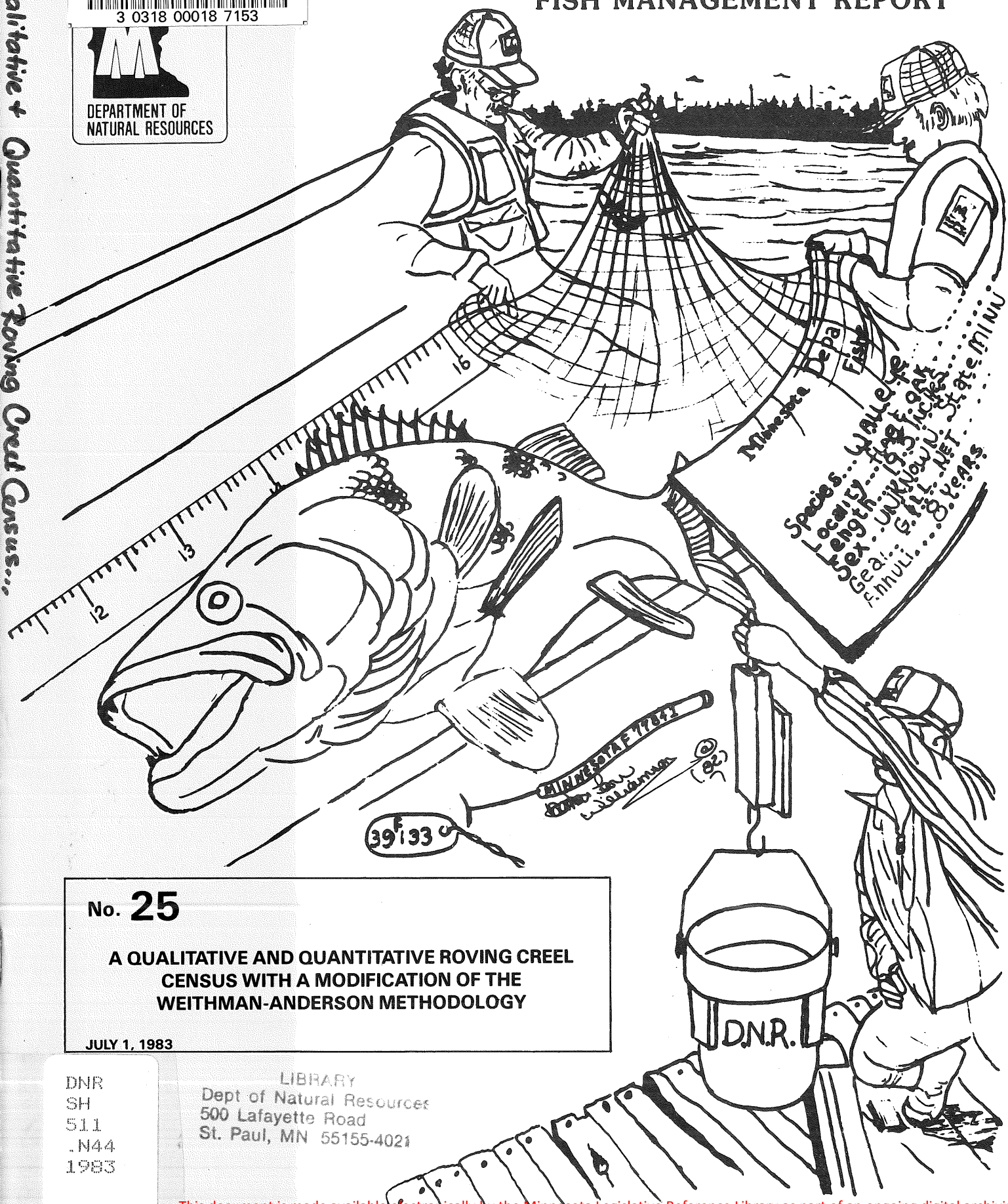
Section of Fisheries

FISH MANAGEMENT REPORT

DEPARTMENT OF NATURAL RESOURCES



No. 25

A QUALITATIVE AND QUANTITATIVE ROVING CREEL CENSUS WITH A MODIFICATION OF THE WEITHMAN-ANDERSON METHODOLOGY

JULY 1, 1983

Division of Fish and Wildlife

A QUALITATIVE AND QUANTITATIVE ROVING CREEL CENSUS WITH A MODIFICATION OF THE WEITHMAN-ANDERSON METHODOLOGY

by

Kit K. Nelson

ABSTRACT

An incompleted trip creel census was completed on eight lakes in Douglas and Pope Counties, Minnesota during 1980. Estimates of fishing pressure, fishing success and harvest were calculated for the summer fishing season. Distance traveled and species preference data were tabulated. Comparisons of data to previous creel census estimates were made. Fishing pressure has increased over 50% on some lakes that were censused during the 1950's. The range of fishing pressure from 20.7 to 78.0 mh/A represents moderate pressure which is consistent with estimates from other geographic areas. Estimates of fishing success are similar to those documented during the 1972 early panfish census for three lakes that were sampled during this census period. The harvest estimates are generally higher than estimates available from earlier time periods. Maple Lake, however, was an exception. The sunfish was greatly reduced as the stunted sunfish were not readily accepted by the anglers. Fishing quality indices for the eight lakes were calculated utilizing a modification of the method developed by Weithman and Anderson (1978). This modification allowed an estimate of the length of northern pike, walleye and sunfish that the average angler determined to be markedly superior to a fish that was one inch less in length.

INTRODUCTION

Increasing pressure on the sport fishery in Pope and Douglas Counties, Minnesota has stimulated local public concern about the status and quality of the fishery. General lake management plans are usually based on indices from test-netting during lake surveys but angler satisfaction and expectations have largely been judged intuitively by fishery managers.

Weithman and Anderson (1978) developed a method to objectively assess angler perceptions of the quality of their fishing. The quality indices are derived by direct input from anglers in relation to their expectations and attitudes that can be evaluated and incorporated into a lake, area wide or regional management plans.

The purpose of this study was to identify trends and effects of increased fishing pressure on typical lakes in the two counties through a quantitative creel census. These results were compared to other lakes and trends throughout the state.

METHODS

The eight lakes (Table 1) selected for creel census work encompassed a diverse sample representative of the waters in the area, were conveniently located to minimize travel time between lakes and were of a size that could be sampled within the time constraints. Availability of past creel census data was also a consideration. The creel census was conducted from 17 May to 25 September 1980.

Table 1. Lakes selected for creel census in Douglas and Pope Counties with identification number and area in acres.

Lake	County	I.D. Number	Area (A)
Andrew	Douglas	21-85	948
Brophy	Douglas	21-102	281
Darling	Douglas	21-80	1,126
Maple	Douglas	21-79	867
Mill	Douglas	21-180	461
Latoka	Douglas	21-106	872
Amelia	Pope	61-64	948
Villard	Pope	61-67	559

Three permanent employees were used as creel census clerks. Each censused approximately one-third of the summer season and worked together for a few days at the time of transition between clerks. The clerks worked an 8 hour day which started at 0600 or 1400 hours. Four lakes were considered a unit, therefore two lake groups (A and B) were established. The starting lake in each group was randomly selected. A sample schedule illustrated in Table 2 provides detail of the design. An additional day off for the creel clerk was selected randomly, when necessary, to maintain an 80 hour pay period. Holidays were given no special treatment and were worked according to the schedule.

