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FINAL REPORT

RESEARCH AND SURVEYS

FEDERAL AID GRANT NO. F-50-R

FISH RESEARCH FOR OKLAHOMA WATERS

PROJECT NO. 9

OPTIMIZING SAUGEYE SAMPLING PROTOCOL

MARCH 1, 1996 through FEBRUARY 28, 1997

FINAL REPORT

State: Oklahoma

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Project Title: Optimizing saugeye sampling protocol.

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ABSTRACT

Monthly electrofishing samples for saugeye (walleye x sauger hybrids; *Stizostedion vitreum vitreum x S. canadense*) were collected on three lakes during spring and fall, 1996. Sampling was stratified by day and night and habitat type. Catch per hour (CPUE) was calculated for four size classes and compared for each sampling strata. Precision of the estimates was calculated and sampling recommendations made.

Differences in seasonal catch rates were inconsistent between lakes and among size classes. CPUE's of night samples were higher for all lakes for the "small" and "intermediate" size classes. However, no clear diel pattern in catch rates of "large" saugeye were observed. Habitat type had little effect on sampling efficiency. Precision of most samples was poor. Ten hours of electrofishing would be needed to obtain estimates $\pm 75\%$ of the mean.

Sampling recommendations included collecting data on the "small" and "intermediate" size classes using fall night electrofishing. Data on "large" saugeye could be collected during the fall night samples and also during spring, day time electrofishing sampling targeting largemouth bass. In order to collect statistically reliable data, sampling effort needs to be increased 7-fold over existing sampling protocols.

I. Problem or Need:

With increasing demands placed on the time of fisheries management staff and ever shrinking budgets, increased sampling efficiency is imperative to effective management programs. Further complicating the balance between available time and funds and collecting quality information, is the increased awareness that collecting statistically reliable data is often dependent on designing species-specific sampling programs (Parrish et al. 1995).

The Oklahoma Department of Wildlife Conservation (ODWC) has been stocking saugeye (walleye-sauger

hybrids; *Stizostedion vitreum vitreum x S. canadense*) since 1985. Saugeye stockings have become an important part of Oklahoma's fisheries management program (saugeye were stocked in 18 lakes in 1996). The ODWC has developed specific stocking criteria and objectives for the saugeye stocking program (Gilliland and Boxrucker 1995). One of these objectives has been to control slow-growing and/or stunted crappie populations. However, for saugeye to be effective predators on crappie, they must be approximately 50 cm TL (Horton and Gilliland 1991). Current saugeye sampling procedures (night electrofishing and gill netting) do not adequately sample adult saugeye populations (ODWC survey data; F-44-R, Project 5). As a result, it has not been possible to set realistic target catch rates for adult saugeye to provide effective control of overcrowded crappie populations. A statewide 18-inch length limit on saugeye is also in effect. Without adequate sampling techniques in place, it is difficult to reliably assess the effect the regulation is having on adult saugeye densities.

ODWC staff routinely collects spring daytime electrofishing samples for largemouth bass *Micropterus salmoides*. These samples are concentrated in cove-type habitat. Preliminary data from Thunderbird Reservoir indicate that catch rates of saugeye from samples collected off points and main-lake shoreline are higher than those from cove samples (ODWC, unpublished data). If day time sampling in habitat typically electrofished for bass would also be conducive to collecting quality data on saugeye, sampling efforts for these two species could be combined and overall sampling efficiency would be improved.

Sampling was conducted on three reservoirs; Holdenville, Jean Neustadt, and Thunderbird. These reservoirs were chosen for study largely based on past stocking history; saugeye have been stocked long enough for adult populations to develop. The objective of this study was to determine the differences in saugeye electrofishing catch rates and associated variability of the samples for each of four size groups by 1) month and season; 2) time of day; and 3) habitat type.

III. Project Objective:

To determine the differences in saugeye catch rate and associated variability along with length distribution of electrofishing samples by month, time of day, and habitat type on three reservoirs as a method to improve sampling efficiency.

IV. Approach

Study Sites

Thunderbird Reservoir was impounded in 1965 as the municipal water supply for several central-Oklahoma communities. It covers 2,448 ha and has a shoreline development ratio of 7.9, mean depth of 6 m, maximum depth of 21 m, and a water exchange rate of 0.57. The lake is moderately turbid (mid-summer secchi disk readings average approximately 60 cm). Thunderbird was first stocked with saugeye in 1985 and has since received annual stockings.

