STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-35-R-24

Study No.: 673 **Title:** Evaluation of on-site angler survey methods

Period Covered: April 1, 1998 to September 30, 1999

Study Objective: Determine if a mean-of-ratios estimator provides an unbiased estimate of angler catch rate for Michigan angler surveys utilizing roving interviews and determine if angling effort may be accurately estimated from access interview distribution of angler activity.

Summary: Access surveys use angler interviews from completed angler trips while roving surveys use interviews from incompleted angler trips. Catch rates are calculated using a ratio-of-means estimator for access interviews and a mean-of-ratios estimator for roving interviews (Lockwood 1997; Jones et al. 1995). Access interviews may be recorded by angling party or by individual angler while catch information from roving interviews are recorded by individual angler to avoid angler party size bias (Lockwood 1997). When roving interviews are collected, anglers are interviewed prior to completion of their angling trip. Minimum fishing time for each roving interview is 0.5 h (Pollock et al. 1997). Pollock et al. (1997) showed that accuracy of roving interview catch rates may be affected by bag limits. The assumption is also made that angler catch rates are relatively constant throughout their individual fishing trips. To test this assumption, comparisons were made of catch rates during the initial portion of angler's fishing trips with latter portion. Additional access and roving interviews were collected from a winter ice fishery to further compare catch rates.

Michigan conducts access and roving angler surveys to estimate angling effort and catch. Traditionally, estimated effort has been calculated using a randomized count method (Lockwood et al. 1999). Parker (1956), and McNeish and Trial (1991) have described an alternative method using the probability of angler presence (proportion) from access interviews. Comparisons of the randomized count and probability methods were made to determine appropriateness of method for use with Michigan angler surveys.

Job 3. Title: Select angler count data sets.

Findings: Twenty-seven count and interview data sets were selected for evaluation. To evaluate the proportional count method across various fishery/survey types, data were selected for boats, pier anglers, ice shanties and open ice anglers, from Great Lakes and inland angler surveys. These data were originally collected in conjunction with previously completed angler surveys. Counts were made at randomly selected times of day and were intended for use with methods found in Lockwood et al. (1999). However, the relationship between distribution of angler hours in an interview data set and distribution of angler hours in a corresponding count data set may still be compared.

Job 4. Title: Evaluate counting methods.

Findings: Traditional roving survey methods estimate angling effort using counts of angling activity made at randomly selected times within a survey day. These counts are expanded by the number of hours within a time period (e.g., daylight-weekday hours within a month) and averaged to estimate hours of activity by angling mode (e.g., shore anglers). These methods are used to estimate fishing effort and catch by numerous agencies (e.g., Lockwood et al. 1999, Bernard et al. 1998, Pollock et al. 1994). Parker (1956), and McNeish and Trial (1991) gave an alternative to this method. Using access interviews, angling effort is estimated from counts expanded by the frequency (probability) of angler presence. This method assumes that the distribution of anglers present in the interview data set is proportional to the distribution of anglers present at that site.

From the interview data set, the number of anglers present each hour is tallied. For hour t from a distribution of k hours the probability of angler presence $\hat{b}$ is:

$$\hat{b}_t = \frac{1}{\sum_{i=1}^{k} b_i} \bullet b_t \,. \qquad (1)$$

Total effort e for some period with h hours based on count c made at time t then is:

$$e = \frac{c_t}{b_t} \bullet h \,. \qquad (2)$$

For each data group (count and interview) used to evaluate this method, data were collected within specific daily time periods. Typically, these time periods reflected daylight hours. During early morning hours, most counts were low (relative to the remainder of the day) and, similarly, the distribution of anglers in the interview data set indicated few anglers were present. Also, anglers beginning their trip prior to the clerks arrival, were generally available for interviewing upon completion of their trip. However at the end of the daily survey period, counts were commonly high while the frequency of anglers (or boats, shanties, etc.) in the interview data set tailed off indicating few were present. This was due to the specific shifts worked by the clerk. Anglers present for counting during the last hour of data collection continued fishing and were not available for access interviews since the clerk was no longer present. Expanding counts made during the latter part of a clerk’s shift by the probability of angler presence from the interview data set resulted in an overestimation of fishing effort. To compensate, the mean length of fishing trip for a given survey was used to truncate the interview data set distribution. Consequently, any counts made during this period were ignored and not used in this analysis.

Bootstrapping techniques with 10,000 replications were used to evaluate differences in methods. Estimates were considered significantly different when 0.0000 was not included in the central 95% bootstrap estimates.

Currently, 11 data sets have been evaluated. Results are given in Table 1. Significant difference, $P \leq 0.05$, was detected for 1994 August weekday boat counts from Pomeroy Lake. Magnitude of difference between methods for all 11 evaluations was generally minimal. Eight of 11 evaluations differed by <10% of the random method estimate and 3 of 11 were >18%. From these 11 comparisons no significant trend in direction of differences was detected (Wilcoxon Signed Ranks Test, P=0.343).