An incompleted trip creel census method developed by Daley and Skrypek (1964) was used to cover the large area that was sampled. Upon

TABLE 2. Sample time schedule illustrating rotational scheduling and alternating lake groups for the May 1980 period.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						17 a b c A-1 C_1
18 a b c B-1 C_1	19 a b c A-1 C_2	20 a b c B-1 C_2	21 Day Off	22 Day Off	23 a b c A-2 C_1	24 a b c B-2 C_1
25 a b c A-2 C_2	26 a b c B-2 C_2	27 a b c A-3 C_1	28 a b c B-3 C_1	29 Day Off	30 Day Off	31 a b c A-3 C_2

a = lake group (A) or (B)

b = starting lake (1-4)

c = sampling period
C_1 0600-1400 hours
C_2 1400-2200 hours

arrival at the scheduled lake, the clerk would traverse the entire lake by boat and count fishing boats, boat anglers, shore anglers and recreational watercraft in appropriate categories. The boat counts were treated as instantaneous counts for calculation purposes.

Interviews were conducted following the instantaneous counts. As many interviews as possible were conducted in the 80 minutes on each lake. The clerk alternated starting points on each lake to minimize bias and made an effort to contact distinguishable groups of boats so that each grouping would be represented in the sample. The following information was collected for each interview: time of interview; if the trip was completed; time the angler started fishing; home town of each angler; number of anglers; species sought; and numbers and weight of all fish creeled by species for each angler. All fish were measured, unless there were large numbers of panfish, in which case subsamples were measured to minimize the time spent on each interview. Total weights of individual species were tallied.

The calculations for fishing pressure, success and harvest were calculated for each 14 day period and then summed to provide estimates for the season. Fourteen day periods were chosen to provide the opportunity for future comparisons.

Total fishing pressure in the period was estimated using the following formula:

Total fishing manhours in period = Total hours in census period X

$$\frac{\text{Total anglers counted}}{\text{Number of instantaneous counts}}$$

Estimates of total pressure were based on daylight fishing hours. Random starting times as described by Hawkinson and Krosch (1972) would be an alternate method for time scheduling. The systematic method used here provided estimates consistent with those from a completed trip creel census by Newburg (Unpublished 1980) on a similar lake in the area.

Fishing success is expressed as catch of fish/manhour. This rate was calculated by period for all species combined and for selected individual species. The formulas used are as follows:

$$\text{Fish caught/hour} = \frac{\text{Total tallied numbers caught}}{\text{Total hours fished}}$$

Fish caught/hour of selected species =

$$\frac{\text{Total tallied number of selected species caught}}{\text{Hours spent fishing for that species (from angler interviews)}}$$

The percentage of successful anglers was also calculated. A successful angler was defined as one who had caught and kept at least one fish.

The total number of each species harvested was estimated using the following formula:

Number of each species harvested = Catch rate x Estimated total manhours fished

Total weight harvested for each species was calculated by multiplying the estimated number of harvested fish of each species by the average weight of that species. Estimates of harvest were calculated by period and then summed to provide the season estimates.

The method of evaluating fishing quality based on angler attitudes

was modified from Weithman and Anderson (1978).

The following questions were asked:

How important (desirable) is:

a) Catching a particular kind of fish?

b) The size of fish you catch?

c) The number of fish you catch?

d) Catching more than one different kind of fish?

e) Catching and releasing fish? [1]

f) Catching (the individual fish creeled)?

One angler/boat was queried for each boat contacted unless fishing pressure was light, then more than one angler/boat was queried. Only responses from anglers who creeled fish or indicated catching and releasing fish are meaningful for the calculation of trip quality (TQ). Some bias is introduced when questioning more than one angler in a party.

Anglers were provided with a 5 x 9 inch index card with a brief, direct explanation of the response system. The responses sought ranged from 1 to 5 with (1) being very important and desirable, to (5) being unimportant or undesirable. Both the standard questions and the individual fish creeled were rated using the same system.

Asking the anglers opinion of the individual fish creeled is a deviation from the Weithman and Anderson (1978) method. The response obtained from the angler for each creeled fish is substituted for the rating of the species caught (in general). This modification includes

---

[1] It was our experience that a majority of the anglers failed to understand the concept of catch and release fishing without an exhaustive explanation. I therefore chose not to evaluate the worth of catch and relase fishing.

a judgment of the value of the species creeled as well as an instantaneous judgment as to how meaningful that particular fish was to the angler at the time of the interview. This modification allows for interpretation of the data for fish creeled of a particular size and allows for analysis of data for particular "groups" of anglers.

Numerical responses to the preceding questions that relate to tabled values derived by Weithman and Anderson (1978) provide the necessary components to calculate fish quality (FQ), harvest quality (HQ) and trip quality (TQ). The equations used are as follows:

Fish Quality (FQ) = (X) (W)

X = (table value^2) standard point value of each fish derived from its relationship to the world record fish;
W = weight (kg) of fish;

Harvest Quality (HQ) = (FQ) (L) (S)

FQ = the point value of an individual fish creeled by a particular angler (above);
L = (table value^2) the combination of importance of catching a particular size fish as to the fish actually caught;
S = (table value^2) the importance of catching a particular species as to the response for the particular fish (a modification);

Trip Quality (TQ) = $\frac{(A)+D(M-1)^N (CQ)}{T}$

CQ = the relative quality of a particular fishing trip for a particular angler for all fish caught that trip; (CQ = HQ in this study)
A = total fish caught;
D = (table value^2) importance of diversity;
M = number of different species caught;
N = (table value ^{2}) importance of number of fish caught;
(ΣCQ) = sum of all points for all fish caught;
T = time spent fishing at the time of the interview.

A complete explanation of the method and derivation of the components of the formulas can be found in Weithman and Anderson (1978).

Trip quality (TQ) for a given angler is a measure of the value of the fish creeled or caught and released during that trip in relation to that angler's expectation of a quality creel. The mean value of the TQ points over a period of time provide a base line to measure relative changes in the fish community as perceived by the angler. Mean TQ values were recorded by bi-monthly periods so that appropriate comparisons of data from short-term censuses could be made in the future. The values for average fish quality (FQ) and harvest quality (HQ) were also examined. Changes in the average values of FQ and HQ associated with a particular species were evaluated in relation to changes in TQ.

Overall fishing quality (Q) describes the overall quality of the fishery for all anglers (Weithman and Katti 1979). The $\log_{10}$ of the average TQ is multiplied by the percent of the successful anglers to estimate Q for each lake. Successful anglers are defined as those who had a TQ of 1 or larger (Weithman and Anderson 1978). The value TQ was used to compare lakes.

RESULTS

Fishing pressure on the eight sampled lakes was considered to be moderate. Estimates ranged from 20.7 to 78.0 manhours/acre (mh/A) with the mean weighted value for all lakes being 46.3 mh/A (Table 3). Fishing pressure increased by 161 and 53%, respectively at Andrew and Maple lakes since the 1950's (Table 4) (Larson 1961).

---

2 See Weithman and Anderson (1978)

Fishing success for the 8 sampled lakes (all species combined) ranged from 0.51 to 1.47 fish/mh (Table 5). Success rates for anglers who were actively seeking a particular species ranged from 0.22 to 3.07 fish/mh (Tables 6a-6h). Success rates for anglers by species for non-directed effort ranged from 0.01 to 1.06 fish/mh (Table 7). The percent of successful anglers, anglers who caught at least one fish, ranged from 44.1 to 67.3% (Table 8). Five metro area lakes had a range from 39.5 to 49.9% (Tureson 1978).

Estimates of harvest for the eight Douglas and Pope County lakes censused in 1980 were generally near or above estimates reported for the 1950's and 1960's (Tables 9, 10 and 11). Walleye harvest from Maple and Andrew Lakes increased approximately 3.5 times from the 1950's to the 1980's (Table 12). Northern pike harvest increased more than 11-fold for Andrew Lake but was virtually unchanged for Maple Lake while sunfish harvest from Maple Lake decreased over 300%. The decreased harvest of sunfish was reflected in the 31% decrease in the overall harvest estimate in Maple Lake compared to the 1952-58 average. The percentage reduction is even greater when compared to the 1952 or 1953 estimates.

