STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-81-R-1

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

Period Covered: October 1, 1999 to September 30, 2000

Study Objective: Determine if the 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.

To test the assumption that roving interview catch rates are not different from access interview catch rates, both interview types were collected for comparison from anglers fishing in nine sections of the AuSable River (Oscoda, Alcona and Iosco Counties) during the summer months of 1999 and 2000.

Currently from these data, 38 comparisons of catch rates have been made. Catch rates from access interviews were significantly greater (α=0.05) than catch rates from roving interviews 1 time and significantly less 1 time. No significant trend in differences was detected. These preliminary results indicated that, using the appropriate roving data, the mean-of-ratios estimator provides an unbiased estimate of catch rate.

Job 5. Title: Conduct angler access survey.

Findings: Using methods for a multiple-day period (Lockwood et al. 2000), angler creel surveys were conducted at nine sections (34 river miles) of the AuSable River and on three AuSable River impoundments (Table 1). Survey data were collected during spring to fall months in 1999 (Table 2) and 2000 (Table 3). Both harvested and caught-and-released fish were recorded by species. Two modes of angling were sampled (boat and shore/wading) over a 5-month period. Anglers were either interviewed as they fished (roving interview) or at the completion of their trip (access interview). No anglers were interviewed as they fished and then again at the completion of their trip. All interviews, regardless of type, were by individual angler.

Thirty-eight comparisons of access and roving interview catch rates from the 1999 data were made (Tables 4-6). Bootstrapping techniques with 10,000 replications were used to calculate estimated

difference in catch rates. The percentile method for detecting differences in catch rate was used and differences were considered statistically significant when 0.0000 was not included in the central 95% bootstrap differences (Efron and Tibshirani 1993). Ten thousand replications have been shown adequate to overcome severe deviations from normality in data sets and correctly represent confidence limits (Buckland 1984).

From these 38 catch rate comparisons, catch rates from access interviews were significantly greater (α=0.05) than those from roving interviews 1 time, or 2.6%, and significantly less 1 time, or 2.6% (Tables 4-6).

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

$$\text{shape} = \frac{\hat{\Theta}_{up} - \hat{\Theta}}{\hat{\Theta} - \hat{\Theta}_{lo}}, \qquad (1)$$

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 <1.00 indicates a greater distance between $\hat{\Theta}_{lo}$ and $\hat{\Theta}$ than between $\hat{\Theta}_{up}$ and $\hat{\Theta}$. For the 38 estimated differences, a right skew was evident for 14, a left skew for 23, and 1 had a symmetrical distribution (Tables 4-6). However, Efron and Tibshirani (1993) noted that exact intervals are usually asymmetrical. Calculating symmetrical intervals would tend to underestimate upper limits 37% of the time and lower limits about 60%.

Ratio-of-means catch per hour for access interviews and mean-of-ratios catch per hour for roving interviews were calculated, appropriately, for each data set. Calculated catch rates for each data set were compared using Wilcoxon signed ranks test for paired data. Mean catch per hour for the 38 access interview data sets was 0.0158 and 0.0190 for the roving data sets. No significant differences were detected (P=0.52).

Estimated catch is the product of estimated effort and estimated catch rate. Jones et al. (1995) and Lockwood (1997) showed that the ratio-of-means estimator used with access interviews provides an unbiased estimate of catch rate. My current preliminary evaluations indicate that the mean-of-ratios estimator, using roving interviews, provides an unbiased estimate of the ratio-of-means estimator using access interviews.

Evaluations of catch-rate differences will be made on the remaining data. These results will be coupled with previous analysis (see Lockwood 1998 and Lockwood 1999).

Literature Cited:

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Table 1.–Au Sable River angler survey sections, 1999-2000. Lengths were measured using ArcView 3.1 (Environmental Systems Research Institute, Inc.).

