STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-4

Study No.: 710 **Title:** Evaluation and development of quantitative methods for fishery surveys, assessments, and inventory programs in Michigan

Period Covered: October 1, 2002 to September 30, 2003

Study Objective: To develop appropriate statistical survey design to evaluate Michigan's inland stocking program as part of a Statewide Resource Inventory Program.

Summary: Sample size evaluations to estimate lake shoreline development were initiated during current study period. Two shoreline development estimation methods were evaluated: classification (developed or undeveloped) and dock counts. Results suggested that classification method requires less sampling effort. However, dock counts provide more quantitative measure of shoreline development. Monte Carlo methods with equal selection probability were used to evaluate two levels of development for a 4,123 acre lake with 96,000 ft of shoreline. When 75% of shoreline was considered developed, classification method required minimum of 16 1,000 ft sections sampled and the dock count method 24 sections sampled to ensure 90% accuracy with acceptable variability of 15% of estimate. Both methods required additional sampling when 50% of shoreline was developed to ensure 90% accuracy with estimate variability of 15%. Classification method required minimum of 36 sections sampled and dock count method 42 sections sampled.

I continue to serve on the Resource Inventory Program and Statewide Creel Program committees.

Findings: Jobs 1, 2, and 3 were scheduled for 2002-03, and progress is reported below.

Job 1. Title: Advise on sampling, sample size and similar issues.–One of the objectives of the Statewide Resource Inventory Program is to inventory lake shoreline development. Current sampling protocol requires measures of development in 1,000 ft segments of shoreline. Measures may include classification of development (i.e., developed or undeveloped) or enumeration of docks within the shoreline segment. Standards for development classification are being developed. However, sample sizes necessary to accurately portray lake wide development have not been estimated. During current study period sampling criteria were begun to estimate sample size for shoreline development.

Monte Carlo sampling methods with equal selection probability were used to evaluate appropriate sample sizes for a 4,123 acre lake with 96,000 ft of shoreline. Two sample data sets with shoreline development classified were created. One data set with 75% of the shoreline classified as "developed" and the other with 50% of the shoreline classified as "developed". In each data set the remaining records (25% or 50%) were classified as "undeveloped". Each data set contained 96 records with the appropriate classification proportions. Each of the 96 records was assumed to be representative of 1,000 ft of shoreline and followed current Resource Inventory Program protocol. Monte Carlo sampling program was written in dBase IV and followed methods described in Hammersley and Handscomb (1964). Variability in estimates was stabilized at 500 iterations. To ensure estimation stability, 1,000 iterations were used for all sample estimation.

When 75% of shoreline was classified as developed, 90% of results produced estimated development at 75%±15% with 16 sections (records) sampled (Figure 1). Only 68% of results produced satisfactory estimates with 4 sections sampled. However, near perfect results (98%) were attained with 32 sections sampled.

Additional sampling effort was required when 50% of shoreline was developed. Ninety percent of results produced estimated development at 50%±15% with 36 sections sampled (Figure 2). Only 61% of results produced satisfactory estimates with 4 sections sampled and 97% with 56 sections sampled.

Similar analysis using Monte Carlo methods was completed for mean number of docks per 1,000 ft of shoreline. Dock counts are anticipated to produce more appropriate measures of development as they do not require development rating criteria and include cottage or home owners living away from the lake yet having lake access (i.e., docks). Two sample data sets were generated using SPSS 11.0.1 RV.NORMAL function. Each data set contained 96 records. One data set contained 75% of the records with dock count mean ($\bar{x}$) 9.8824 and SD=2.5411, and 25% of the records with data set $\bar{x}$ =0.1979 and SD=0.1300. Grand mean for this data set was 7.4613 and SD=4.7540. Data set was assumed to represent a lake with 75% of shoreline classified as developed and 25% classified as undeveloped. The second data set contained 50% of records with dock count $\bar{x}$ =10.8115 and SD=2.0287, and 50% of records with dock count $\bar{x}$ =0.2627 and SD=0.1162. Grand mean for this data set was 5.5371 and SD=5.4913. This data set was assumed to represent a lake with 50% of shoreline classified as developed and 50% as undeveloped.

When 75% of shoreline was classified as developed, 90% of results produced estimated dock count at 7.4613±15% with 24 sections (records) sampled (Figure 3). Only 68% of results produced satisfactory estimates with 4 sections sampled. However, near perfect results (98%) were attained with 44 sections sampled.

Additional sampling effort was required when 50% of shoreline was developed. Ninety percent of results produced estimated dock count at 5.5371%±15% with 42 sections sampled (Figure 4). Only 59% of results produced satisfactory estimates with 4 sections sampled and 98% with 62 sections sampled.

Job 2. Title: Serve as a member of R.I.P. committee.–I continue to serve as a member of this committee. Results to date of this committee's progress and sampling design are presented in:

Hayes, D., E. Baker, R. Bednarz, D. Borgeson, Jr., J. Braunscheidel, et al. 2003. Developing a standardized sampling program: the Michigan experience. Fisheries 28(7):18-25.

Job 3. Title: Consult on design of statewide creel program.–I am currently serving on the Statewide Creel Survey Committee.

Job 4. Title: Prepare annual report.–This report was prepared on schedule.

Literature Cited:

Hammersley, J. M., and D. C. Handscomb. 1964. Monte Carlo methods. Wiley, New York.