A majority of anglers traveled at least 15 miles to fish. Lakes with large, well-known or numerous resorts can be identified by the percentage of anglers that traveled a longer distance (Table 13). Nonresident anglers comprised 22.6% of the total anglers interviewed for all censused lakes with Iowa, Illinois and Nebraska accounting for 78% of these nonresident anglers. Darling and Maple lakes were heavily used by anglers from the metropolitan area while Latoka Lake, with limited resort facilities, was fished primarily by local anglers.

Table 3. Estimated fishing pressure in manhours on eight lakes in Douglas and Pope Counties, 17 May - 25 September 1980.

Lake	County	Pressure (mh)	mh/A
Andrew	Douglas	48,250	50.9
Brophy	Douglas	21,920	78.0
Darling	Douglas	46,550	41.3
Maple	Douglas	34,650	40.0
Mill	Douglas	35,160	76.3
Latoka	Douglas	18,020	20.7
Amelia	Pope	48,310	51.0
Villard	Pope	27,510	49.2

Table 4. Comparison of fishing pressure success in pounds/manhour and number/manhour for Maple and Andrew Lakes for three sampling periods, 1952-58, 1955, 1980.

Lake	Year	Northern pike	Walleye	Largemouth bass	Sunfish	Black crappie	Total	Pressure (mh/A)
Andrew	1955	0.03(0.02)	0.05(0.03)	0.06(0.05)	0.23(0.53)	0.07(0.09)	0.47(0.77)	19.5
Andrew	1980	0.14(0.10)	0.07(0.07)	0.02(0.02)	0.17(0.39)	0.01(0.02)	0.38(0.63)	50.9
Maple	1952,58	0.17	0.03	0.09	0.27	0.02	0.65	26.1
Maple	1980	0.07	0.06	0.04	0.04	0.09	0.56	40.0

Table 5. Overall success rate (fish/manhour) for all species by two week interval for eight Douglas and Pope County lakes, 17 May to 25 September 1980.

Lake	Period									Weighted mean all periods
	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	
Amelia	0.39	0.29	0.84	2.75	1.00	0.61	0.91	0.41	0.46	0.80
Andrew	0.27	0.21	0.69	0.62	1.22	0.88	0.45	0.31	0.16	0.53
Brophy	0.80	1.15	1.10	1.97	1.61	0.56	2.43	1.93	1.69	1.47
Darling	0.28	0.77	0.52	0.81	0.97	0.91	1.74	0.92	0.21	0.79
Maple	0.58	0.62	0.38	1.02	0.72	0.26	0.22	0.49	1.37	0.63
Mill	0.44	0.48	0.60	0.44	0.34	0.55	0.76	0.52	0.51	0.51
Latoka	0.84	0.85	0.83	0.87	0.84	1.13	0.52	0.48	-[a]	0.71
Villard	1.04	0.93	1.08	1.04	3.76	0.86	0.78	0.84	1.00	1.26

[a] <10 interviews were conducted during the time period.

Table 6a. Success of anglers (fish/manhour) fishing for selected species, 17 May to 25 September 1980 in Amelia Lake.

Species	Period									Mean [a] success
	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	
Northern pike	0.29	-	-	-	0.40	0.27	2.00	-	0.65	0.72
Walleye	0.18	0.53	-	-	0.17	0.40	-	-	0.32	0.32
Largemouth bass	-	-	-	-	0.44	-	0.89	0.26	-	0.53
Sunfish	-	0.50	1.22	6.22	2.53	1.49	1.09	-	-	2.18
Black crappie	-	-	-	1.94	0.89	0.36	-	-	-	1.06

Table 6b. Success of anglers (fish/manhour) fishing for selected species, 17 May to 25 September 1980 in Andrew Lake.

Species	Period									Mean [a] success
	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	
Northern pike	0.45	0.31	0.12	0.52	0.44	0.91	1.43	0.11	1.00	0.59
Walleye	0.25	0.09	0.80	0.14	0.67	0.73	0.50	0.17	0.50	0.43
Largemouth bass	-	-	-	-	-	-	-	-	-	-
Sunfish	0.19	1.20	0.38	1.46	2.11	3.17	-	-	-	1.42
Black crappie	-	-	-	-	-	0.80	-	-	-	0.80

[a] Mean of periods with entries only.

Table 6c. Success of anglers (fish/manhour) fishing for selected species, 17 May to 25 September 1980 in Brophy Lake.

Species	Period									Mean [a] success
	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	
Northern pike	0.73	0.43	0.40	-	-	1.33	1.14	1.00	-	0.84
Walleye	-	-	-	-	-	-	-	-	-	-
Largemouth bass	-	0.50	-	-	-	0.17	-	-	-	0.33
Sunfish	1.89	2.41	1.01	2.81	5.06	4.00	2.61	2.93	1.96	2.74
Black crappie	-	-	1.27	2.17	1.41	-	-	-	-	1.62

Table 6d. Success of anglers (fish/manhour) fishing for selected species, 17 May to 25 September 1980 in Darling Lake.

Species	Period									Mean [a] success
	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	
Northern pike	0.18	0.30	0.44	0.63	-	0.35	0.50	-	-	0.40
Walleye	0.11	-	-	-	-	-	-	-	0.57	0.34
Largemouth bass	-	-	0.17	0.53	-	0.22	-	0.73	0.22	0.37
Sunfish	-	4.80	1.33	2.15	2.00	2.60	4.89	1.20	-	2.71
Black crappie	-	1.0	0.87	0.98	0.25	-	-	-	-	0.78

Table 6e. Success of anglers (fish/manhour) fishing for selected species, 17 May to 25 September 1980 in Latoka Lake.

Species	Period									Mean [a] success
	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	
Northern pike	0.51	-	-	0.89	-	-	0.33	-	-	0.58
Walleye	1.13	0.12	0.15	-	-	-	-	0.41	-	0.45
Largemouth bass	-	0.23	-	-	1.87	0.45	0.56	-	-	0.78
Sunfish	1.14	5.50	5.33	-	2.24	1.14	-	-	-	3.07
Black crappie	1.08	-	-	1.00	-	-	-	-	-	1.04

Table 6f. Success of anglers (fish/manhour) fishing for selected species, 17 May to 25 September 1980 in Maple Lake.

Species	Period									Mean [a] success
	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	
Norther pike	0.36	0.68	-	2.67	-	0.68	-	0.28	-	0.93
Walleye	0.32	0.26	0.38	1.07	-	0.36	0.34	-	-	0.45
Largemouth bass	0.22	-	-	-	-	-	-	-	-	0.22
Sunfish	-	2.32	1.68	4.96	1.75	-	-	0.92	2.80	2.41
Black crappie	1.46	-	0.67	0.84	1.40	0.73	-	-	-	1.01

Table 6g. Success of anglers (fish/manhour) fishing for selected species, 17 May to 25 September 1980 in Mill Lake.

	Period									
Species	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	Mean success [a]
Northern pike	0.39	0.30	0.18	0.38	0.35	0.50	0.57	-	0.53	0.40
Walleye	0.26	0.47	-	-	0.06	2.67	0.67	0.36	-	0.75
Largemouth bass	-	0.55	-	-	-	-	0.44	-	-	0.49
Sunfish	1.22	1.03	2.73	1.48	0.88	1.18	3.00	4.00	-	1.94
Black crappie	-	-	0.57	-	-	-	-	-	-	0.57

Table 6h. Success of anglers (fish/manhour) fishing for selected species, 17 May to 25 September 1980 in Villard Lake.