Section code	Boundaries	Name	Length (miles)
240	End of riverine stretch to Mio Dam	Mio Pond	-
250A	M-33 to Power Line	-	0.46
250B	Power Line to Comins Flats	-	6.96
251	Comins Flats to McKinley Bridge	-	7.58
252	McKinley Bridge to 4001 Bridge	-	7.09
254	1.65 miles below 4001 Bridge to Alcona Dam	Alcona Impoundment	-
255	Alcona Dam to Hoppy Creek	-	6.57
256	Hoppy Creek to end of riverine stretch above Loud Impoundment		5.50
257	End of Riverine stretch to Loud Dam	Loud Impoundment	-

Table 2.–Beginning and ending period dates of 1999 AuSable River angler surveys by survey section. See Table 1 for description of survey sections.

240, 250	250A, 250B, 251, 252	255, 256, 257
April 24 – May 31	April 24 – June 7	May 20-31
June 1-30	June 8 – July 15	June 1-30
July 1-31	July 16 – August 24	July 1-31
August 1-31	August 25 – September 7	August 1-31
September 1-30	September 8-30	September 1-30

Table 3.–Beginning and ending period dates of 2000 AuSable River angler surveys by survey section. See Table 1 for description of survey sections.

240, 250	250A, 250B, 251, 252	255, 256, 257
April 29 – May 31	April 29 – June 7	April 20 – May 31
June 1-30	June 8 – July 15	June 1-30
July 1-31	July 16 – August 24	July 1-31
August 1-31	August 25 – September 7	August 1-31
September 1-30	September 8-30	September 1-30

Table 4.–Catch rates by species for shore anglers fishing section 240 of the AuSable River, April 24 – May 31, 1999. Differences were considered significant and noted with an "*" when 0.0000 falls outside the central 95% bootstrap limits.

Day type/ Species	Access		Roving		Δ	95% limits		Shape
	Records	$\hat{R}$	Records	$\overline{R}$		$\hat{\Delta}_{min}$	$\hat{\Delta}_{max}$	
Weekday								
NOPk[1]	24	0.0000	16	0.0250	-0.0250	0.0000	0.0750	2.00
NOPr[2]	24	0.0149	16	0.1625	-0.1476*	0.0072	0.3118	1.18
SMBr[3]	24	0.0149	16	0.0000	0.0149	-0.0420	0.0000	0.50
CWSk[4]	24	0.0149	16	0.0000	0.0149	-0.0472	0.0000	0.45
Weekday								
WAEr[5]	46	0.0063	30	0.0000	0.0063	-0.0195	0.0000	0.46
NOPk[1]	46	0.0254	30	0.0000	0.0254	-0.0564	0.0000	0.80
NOPr[2]	46	0.0444	30	0.0268	0.0176	-0.0677	0.0315	1.00
RKBr[6]	46	0.0063	30	0.0000	0.0063	-0.0215	0.0000	0.43
YEPk[7]	46	0.0190	30	0.0000	0.0190	-0.0538	0.0000	0.57
YEPr[8]	46	0.0254	30	0.0000	0.0254	-0.0680	0.0000	0.60
SMBr[9]	46	0.0127	30	0.0133	-0.0006	-0.0378	0.0400	1.04
CWSr[10]	46	0.0000	30	0.0507	-0.0507	0.0000	0.1347	1.66

[1]Northern pike kept.
[2]Northern pike caught and released.
[3]Smallmouth bass caught and released.
[4]Common white sucker kept.
[5]Walleye caught and released.
[6]Rock bass caught and released.
[7]Yellow perch kept.
[8]Yellow perch caught and released.
[9]Smallmouth bass caught and released.
[10]Common white sucker caught and released.

Table 5.–Catch rates by species for shore anglers fishing section 240 of the AuSable River, June 1999. Differences were considered significant and noted with an "*" when 0.0000 falls outside the central 95% bootstrap limits.