Holdenville Lake covers 223 ha and was constructed in 1932 by the City of Holdenville as a water supply. The lake has a mean depth of 6 m and a maximum depth of 16 m, a shoreline development ratio of 3.3, a water exchange rate of 0.36, and a secchi disk reading of 180 cm. Saugeye have been stocked annually since 1988, with the exception of 1992.

Jean Neustadt was impounded in 1968 and covers 187 ha. It has a mean depth of 3 m and a maximum depth of 14 m, a shoreline development ratio of 3.3, a water exchange rate of 0.76, and a secchi disk reading 76 cm. With the exception of 1992, saugeye have been stocked annually since 1989.

Electrofishing Procedures

Electrofishing samples were collected on two dates on each lake during March, April, May, October, and November, 1996. Samples were collected at fixed sites, with two-person crews (one dipper/one boat driver) using pulsed DC current (60 pulses/sec; 8-10 amps). Electrofishing sites were stratified by habitat; 1) points and main-lake shoreline, hereafter referred to as "saugeye" habitat; and 2) coves, hereafter referred to as "bass" habitat. Six 15-minute units of effort were collected in each habitat type during daylight on each date. Six units of effort also were collected after dark in "saugeye" habitat on each date for a total of 18 units of effort. The day and night samples in "saugeye" habitat were collected at the same sites. Data from both sampling dates for each month were pooled (36 units of effort per lake per month).

Saugeye were the only fish collected during sampling. All fish were measured to the nearest mm and weighed to the nearest g and with one of four size categories used for analysis; 1) $\leq$ 310 mm (age 0; hereafter referred to as "small"); 2) $\leq$ 400 mm (age 0 and yearling; hereafter referred to as "intermediate"); 3) $\geq$ 457 mm (statewide minimum length limit; hereafter referred to as "large"); and 4) all size classes combined. Spring, 1996 and fall, 1996

samples collected different year classes, particularly in the "small" and "intermediate" size classes. However, stocking rates were the same for all lakes (50/ha) and assuming relatively similar survival of stocked fish between years, I felt that this would not compromise the study objectives.

Catch rates (CPUE) were expressed as number of fish per hour of electrofishing. Electrofishing catch rates for each lake were compared by month and season, day and night, and habitat type for each size group. Catch data from all lakes were not pooled due to differences in population abundance. CPUE data were log-transformed [$\log_e$(CPUE+1)] to normalize data and stabilize variances. Standard t-tests were used to determine differences in CPUE by season and habitat type for each lake and size class. Paired t-tests were used to test for differences between day and night samples collected from "saugeye" habitat. Ryan's multiple comparison test was used to determine differences in CPUE by month. Statistical significance was assessed at $P=0.05$.

Sampling precision was measured by determining the coefficient of variation of the mean ($CV_{\bar{x}}=S.E.\bar{x}^{-1}$). A target level of precision was set at $CV_{\bar{x}}=0.125$. This value corresponds to the $\bar{x}\pm0.25_{\bar{x}}$ and coincides with standards established for "management studies " by Robson and Regier (1964). Rearranging the above equation, inserting the desired level of precision, and solving for N (number of samples) yields the equation:

$$N=0.125^{-2}\bar{x}^{-2}s^2. \qquad \text{(equation 1)}$$

Standard equations for estimating sampling size assume that the data are normally distributed and that the sample mean and variance are uncorrelated. A mean-variance relationship for this study was calculated from all sampling strata, lakes, and dates combined by linear regression of $\log_e s^2$ on $\log_e \bar{x}$, yielding the equation:

$$\log_e s^2=1.61+1.22\log_e \bar{x}. \qquad \text{(equation 2)}$$

The regression equation relating s^2 and $\bar{x}$ was back-transformed to a linear scale and corrected for transformation bias by adding the mean square error of the regression (MSE)/2. The mean-variance relationship for all samples collected then becomes:

$$s^2=\exp[(MSE/2)+1.61+1.22\bar{x})] \qquad \text{(equation 3)}$$

$$=\exp[(0.45/2)+1.61+1.22\bar{x}], \quad \text{(equation 4)}$$

$$=6.26\bar{x}^{1.22}. \quad \text{(equation 5)}$$

These results were substituted into equation 1 and used to compute sample size requirements:

$$N=6.26\bar{x}^{1.22}\bar{x}^{-2}0.125^{-2} \quad \text{(equation 6)}$$

$$N=6.26\bar{x}^{-0.78}0.125^{-2}. \quad \text{(equation 7)}$$

V. Results

Differences in seasonal catch rates were not consistent among lakes nor size classes (Table 1). CPUE of "small" saugeye was higher in the fall from Holdenville, whereas no seasonal differences in CPUE of the "small" size class were observed in the Jean Neustadt and Thunderbird data (Table 1). CPUE of the "intermediate" size class was higher in the fall from Jean Neustadt and Thunderbird; no seasonal difference was detected from Holdenville (Table 1). CPUE of "large" saugeye was higher in the spring from Holdenville and Jean Neustadt; however, higher CPUE's were found in the fall samples from Thunderbird (Table 1). Catch rates for all size classes combined did not differ by season from Holdenville and Jean Neustadt, but were higher at Thunderbird in the fall (Table 1).