	Period									
Species	May 17-31	June 1-15	June 16-30	July 1-15	July 16-31	Aug 1-15	Aug 16-31	Sep 1-15	Sep 16-25	Mean success [a]
Northern pike	0.56	0.54	0.22	0.67	-	0.15	0.33	0.47	0.55	0.44
Walleye	0.18	0.36	-	-	-	-	-	-	-	0.27
Largemouth bass	-	0.27	-	-	-	-	-	-	-	0.27
Sunfish	3.83	2.00	2.80	1.29	4.22	1.38	5.33	0.33	-	2.65
Black crappie	2.29	6.86	1.24	2.50	-	-	-	-	-	3.22

Table 7. Overall fishing success rate (fish/manhour) for eight Douglas and Pope County lakes for the summer fishing season, 17 May to 25 September, 1980.

Species	Lake								
	Amelia	Andrew	Brophy	Darling	Maple	Mill	Latoka	Villard	Mean (all lakes)
Northern pike	0.07	0.10	0.10	0.07	0.08	0.12	0.06	0.14	0.09
Walleye	0.04	0.07	-[a]	0.01	0.05	0.05	0.04	0.01	0.04
Largemouth bass	0.02	0.02	0.03	0.08	0.04	0.01	0.16	0.01	0.05
Sunfish	0.71	0.32	1.06	0.44	0.30	0.31	0.48	0.63	0.53
Black crappie	0.13	0.02	0.18	0.08	0.09	0.01	0.08	0.14	0.09

[a] Sample size (n) less than 4

Table 8. Number and percent (in parenthesis) of successful anglers (anglers who caught and kept at least one fish) for eight Douglas and Pope County lakes by period, 17 May to 25 September 1980.

Period	Amelia	Andrew	Brophy	Darling	Latoka	Maple	Mill	Villard
May 17-31	66(43.1)	77(42.6)	25(53.8)	31(30.5)	38(54.6)	46(36.0)	45(52.3)	68(67.1)
June 1-15	27(20.0)	51(30.6)	42(64.2)	47(52.6)	53(56.9)	48(43.4)	40(49.1)	33(53.4)
June 16-30	37(38.8)	38(43.5)	57(52.2)	50(52.7)	14(43.7)	69(28.1)	73(38.7)	41(53.0)
July 1-15	63(55.7)	57(51.4)	47(53.0)	63(58.2)	13(38.0)	46(45.4)	74(25.2)	53(56.8)
July 16-31	39(59.7)	48(63.0)	40(63.3)	39(54.6)	33(35.7)	31(45.2)	42(38.4)	15(100)
August 1-15	58(42.8)	54(98.4)	21(58.3)	49(42.4)	35(58.9)	67(37.7)	30(47.0)	60(51.7)
August 16-31	30(47.7)	18(50.0)	17(87.5)	16(72.8)	23(55.5)	17(43.7)	30(65.6)	23(45.4)
Sept. 1-15	15(43.7)	17(66.6)	16(83.3)	18(55.0)	7(54.0)	25(75.0)	8(40.0)	16(78.5)
Sept. 16-25	13(78.5)	6(25.0)	10(66.6)	12(50.0)	2(-)	3(50.0)	11(70.0)	5(100)
Mean % (All periods)	(47.8)	(46.8)	(64.7)	(52.1)	(44.1)	(44.9)	(47.4)	(67.3)

Table 9. Estimated harvest, number and pounds (in parenthesis), for eight Douglas and Pope County lakes, 17 May to 25 September 1980.

Lake	Species						
	Northern pike	Walleye	Largemouth bass	Sunfish	Black crappie	Misc. species	All species combined
Amelia	3,087 (5,013)	1,968 (1,720)	1,373 (1,708)	37,785 (9,767)	7,645 (4,240)	1,397 (456)	53,255 (22.904)
Andrew	4,779 (6,890)	3,488 (3,380)	1,012 (1,204)	18,743 (5,606)	725 (465)	1,421 (797)	30,168 (18,342)
Brophy	3,139 (3,694)	-	636 (602)	24,603 (6,110)	3,368 (1,664)	404 (308)	32,150 (12,378)
Darling	3,675 (6,324)	262 (290)	3,429 (2,825)	20,446 (4,529)	3,349 (1,642)	1,366 (632)	32,527 (16,237)
Maple	2,473 (3,723)	1,984 (2,178)	1,039 (1,256)	10,869 (1,483)	3,135 (1,497)	76 (76)	19,576 (10,213)
Mill	4,199 (5,339)	2,434 (2,809)	427 (756)	10,964 (3,914)	176 (155)	283 (172)	18,483 (13,145)
Latoka	1,141 (2,007)	1,017 (901)	2,285 (2,049)	7,653 (1,708)	2,422 (1,218)	446 (134)	14,964 (8,017)
Villard	4,993 (8,409)	260 (378)	163 (236)	21,253 (4,863)	3,969 (1,603)	326 (268)	30,964 (15,757)

Table 10. Estimated harvest in pounds/A for eight Douglas and Pope County lakes, 17 May to 25 September 1980.

Lake	Northern pike	Walleye	Largemouth bass	Sunfish	Black crappie	Misc. species	All species combined
Amelia	5.3	1.8	1.8	10.3	4.5	0.5	24.2
Andrew	7.3	3.6	1.3	5.9	0.5	0.8	19.4
Brophy	13.2	-	2.1	21.7	5.9	1.1	44.1
Darling	5.6	0.3	2.5	4.0	1.5	0.6	14.4
Maple	4.3	2.5	1.5	1.7	1.7	0.1	11.8
Mill	11.6	6.1	1.6	8.5	0.3	0.4	28.5
Latoka	2.3	1.0	2.4	2.0	1.4	0.2	9.2
Villard	15.0	0.7	0.4	8.7	2.9	0.5	28.2

Table 11. Harvest estimates for the summer fishing season in number and pounds/A (in parenthesis) for similar lake groups for four time periods (1953, 1954, 1955, 1980).

Year	Mean harvest estimates				
	Northern pike	Walleye	Largemouth bass	Sunfish	Black crappie
1953 [a]	2.2(3.8)	1.4(1.8)	0.4(0.6)	9.9(3.0)	4.3(1.9)
1954 [b]	1.6(3.4)	1.4(1.9)	0.4(0.7)	10.3(3.4)	4.3(1.8)
1955 [c]	2.1(4.1)	0.6(1.0)	1.5(1.9)	20.7(5.0)	13.6(4.2)
1980	4.5(6.8)	1.8(1.9)	1.7(1.8)	25.1(5.5)	4.1(2.1)

Table 12. Comparison of harvest estimates (pounds/A) between Maple and Andrew Lakes for three time periods (1952-58, 1955 and 1980).

Lake	Years	Northern pike	Walleye	Largemouth bass	Sunfish	Black Crappie	Other	Totals
Andrew	1955	0.65	1.02	1.11	4.52	1.38	0.64	9.32
Andrew	1980	7.27	3.57	1.27	5.91	0.49	0.84	19.35
Maple	1952-58	4.60	0.70	2.30	7.10	0.50	1.80	17.00
Maple	1980	4.29	2.51	1.45	1.71	1.73	0.09	11.77

Angler preferences for species sought appeared to be a function of both the lake type and the resort facilities available. The public's perception of a particular lake was reflected by the indicated preference for a given species (Table 14). There was an inverse relationship in species preference for walleye or northern pike between adjoining Amelia and Villard Lakes. Maple Lake is promoted as a walleye lake and walleye was the principal species sought.

Fishing quality data incorporates the anglers attitudes in evaluating the worth of various sizes of creeled fish. The mean fish quality (FQ) and harvest quality (HQ) data establishes the relationship between FQ and HQ for each lake (Table 15). Mean TQ values are the result of the calculation utilizing all the variables associated with the interview (Table 16). This data will be considered as base line information for future evaluations. Overall fishing quality (Q) provides an index to compare the relative quality of fishing in different lakes over a given time period. The Q index incorporates anglers who were unsuccessful (TQ<1) and is an indicator of the fishery as a whole. The values for Q for the eight lakes sampled and their relative positions show the similarities and differences between lakes (Figure 1). The relative positions of the plotted values show the relationship between percent success and TQ. Brophy and Latoka Lakes have similar Q values 0.38 and 0.40, respectively.