Day type/ Species	Completed trip		Incompleted trip		Δ	95% limits		Shape
	Records	$\hat{R}$	Records	$\overline{R}$		$\hat{\Delta}_{min}$	$\hat{\Delta}_{max}$	
Weekday								
NOPk[1]	42	0.0068	36	0.0000	0.0068	-0.0212	0.0000	0.46
NOPr[2]	42	0.0137	36	0.0025	0.0112	-0.0330	0.0049	0.74
RKBr[3]	42	0.0478	36	0.0000	0.0478	-0.0350	0.0000	0.64
YEPk[4]	42	0.0068	36	0.0000	0.0068	-0.0350	0.0000	0.64
SMBr[5]	42	0.0000	36	0.0025	-0.0025	0.0000	0.0074	1.99

[1]Northern pike kept.
[2]Northern pike caught and released.
[3]Rock bass caught and released.
[4]Yellow perch kept.
[5]Smallmouth bass caught and released.

Table 6.–Catch rates by species for shore anglers fishing section 240 of the AuSable River, July 1999. Differences were considered significant and noted with an "*" when 0.0000 falls outside the central 95% bootstrap limits.

Day type/ Species	Completed trip Records	$\hat{R}$	Incompleted trip Records	$\overline{R}$	Δ	95% limits $\hat{\Delta}_{min}$	$\hat{\Delta}_{max}$	Shape
Weekday								
WAEr[1]	47	0.0048	56	0.0000	0.0048	-0.0350	0.0000	0.64
NOPk[2]	47	0.0048	56	0.0000	0.0048	-0.0350	0.0000	0.64
NOPr[3]	47	0.0095	56	0.0137	-0.0042	-0.0330	0.0049	0.74
RKBr[4]	47	0.0048	56	0.0038	0.0010	-0.0138	0.0115	0.97
YEPk[5]	47	0.0048	56	0.0481	-0.0433	-0.0056	0.1186	1.55
YEPr[6]	47	0.0095	56	0.0337	-0.0242	-0.0104	0.0692	1.34
SMBk[7]	47	0.0000	56	0.0060	-0.0060	0.0000	0.0179	1.99
SMBr[8]	47	0.0095	56	0.0420	-0.0325	-0.0081	0.0838	1.26
SFSr[9]	47	0.0048	56	0.1448	-0.1400	-0.0013	0.3943	1.78
Weekday								
WAEk[10]	35	0.0000	74	0.0062	-0.0062	0.0000	0.0187	2.03
WAEr[1]	35	0.0000	74	0.0042	-0.0042	0.0000	0.0125	1.93
NOPk[2]	35	0.0088	74	0.0014	0.0074	-0.0277	0.0043	0.57
NOPr[3]	35	0.0263	74	0.0222	0.0041	-0.0388	0.0272	0.90
RKBk[11]	35	0.0263	74	0.0000	0.0263	-0.0713	0.0000	0.59
RKBr[4]	35	0.0176	74	0.0302	-0.0126	-0.0361	0.0515	0.81
YEPk[5]	35	0.0527	74	0.0000	0.0527*	-0.1183	-0.0084	0.68
YEPr[6]	35	0.0263	74	0.0527	-0.0264	-0.0473	0.1251	1.34
SMBr[8]	35	0.0088	74	0.0282	-0.0194	-0.0158	0.0602	1.17
SFSk[12]	35	0.0263	74	0.0000	0.0263	-0.0597	0.0000	0.81
SFSr[9]	35	0.0878	74	0.0000	0.0878	-0.2109	0.0000	0.73
CATk[10]	35	0.0088	74	0.0000	0.0088	-0.0282	0.0000	0.45

[1]Walleye caught and released.
[2]Northern pike kept.
[3]Northern pike caught and released.
[4]Rock bass caught and released.
[5]Yellow perch kept.
[6]Yellow perch caught and released.
[7]Smallmouth bass kept.
[8]Smallmouth bass caught and released.
[9]Sunfish sp. caught and released.
[10]Walleye kept.
[11]Rock bass kept.
[12]Sunfish sp. kept.
[13]Catfish sp. kept.