Shape of bootstrap differences was evaluated to further assess accuracy of percentile confidence limits. Efron and Tibshirani (1993) measured shape as:

$$\text{shape} = \frac{\hat{\Theta}_{up} - \hat{\Theta}}{\hat{\Theta} - \hat{\Theta}_{lo}}, \qquad (3)$$

where, $\hat{\Theta}$ is the estimated difference between access and roving interview catch rates, and $\hat{\Theta}_{up}$ and $\hat{\Theta}_{lo}$ are the upper and lower 95% limits. Shape >1.00 indicates a greater distance between $\hat{\Theta}_{up}$ and $\hat{\Theta}$ than between $\hat{\Theta}_{lo}$ and $\hat{\Theta}$. Similarly, shape <1.0 indicates a greater distance between $\hat{\Theta}_{lo}$ and $\hat{\Theta}$ than between $\hat{\Theta}_{up}$ and $\hat{\Theta}$. However, Efron and Tibshirani (1993) note that exact intervals are usually asymmetrical.

For the differences of effort estimates from 11 count data sets, a right skew was evident for 3, a left skew for 6, and symmetrical intervals for 2. Shape of difference distributions is noted in Table 1.

Job 5. Title: Conduct angler access survey.

Findings: Using methods for a multiple-day period with instantaneous counts (Lockwood et al. 1999), an angler creel survey was conducted on Gogebic Lake from January to April, 1999. A creel clerk roved the lake on a snowmobile, and counted and interviewed anglers. Order of counting direction and time of count were randomized. Both access (835 records) and roving interviews (689 records) were collected for analysis of catch rate estimators. In addition, post cards were randomly distributed to anglers. Each card was self addressed and post paid. Cards were given to approximately every 7th angler. On each distributed post card, the clerk recorded the area (grid) of the lake the angler was fishing in, month, day, start time of the fishing trip (reported to the clerk by the angler), and number of fish harvested by species. The angler was also given a pencil and asked to record the time the fishing trip ended and number of fish harvested after receiving the card. Fish caught and released were not included. Each card had a unique number, which was recorded on the clerk's interview form. Post cards could then be tied to the clerk's interview form. From these records catch rate by species could be measured during the initial portion of an angler's fishing trip and for the latter portion.

A total of 217 cards were distributed to anglers. Of these a total of 101 were returned, 5 of which were discarded for recording errors. Fishing effort during initial and latter portion of trips was similar (Table 2). Anglers fished, on average, 3.1 h during the initial period and 3.5 h during the latter period. All anglers fished a minimum of 0.5 h during each period.

Catch rates, by species, of 6 species of fish were compared (Table 3). Catch per hour of yellow perch was significantly greater during the latter period (Wilcoxon Signed Ranks Test, $P<0.01$). Catch rates were averaged, across species, by initial and latter periods. Catch per hour was 0.0796 and 0.1088 for initial and latter periods. No significant trend in direction of differences between these means was detected.

Literature Cited:

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Table 1.–Bootstrap estimates of difference between proportion and random count estimates of angling effort and 95% percentile confidence limits. Significant differences are noted with “*”. Estimates are based on 10,000 replications of data sets. Weekdays are noted as “WD” and weekend days as “WE”.

Site/ Year/ Month/ Day/ Mode	Sample					Bootstrap			
	N	Mean trip length	Proportion	Random	Δ	$\hat{\Delta}$	$\hat{\Delta}_{min}$	$\hat{\Delta}_{max}$	Shape
Fletcher 1995 January WD Shanty	3	4.6	560.4	564.0	-3.6	7.0	-616.8	609.6	1.01
WE Shanty	4	4.4	970.2	942.0	28.2	30.2	-325.8	382.2	0.99
WD Open ice	3	4.7	752.0	714.0	38.0	41.0	-771.8	855.1	1.00
WE Open ice	4	4.2	693.8	699.0	-5.2	-3.7	-334.0	320.8	0.98
February WD Shanty	3	4.6	724.7	730.0	-5.3	-4.5	-208.0	197.3	0.99
WE Shanty	4	4.8	530.8	558.0	-27.2	-25.6	-459.6	405.2	0.99
WE Open ice	4	3.6	604.2	640.0	-35.8	-29.8	-1123.2	1035.6	0.97
Pomeroy 1994 May WE Boat	3	3.2	707.1	521.1	185.9	183.7	-173.7	610.2	1.19
June WD Boat	7	2.8	351.7	345.1	6.6	6.9	-333.8	337.8	0.97
August WD Boat	4	3.8	327.8	616.7	-288.9	-288.0*	-507.4	-54.6	1.06
Duck 1993 May WE Boat	3	4.7	536.0	657.5	-121.5	-121.9	-369.1	126.3	1.00

Table 2.–Fishing effort for 96 anglers voluntarily returning post cards.

	Portion of trip	
	Initial	Latter
Minimum fishing time	0.5	0.5
Maximum fishing time	7.5	10.5
Average	3.1	3.5
Standard deviation	1.5	2.2

Table 3.–Catch per hour by species for angler returned post cards.

	Catch per hour by trip period		
Species	Initial	Latter	P
Yellow perch	0.3768	0.5525	<0.01*
Black crappie	0.0017	0.0000	0.32
Rock bass	0.0104	0.0000	0.32
Northern pike	0.0304	0.0090	0.60
Walleye	0.0446	0.0914	0.09
Lake herring	0.0134	0.0000	0.18