Mean TQ values varied between groups of anglers. TQ values for local anglers and nonresident anglers were compared (all lakes combined) and a significant difference existed ($P<0.025$) between the TQ of the average local and average nonresident anglers.

Table 13. Distance traveled by anglers who fished eight Douglas and Pope County lakes expressed as a percent of the total for each lake, 17 May to 25 September 1980.

Lake	Miles traveled									
	0 [a]	1-15	16-40	41-65	66-90	91-115	116-165	166-225	>225	Total nonresidents [b]
Amelia	11.4	10.8	7.4	6.3	12.8	19.4	25.6	1.7	4.6	5.5
Andrew	7.9	11.4	0.8	3.5	6.2	8.4	38.6	4.9	18.2	21.2
Brophy	14.6	17.6	0.7	1.0	5.1	4.0	22.3	2.9	31.5	31.9
Darling	4.7	9.3	1.9	1.2	3.1	4.0	40.8	5.0	30.0	32.5
Maple	5.7	2.3	1.1	3.4	9.5	10.9	40.5	5.2	21.1	25.4
Mill	5.6	6.2	2.8	3.7	9.9	9.1	29.6	5.9	26.7	28.7
Latoka	20.7	29.6	3.8	2.8	0.5	2.3	22.1	2.8	15.4	17.3
Villard	3.8	6.4	4.8	8.3	12.8	15.3	32.6	7.7	8.3	13.7

[a] Lake shore residents

[b] Percentage of anglers who reside in states other than Minnesota

Table 14. Indicated preference of anglers (%) for various species of fish on eight Douglas and Pope County lakes, 17 May to 25 September 1980.

Species	Lake								
	Amelia	Andrew	Brophy	Darling	Latoka	Maple	Mill	Villard	All lakes combined
Northern pike	9.1	7.6	12.1	9.5	5.2	8.5	15.4	22.5	11.2
Walleye	25.6	39.0	3.0	12.8	26.0	30.1	14.2	7.8	20.5
Largemouth bass	3.7	1.7	4.5	8.1	14.6	5.9	6.1	2.3	5.4
Sunfish	9.8	15.1	29.5	12.8	8.3	7.8	27.0	24.0	16.7
Crappie	11.6	0.6	13.6	14.9	5.2	10.5	1.4	7.8	8.1
Combination [a]	29.3	23.2	31.8	32.5	29.3	28.0	20.3	26.3	27.5
Walleye and northern pike	10.3	11.6	3.8	4.7	3.1	7.2	14.2	9.3	8.4
Largemouth bass and northern pike	0.5	1.2	1.5	4.7	8.3	2.0	1.4	0.0	2.2

[a] People who indicated combination were fishing for more than one species.

Table 15. Mean fish quality (FQ) and harvest quality (HQ) (in parenthesis) values for eight Douglas and Pope County lakes, 17 May to 25 September 1980.

Lake	Species						
	Northern pike	Walleye	Largemouth bass	Sunfish	Black crappie	Yellow perch	Bullhead
Amelia	1.34(8.45)	0.64(3.81)	0.73(4.62)	0.17(1.10)	0.41(2.53)	0.20(0.87)	0.80(4.74)
Andrew	1.06(6.64)	0.74(4.18)	0.78(2.86)	0.21(1.44)	0.67(3.75)	0.14(0.77)	0.99(0)
Brophy	0.98(6.65)	-	0.62(3.87)	0.19(1.30)	0.34(2.76)	0.98(0)	0.62(4.59)
Darling	1.38(9.08)	0.52(3.32)	0.69(5.20)	0.16(1.05)	0.45(3.37)	0.09(0)	1.29(6.44)
Maple	0.97(6.09)	0.87(6.69)	0.91(5.31)	0.08(0.54)	0.49(4.04)	-	-
Mill	0.85(4.02)	1.13(7.66)	1.01(8.23)	0.27(2.02)	1.19(14.57)[a]	0.16(0.65)	0.83(5.25)
Latoka	1.11(6.56)	2.62(29.33)	0.73(5.73)	0.10(0.93)	0.46(3.47)	-	-
Villard	1.13(8.33)	0.59(3.15)	0.87(3.76)	0.14(0.91)	0.26(1.58)	0.13(0.62)	1.86(0)

[a] Sample (n) <5.

Table 16. Mean trip quality (TQ) for eight Douglas and Pope County lakes, 17 May to 25 September 1980

Lake	Period 1 May 17-31	2 June 1-15	3 June 16-30	4 July 1-15	5 July 16-31	6 Aug 1-15	7 Aug 16-31	8 Sep 1-15	9 Sep 16-25	Mean (all periods)
Amelia	2.95	2.57	4.07	5.69	3.47	2.64	17.93	2.24	11.86	6.35
Andrews	3.42	3.53	3.17	4.22	3.49	4.03	9.35	7.06	-	3.97
Brophy	5.71	7.02	5.18	5.35	3.09	6.08	17.41	13.53	9.06	7.37
Darling	3.47	3.66	5.37	4.08	7.39	8.77	47.37	9.96	0.66	9.27
Maple	3.44	3.84	2.94	5.03	1.48	3.82	13.52	3.47	1.20	3.98
Mill	8.67	4.84	5.19	3.84	3.27	3.40	7.88	13.42	5.03	5.77
Latoka	2.78	6.26	13.14	7.40	3.68	5.52	4.05	2.86	-	5.21
Villard	4.60	6.13	4.76	4.09	8.37	2.99	11.92	5.97	6.19	5.34