Analysis of the monthly electrofishing data did not provide additional insight into temporal differences in CPUE. Therefore, monthly comparisons will not be discussed further.

Precision of most samples was poor. Precision of the Thunderbird data was higher than that for Holdenville and Jean Neustadt (Table 1). However, a minimum of 5 hours of electrofishing was required to obtain a $CV_{\bar{x}}=0.125$ in fall sampling with size classes, day time, and habitats combined (Table 1). Stratifying the data by size class generally made sampling requirements unrealistic. Ten hours of electrofishing would meet the specified target of precision in only three of the 24 sampling strata depicted in Table 1.

Diurnal differences in CPUE were more consistent. CPUE's of night samples were higher for all lakes for the "small" and "intermediate" size classes (Table 2). No diurnal differences in catch rates of "large" saugeye were

found in either season at Holdenville nor in the spring from Thunderbird (Table 2). CPUE of the "large" size class was higher at night in the spring and during the day in the fall from Jean Neustadt (Table 2). Fall CPUE of the "large" size class was higher during the day at Thunderbird. Catch rates were higher at night for size classes combined for all lakes and seasons with the exception of the fall samples from Thunderbird which did not exhibit any diurnal differences in catch rates (Table 2).

Precision of the night electrofishing samples was higher than the paired samples collected during the day (Table 2). The exceptions to this relationship were at Thunderbird for "large" saugeye and for all size classes combined in the fall (Table 2). Ten hours of electrofishing (40 units of effort) at night would be required to ensure obtaining a mean with a 75% confidence interval based on data from the three lakes in this study (Table 2). By stratifying the data by day and night, precision was not sacrificed in many cases when the data were broken out by size classes. Eleven hours of electrofishing would meet the target of precision in 19 of the 48 sampling strata in Table 2. If only night samples were considered, 15 of 24 strata met the target of precision with 11 hours of electrofishing.

Habitat type had little effect on day time electrofishing sampling efficiency. CPUE was higher in "saugeye" habitat for the "intermediate" size class in spring at Holdenville and in the fall at Jean Neustadt (Table 3). CPUE of "large" saugeye was higher in the fall at Thunderbird (Table 3). Catch rates for all size classes combined in "saugeye" habitat were higher in the spring at Holdenville and in the fall at Jean Neustadt and Thunderbird (Table 3). All other comparisons of habitat type by size class for each season and lake were nonsignificant. Precision of the data collected in "saugeye" habitat was higher than the respective data collected in "bass" habitat in 17 of the 24 habitat comparisons in Table 3. However, stratifying the data by habitat type did little to reach realistic sample size requirements.

VI. Discussion:

This study provided no clear evidence indicating that efficiency would be enhanced by limiting data collection to a single season. Seasonal differences in catch rates and precision were inconsistent among lakes and size classes. This is in contrast to the findings of Johnson et al. (1988) who reported higher catch rates of age-1 and older saugeye from night electrofishing samples in spring than in fall from Pleasant Hill Reservoir, Ohio. Stratifying sampling by habitat type during daytime electrofishing also did little to improve efficiency.

Sampling at night clearly improved efficiency, particularly for the "small" and "intermediate" size classes. This is consistent with sampling recommendations for collecting age-0 and yearling walleye (McWilliams and Larscheid 1992; Serns 1982). No clear evidence was found indicating that night sampling efficiency for "small" and "intermediate" saugeye could be improved by stratifying the sampling by season. Differences in CPUE were inconsistent between spring and fall samples; however, precision of the fall night electrofishing samples was typically higher than the respective samples collected in spring. In addition, stocking criteria used by ODWC's management staff (Gilliland and Boxrucker 1995) require data be provided from previous year's stocking to receive subsequent stockings. Therefore, fall collections of age-0 saugeye fit better into existing management protocol.

