we would like to move towards standardization of throat size. Initially we discussed modifying throat openings for this year, but we now recommend waiting until this winter to make changes. The reason for the delay involves the need to determine what aspect of the opening, including total area, maximum height, and shape (circle, square, or triangle), is the most critical factor controlling fish entry and escapement. We will work on this question over the summer and make recommendations in time for changes to be made over the winter.

Job 2. Title: Develop and maintain databases of inland lake samples.–Survey data from 2004 were entered as scheduled.

Job 3. Title: Evaluate the status and trends of inland lakes.–Given the reporting errors and sampling issues encountered during the evaluation of appropriate sample sizes and survey methods, a high priority was placed on analyzing procedures and revising sampling methods. Therefore, no summaries were generated for reporting on the status and trends of inland lakes.

Job 4. Title: Evaluate statewide stocking programs in inland lakes.–No progress was made on this job due to a focus on sampling methods as discussed in Job 3

Job 5. Title: Write reports.–This annual progress report was prepared as scheduled.

References:

Efron, B., and R. J. Tibshirani. 1993. An introduction to the bootstrap. Chapman and Hall, New York, New York.

Manly, B. F. J. 1997. Randomization, bootstrap and Monte Carlo methods in biology. Chapman and Hall, New York, New York.

Schneider, J. C., and R. N. Lockwood. 2002. Use of walleye stocking, antimycin treatments, and catch-and-release angling regulations to increase growth and length of stunted bluegill populations in Michigan lakes. North American Journal of Fisheries Management 22:1041-1052.

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