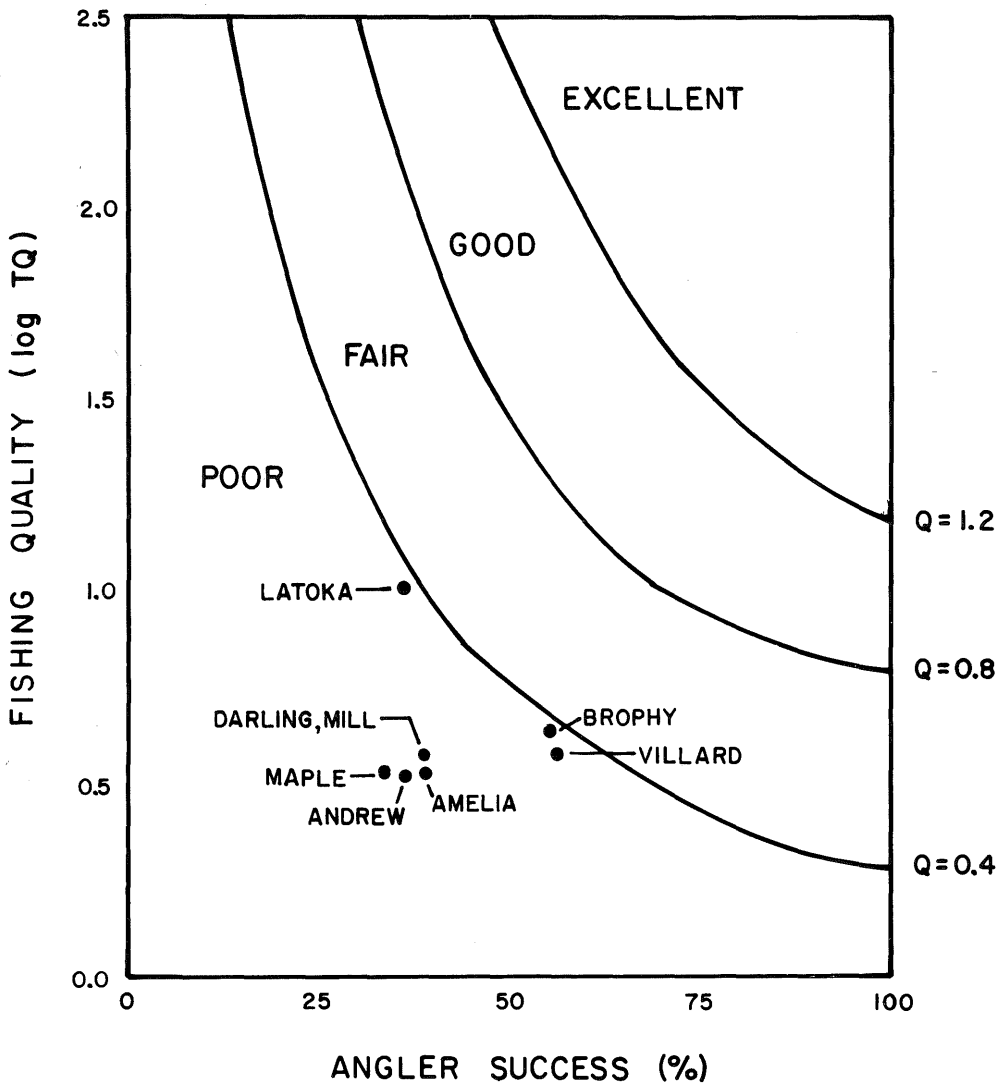


Figure 1. Criteria for evaluation of fisheries management. The overall quality of fishing as measured by Q is a function of the level of benefits (average $\log_{10}$ TQ of successful anglers) and the distribution of benefits (% of successful anglers).

DISCUSSION

Fishing pressure has increased but would be considered moderate in relation to other state waters. The range of the fishing pressure estimates brackets an average increase in pressure of over 50% from estimates made on some of the same lakes during the 1950's. However, fishing pressure estimates from seven similar lakes sampled by Johnson and Kuehn (1950) compare favorably to the pressure estimates of the 1980 creel census. The average fishing pressure value for the seven lakes sampled in 1950 was 47.1 mh/A while an average fishing presure estimate of 36.4 mh/A was reported for five metropolitan area lakes (Tureson 1978). These favorable comparisons suggest that fishing pressure in Douglas and Pope Counties has increased to levels similar to those documented for other geographic areas and times.

The catch rates associated with increased fishing pressure for all lakes combined (Table 7) compare favorably with estimates calculated for similar lakes sampled in the mid-1950's (Moyle and Franklin 1954; Johnson 1957). Fishing success estimates from the 1972 early panfish census were very similar to the 1980 estimate for Brophy, Latoka and Maple Lakes (Toup, Kucera and Hawkinson 1977). Estimates of success for five metro area lakes were generally lower for the summer fishing season of 1977 (Tureson 1978).

The result of increased fishing pressure and stable average success has resulted in higher average harvests. However, the total estimated harvest for Maple Lake is less than the estimate for the 1952-58 time period. This departure from the trend of increasing harvest is a result of a lower sunfish harvest. The size of the sunfish in Maple Lake has decreased to the extent that anglers are

reluctant to creel the fish. Success and harvest estimates for walleye in Maple and Andrews Lakes have increased. This is probably the result of intensive management efforts that resulted in a population structure weighted toward smaller fish which are easier to catch. The resort community has also advertised the lake as a walleye lake, resulting in their clientele seeking walleye.

The popularity of open water angling in Pope and Douglas Counties has resulted in a high percentage of anglers traveling at least 16 miles to fish. It is not known if the proportion of non-local "tourist" anglers to local anglers has changed over recent years. If the ratio has shifted toward tourist anglers, it is likely that fishing pressure comparisons will be difficult as tourist anglers tend to realize lower TQ values than local anglers. A combination of factors are probably responsible for the lower average TQ values. Tourist anglers are less likely to be familiar with the lake; tend to angle more non-prime fishing hours than local anglers; and are less flexible in choosing when they fish.

Species preference data were generally quite consistent and probably are representative of other area lakes. Sunfish, walleye and northern pike were the three species most frequently selected when an individual species was indicated. Combination fishing was the most popular response. "Combination" anglers are more likely to have creeled sunfish and northern pike than other species. Largemouth bass was last in the preference ranking for all lakes combined. One would expect the percentage of bass preference to increase in the future as bass fishing popularity grows. The success rate for anglers who indicated they were fishing for a particular species generally showed

higher values than the average catch rate for all anglers.

To better understand the relationship between fish quality and angler attitudes as the size of fish increased, I plotted the mean FQ against the mean HQ for northern pike, walleye and sunfish using data from all survey lakes. It appears that the data for each of the three species could best be described by a curvilinear relationship but for practical purposes two intersecting straight lines adequately describes the intermediate zone (Figs. 2, 3 and 4). Linear regressions of the pairs of lines were significant ($P \leq .025$) in all cases. The transition zone where the two lines intersected and the slopes changed occurred over a range of one inch for all three species. I defined this as the Mean Attitude Transition Zone (MATZ). The MATZ was also within the 30% difference of FQ that was necessary for Weithman and Katti (1979) to predict the angler's preferences. The maximum HQ might be realized by management measures that provided a population structure that included as many fish as possible larger than the size associated with MATZ.

Management of fish populations so that a majority of the individuals are above the MATZ (Figs. 2, 3 and 4) is usually not possible on a sustained level. Manipulation of one or more species within a community under special circumstances, however, might be possible, thus improving the average quality of creeled fish. The result would yield higher TQ values and a higher overall Q value, provided the catch rate is not severely reduced. Snow (1978) suggests catch rate may not suffer by some reduction in abundance. A balanced population structure will guarantee that a reasonable percentage of desirable sized game fish will be available for harvest at any one time and promote stability within the population.