Improved capture efficiency was not evident for the "large" size class at night. No differences in CPUE were observed in the seasonal day-night comparisons from Holdenville. However, catch rates of "large" saugeye from Holdenville were low throughout the study indicating low population density . This may make drawing any conclusions relative to capture efficiency of "large" individuals from the Holdenville data suspect. CPUE of "large" saugeye was higher at night for spring samples and higher during the day in the fall from Jean Neustadt. No diel differences were seen in the spring data from Thunderbird; however, day samples in the fall had a higher CPUE. Precise data on "large" saugeye are needed to enhance ODWC's crappie management efforts. Saugeye are used as a tool to reduce density of overcrowded crappie populations (Gilliland and Boxrucker 1995). It would be useful to develop correlations between CPUE of "large" saugeye and improvements in crappie size structure and/or growth rates. However, no single sampling strategy improving capture efficiency was evident from this study.

ODWC's management staff typically expends six units of effort or less per lake to collect data evaluating saugeye stocking success (catch/h of age-0 saugeye in fall night electrofishing). This amount of effort appears insufficient to provide the precision needed to meet standards suggested in the literature. Effort needs to be increased 7-fold to provide estimates $\pm$ 25% of the mean. However, given current time and personnel restraints, an increase in sampling effort of this magnitude may not be practical. Given a catch rate of 30/h, a resonable estimate for saugeye $\leq$ 400 mm in fall night electrofishing (Table 2), a 50% change in the mean could be detected with 7 units of effort. This amount of effort is similar to what is currently being spent. If the objective of the sampling is to evaluate abundance of "large" saugeye, 28 samples would be needed to detect a 50% change in the mean, given a CPUE of 5

is assumed. Decreasing the precision of the abundance estimates dilutes our ability to detect cause and effect relationships. As a result, our ability to refine stocking rates, detect environmental and biological influences on survival, and correlate abundance of "large" saugeye with improvements in crappie population structure would be compromised. CPUE is also one criteria used to prioritize annual saugeye stocking requests (Gilliland and Boxrucker 1995). The lack of precision of historical and future estimates makes objective among lake comparisons of CPUE for prioritization purposes difficult.

VII. Recommendations:

1. Fall night electrofishing samples should be used to evaluate abundance of age-0 and yearling saugeye populations. However, effort needs to be increased substantially (10 hours/lake) to provide estimates of sufficient reliability on which to base management decisions. The amount of electrofishing effort currently being spent is sufficient to detect a 50% change in abundance.

2. Data on "large" saugeye should be collected during the fall night electrofishing sampling. Since habitat type had little influence on sampling efficiency, data on "large" saugeye should also be collected during routine largemouth bass sampling efforts (spring, day time). Continued critical analysis of these data are needed. Hopefully as the precision of the data is improved, sampling protocol for "large" saugeye will be refined.

3. The stocking criteria currently being used (Gilliland and Boxrucker 1995) needs continued updating as refinements in sampling procedures are made.

III. Prepared by: Jeff Boxrucker

Jeff Boxrucker

Biologist III

IV. Date: April 1, 1997

V. Approved by: Harold Namminga

Dr. Harold Namminga

Federal Aid Research Coordinator

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Table 1. Catch per hour (CPUE) and standard error (S.E.) of saugeye by electrofishing by size class from spring and fall samples collected from Holdenville, Jean Neustadt, and Thunderbird Reservoirs, 1996. N=number of samples to obtain $CV_x=0.125$. CPUE's within same column with same letter are not significantly different (t-test; $P<0.05$). Differences across size classes and lakes were not tested.

	≤ 310 mm			≤ 400 mm			> 457 mm			All Sizes		
Season	CPUE	S.E.	N	CPUE	S.E.	N	CPUE	S.E.	N	CPUE	S.E.	N
HOLDENVILLE												
Spring	2.07a	0.49	365	6.56a	0.87	109	1.41a	0.24	589	9.74a	1.11	76
Fall	10.67b	2.35	70	12.33a	2.53	62	0.67b	0.24	1678	14.11a	2.61	55
JEAN NEUSTADT												
Spring	6.93a	1.73	104	7.22a	1.75	100	5.74a	0.83	124	14.04a	2.00	55
Fall	7.56a	1.51	96	9.89b	1.73	75	1.11b	0.47	805	11.28a	1.72	67
THUNDERBIRD												
Spring	11.77a	1.83	64	16.04a	2.26	49	8.94a	1.02	82	31.77a	3.09	28
Fall	8.56a	1.84	85	23.61b	2.91	35	14.44b	1.94	54	45.72b	3.93	21

Table 2. Catch per hour (CPUE) and standard error (S.E.) of saugeye by electrofishing by season and size class from day and night samples collected from Holdenville, Jean Neustadt, and Thunderbird Reservoirs, 1996. N=number of samples to obtain $CV_{\bar{x}}=0.125$. CPUE's within same column with same letter are not significantly different (paired t-test; $P<0.05$). Differences across size classes, lakes, and seasons were not tested.