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Date: September 30, 2003

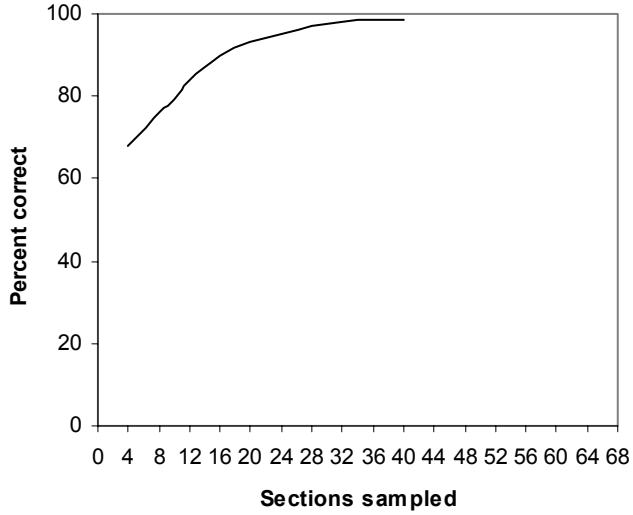

Figure 1.–Percentage of correct lake shoreline development categorization (developed or undeveloped) based on 4 to 44 1,000 ft shoreline sections sampled. Seventy-five percent of shoreline was developed and an individual estimate was considered correct if it fell within 75%±15%. Total shoreline was 96,000 ft.

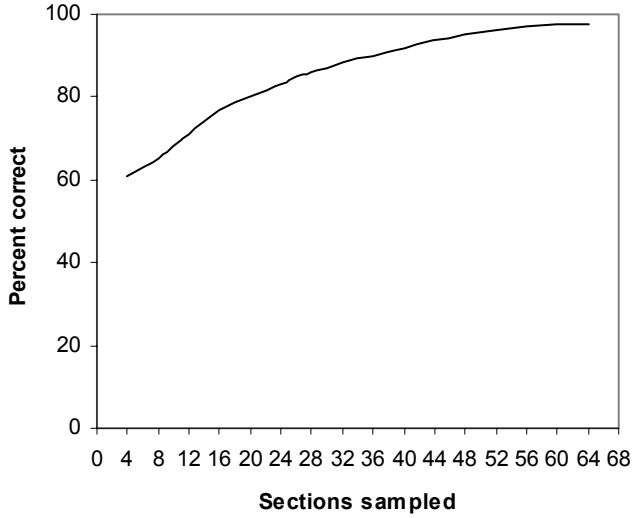

Figure 2.–Percentage of correct lake shoreline development categorization (developed or undeveloped) based on 4 to 64 1,000 ft shoreline sections sampled. Fifty percent of shoreline was developed and an individual estimate was considered correct if it fell within 50%±15%. Total shoreline was 96,000 ft.

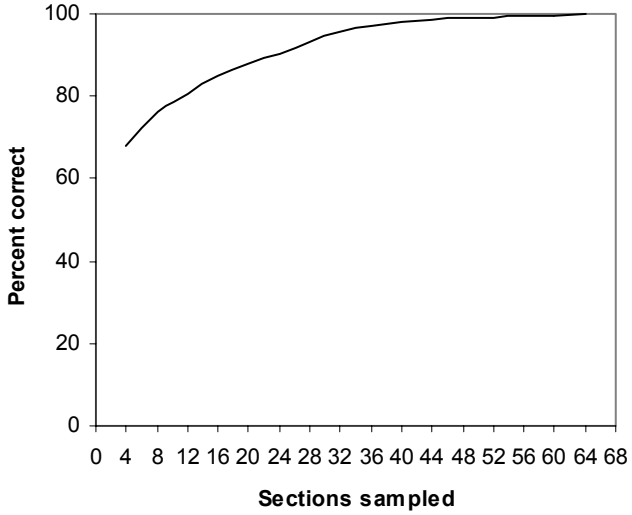

Figure 3.–Percentage of correct lake dock counts based on 4 to 64 1,000 ft shoreline sections sampled. Seventy-five percent of shoreline was developed and mean shoreline dock count was 7.4613 docks per 1,000 ft of shoreline and SD=4.7540. An individual estimate was considered correct if it fell within 7.4613±15%. Total shoreline was 96,000 ft.

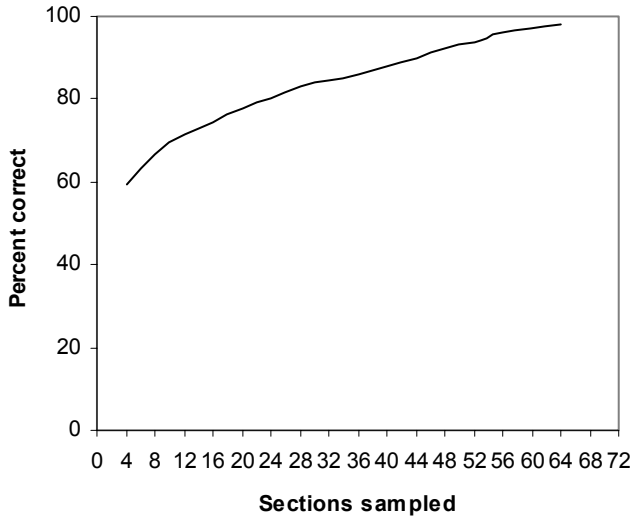

Figure 4.–Percentage of correct lake dock counts based on 4 to 64 1,000 ft shoreline sections sampled. Fifty percent of shoreline was developed and mean shoreline dock count was 5.5371 docks per 1,000 ft of shoreline and SD=5.4913. An individual estimate was considered correct if it fell within 5.5371±15%. Total shoreline was 96,000 ft.