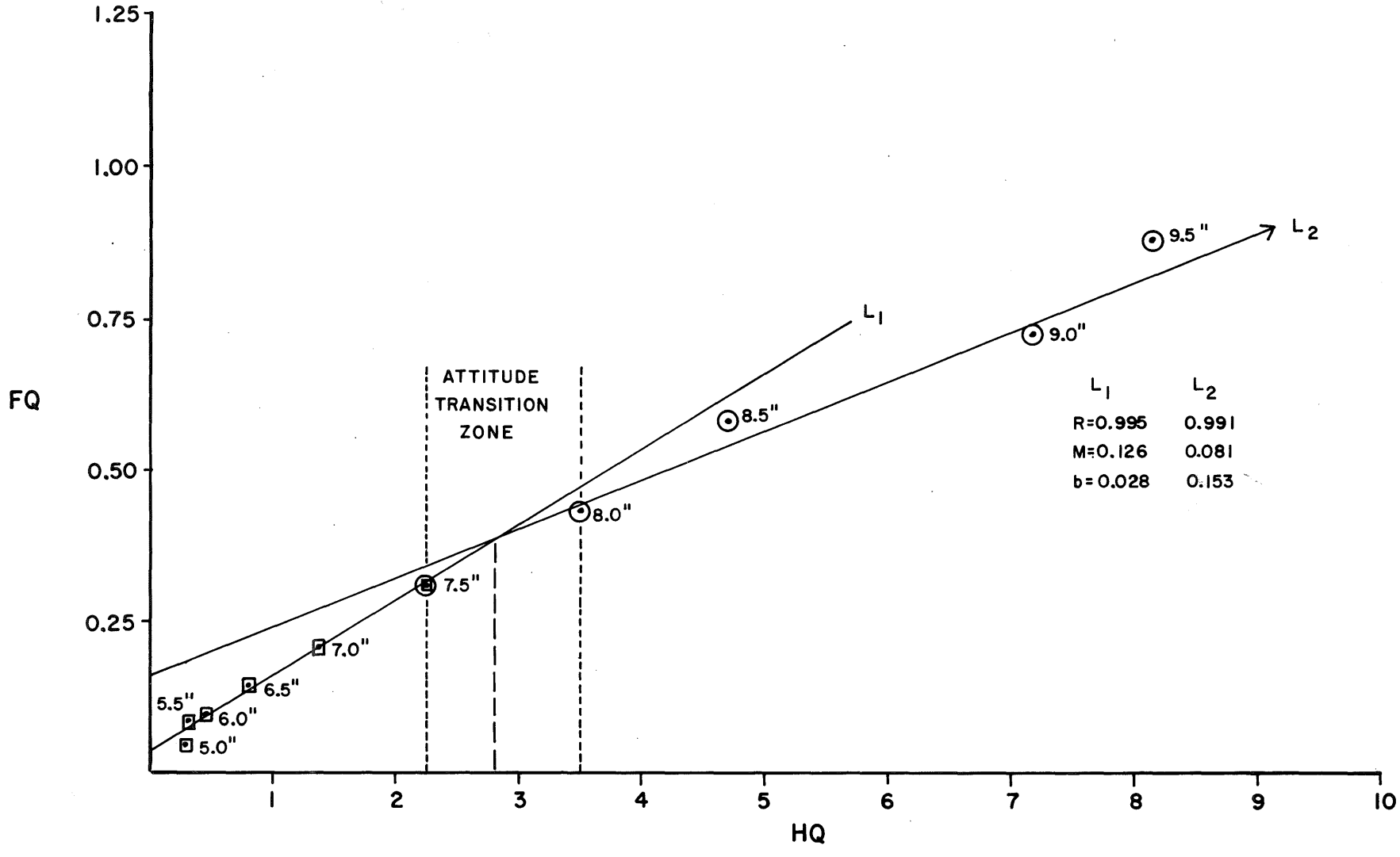


Figure 2. Relationship of mean FQ versus mean HQ for sunfish for all lakes combined at given lengths in inches. In the body of the figure, Line L_1, L_2 intersect and identify the Mean Attitude Transition Zone as defined by adjacent points.

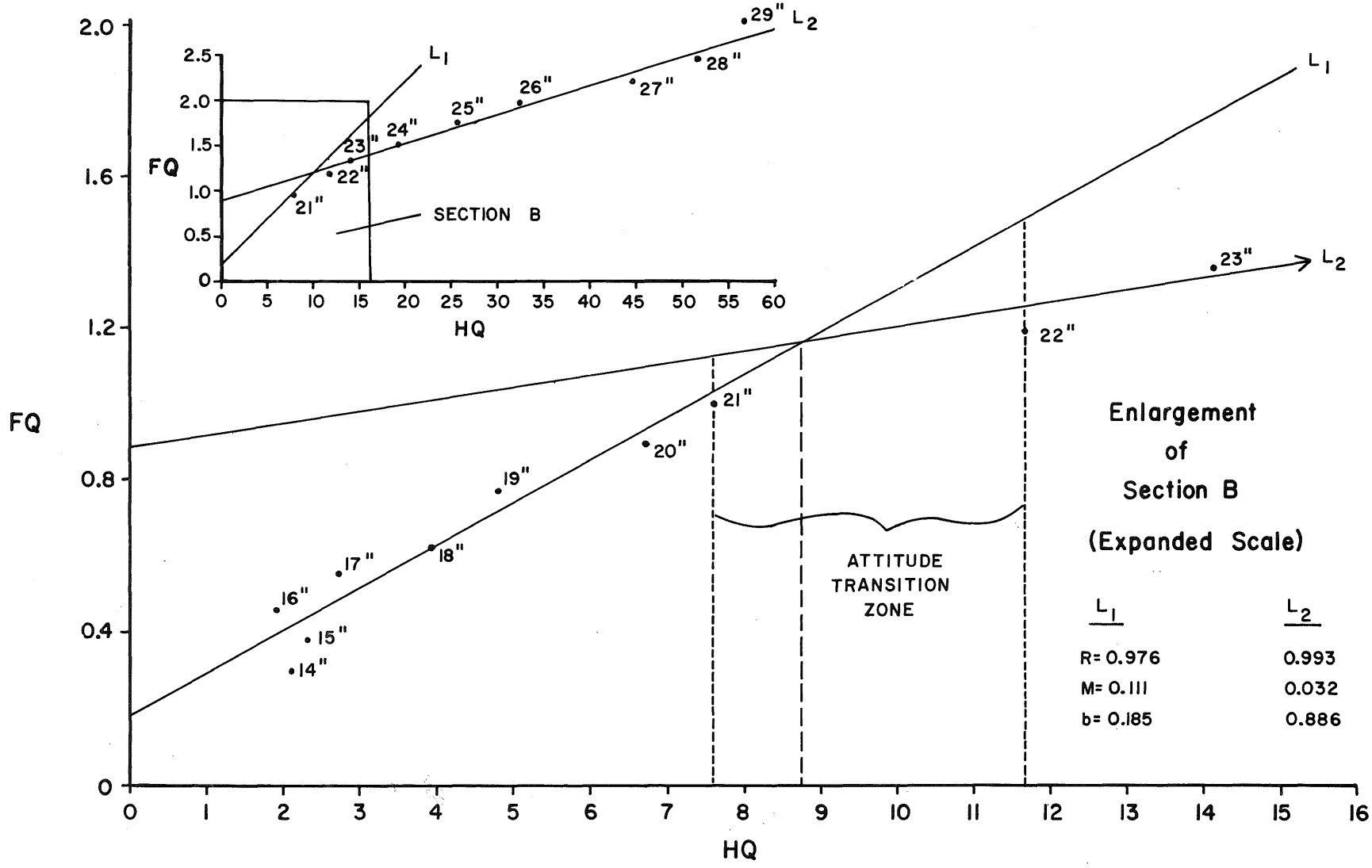


Figure 3. Relationship of mean FQ versus mean HQ for northern pike for all lakes combined at given lengths in inches. In the body of the figure, Line L_1, L_2 intersect and identify the Mean Attitude Transition Zone as defined by adjacent points.