		≤310 mm			≤400 mm			>457 mm			All Sizes		
Season	Daytime	CPUE	S.E.	N	CPUE	S.E.	N	CPUE	S.E.	N	CPUE	S.E.	N
HOLDENVILLE													
Spring	Day	0.44a	0.27	3171	5.00a	1.15	142	1.44a	0.43	570	8.33a	0.63	87
	Night	5.67b	1.27	126	13.89b	1.73	56	1.67a	0.37	476	18.56b	4.64	43
Fall	Day	0.00a	0.00	.	0.50a	0.28	2624	0.50a	0.28	2624	1.50a	1.72	543
	Night	31.67b	4.71	28	36.17b	4.70	25	0.23a	0.54	1206	39.17b	2.00	23
JEAN NEUSTADT													
Spring	Day	0.89a	0.39	1099	1.00a	0.40	931	5.89a	1.35	121	7.78a	1.58	93
	Night	19.33b	4.54	42	19.89b	4.56	41	8.56b	1.83	85	30.67b	4.60	29
Fall	Day	3.00a	1.00	241	6.67a	1.88	108	2.50a	1.20	294	9.17a	2.12	80
	Night	19.17b	3.32	42	21.67b	3.74	38	0.00b	0.00	.	21.83b	3.71	38
THUNDERBIRD													
Spring	Day	8.33a	3.08	87	12.22a	3..72	62	8.89a	1.40	82	27.67a	4.39	31
	Night	18.82b	2.79	43	24.24b	3.53	35	7.88a	1.76	92	38.94b	5.21	24
Fall	Day	3.50a	1.39	204	18.67a	3.90	43	27.50a	4.56	31	58.50a	7.79	17
	Night	17.83b	4.67	45	39.83b	5.72	23	8.67b	1.01	84	54.50a	5.75	18

Table 3. Catch per hour (CPUE) and standard error (S.E.) of saugeye by day time electrofishing by habitat type (Bass-cove habitat; Saugeye-points and main lake shoreline habitat) and size class from samples collected from Holdenville, Jean Neustadt, and Thunderbird Reservoirs, 1996. N=number of samples to obtain $CV_{\bar{x}}=0.125$. CPUE's within same column for each season with same letter are not significantly different (t-test; $P<0.05$). Differences across size classes, lakes, and seasons were not tested.

		≤310 mm			≤400 mm			>457 mm			All Sizes		
Season	Habitat	CPUE	S.E.	N	CPUE	S.E.	N	CPUE	S.E.	N	CPUE	S.E.	N
HOLDENVILLE													
Spring	Bass	0.11a	0.11	36867	0.78a	0.35	1333	1.11a	0.43	805	2.33a	0.74	319
	Saugeye	0.44a	0.27	3171	5.00b	1.15	142	1.44a	0.37	570	8.33b	1.72	87
Fall	Bass	0.33a	0.23	5114	0.33a	0.23	5114	0.67a	0.28	1678	1.67a	0.59	476
	Saugeye	0.00a	0.00	.	0.50a	0.28	2624	0.50a	0.54	2624	1.50a	0.63	543
JEAN NEUSTADT													
Spring	Bass	0.56a	0.32	2221	0.78a	0.38	1333	2.78a	0.83	262	3.67a	0.96	194
	Saugeye	0.89a	0.39	1099	1.00a	0.40	931	5.89a	1.35	121	7.78a	1.58	93
Fall	Bass	0.50a	0.37	2624	1.33a	0.62	632	0.83a	0.68	1206	2.83a	1.04	256
	Saugeye	3.00b	1.00	241	6.67b	1.88	108	2.50a	1.20	294	9.17b	2.12	80
THUNDERBIRD													
Spring	Bass	8.56a	3.35	85	12.11a	4.17	63	10.00a	2.11	74	29.11a	6.25	30
	Saugeye	8.33a	3.08	87	12.22a	3.75	62	8.89a	1.40	82	27.67a	4.39	31
Fall	Bass	4.33a	1.38	164	12.33a	3.56	62	7.17a	1.40	101	24.17a	4.33	35
	Saugeye	3.53a	1.39	204	18.67a	3.90	43	27.50b	4.56	31	58.50b	7.79	17

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