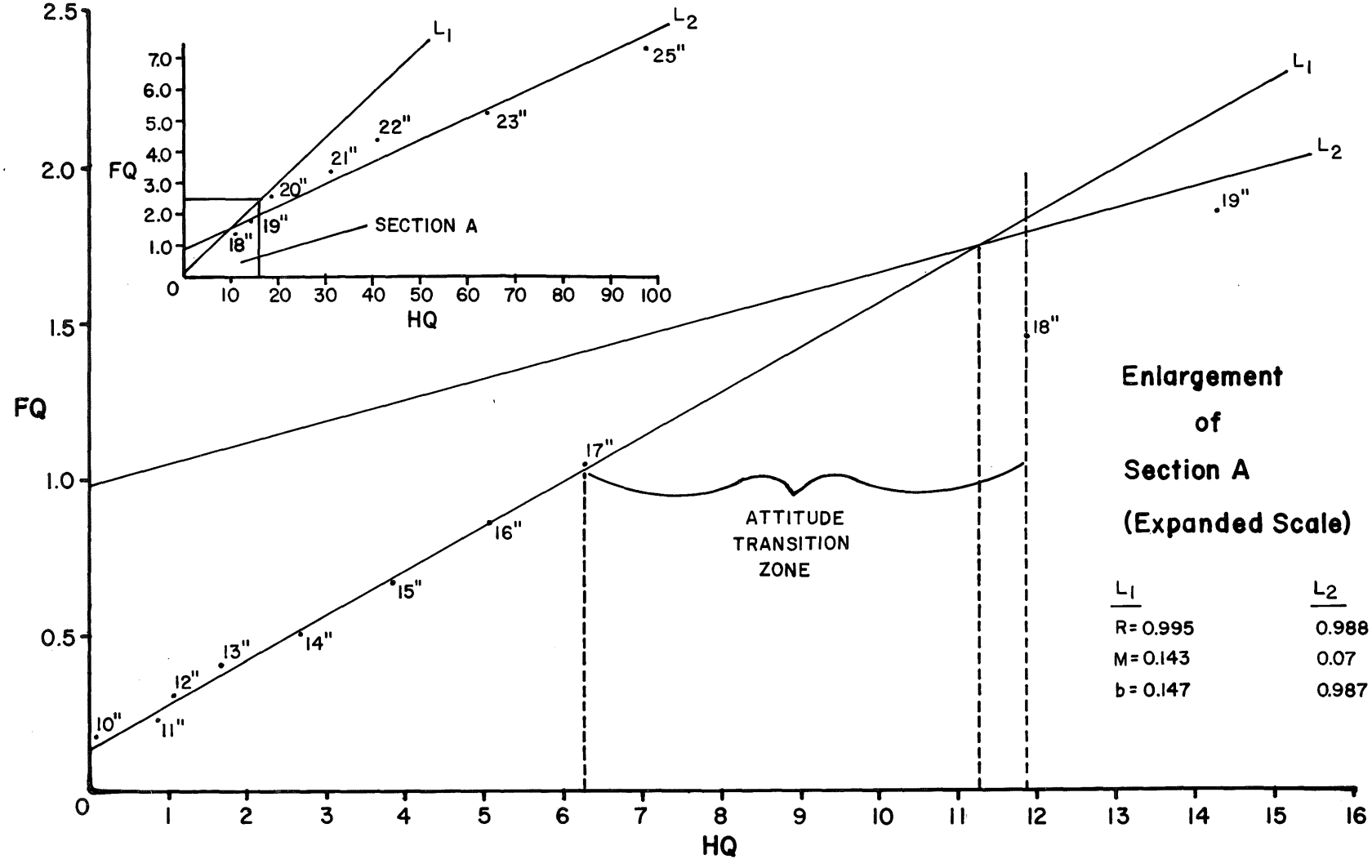


Figure 4. Relationship of mean FQ versus mean HQ for walleye for all lakes combined at given lengths in inches. In the body of the figure, Line L_1, L_2 intersect and identify the Mean Attitude Transition Zone as defined by adjacent points.

Individual species can contribute heavily to high TQ values. For example, Lake Brophy had an overall catch rate of 1.1 sunfish/mh which was the major species creeled. The mean TQ for the season was 7.37, the second ranked lake of the 8 sampled. It is reasonable to assume that sunfish were the major species contributing to this relatively high TQ value.

Disproportionately large numbers of small predators appear to contribute little to increase the TQ. In the case of Lake Andrew, there is reason to suspect that an abundant walleye population is not producing high TQ values. This can be explained by the relatively low fishing success rate and the low average HQ of the creeled walleye. An attempt to improve fish quality might be more meaningful than any attempt to increase standing crop. The test net index for Lake Andrew from the 1980 lake survey provided a mean of 14.8 walleye/gillnet lift. In this case, reduced stocking might be considered which could improve the proportional stock density (Anderson 1978) as well as improve the management benefit-cost ratio.

The major factor contributing to the TQ value for Brophy Lake was the high percent of successful anglers. In contrast, the TQ value was the larger factor responsible for Latoka Lake having a high Q value. Some adjustments of the curves may be necessary to better represent local definitions of fishing quality (poor, fair, good, excellent) and to adjust for the modification of the method. Improvement in the Q can be accomplished either by increasing the proportion of successful trips or the average TQ or a combination of the two (Fig. 4). Decisions as to how this could be most efficiently accomplished should incorporate all available data. Relative abundance and length frequency distri-

butions for each species from test-netting and creel census information should be considered. Potential anglers that might enter the fishery if desirable species were available should also be considered.

When relative abundance of a species is judged to be adequate, a management approach to improve the TQ value might include manipulation of the size of the fish creeled. This approach may be limited by the nature of the natural history of some species but would probably be appropriate for northern pike management where spawning areas are limited or controllable. The study conducted on Lake Harriet in the metropolitan area would suggest that an improved size structure might be attained by adjusting density (Ed Feiler, MN DNR, personal communication 1981). Winter kill lakes would also be good candidates for manipulating fish size structure. The results of such efforts could be measured with standard test-netting procedures and a short-term creel census to evaluate the anglers' perception of the altered fishery. Some sacrifice in catch rate could be more than adequately compensated by increasing the TQ generated by the anglers' satisfaction with his creel.

One further effect of a reduced standing crop of northern pike might be to open the niche for other predators. The increase in abundance or weight of other predators should help reduce the effect of the reduced harvest rates of northern pike.

ACKNOWLEDGEMENTS

I wish to thank Dennis Schupp and Paul Wingate for technical advice and editing of this paper.

LITERATURE CITED

Anderson, R.D. 1978. A concept of balance for coolwater fish populations. Am. Fish. Soc. Spec. Pub. 11:371-381.

Daley, S., and J. Skrypek. 1964. Angler creel census of pools 4 and 5 of the Mississippi River, Goodhue and Wabasha Counties, Minnesota, 1962-63. Minn. Dept. of Nat. Res., Div. Fish Wildl., Sect. Fish. Invest. Rep. No. 227.

Hawkinson, B., and H.F. Krosch. 1972. Annual report of the statewide creel census on 80 lakes and 38 trout streams in Minnesota, May 1971 - Feb. 1972. Minn. Dept. Nat. Res., Div. Fish Wildl., Sect. Fish. Invest. Rep. No. 319.

Johnson, M.W. 1957. Annual report of statewide creel census of 14 Minnesota lakes under Dingell-Johnson project F-4-R April 1, 1956 to March 31, 1957. Minn. Dept. Nat. Res., Div. Fish. Wildl., Sect. Fish. Invest. Rep. No. 183.

Johnson, M.W., and J.H. Kuehn. 1956. Statewide creel census of 14 Minnesota lakes. Minn. Dept. Nat. Res., Div. Fish Wildl., Sect. Fish. Invest. Rep. No. 174.

Larson, G. 1961. A creel census of Lake Andrew, Douglas County. Minn. Dept. Nat. Res., Div. Fish Wildl., Sect. Fish Invest. Rep. No. 229.

_____. 1961. A six-year study of the population and catch on a west-central Minnesota bass-panfish lake, Maple Lake, Douglas County. Minn. Dept. Nat. Res., Div. Fish Wildl., Sect. Fish. Invest. Rep. No. 236.

Moyle, J.B., and D.R. Franklin. 1954. Creel census of 12 Minnesota lakes Dec. 1, 1952 to Dec. 1, 1953. Minn. Dept. Nat. Res., Div. Fish Wildl., Sect. Fish. Invest. Rep. No. 146

_____. 1955. Creel census of 12 Minnesota lakes, Dec. 1, 1953 to Dec. 1, 1954. Minn. Dept. Nat. Res., Div. Fish Wildl., Sect. Fish. Invest. Rep. No. 159.

Snow, H.E. 1978. Responses of northern pike to exploitation in Murphy Flowage, Wisconsin. Am. Fish. Soc. Spec. Publ. No. 11:320-327.

Torp, B.L., T.A. Kucera, and B.W. Hawkinson. 1977. Annual report of the statewide creel census on 83 lakes and 35 trout streams in Minnesota, April, 1972 - February, 1973. Minn. Dept. Nat. Res., Div. Fish Wildl., Sect. Fish. Invest. Rep. No. 339.

Weithman, S.A., and R.O. Anderson. 1978. A method for evaluating fishing quality. Fisheries 4(3):6-10.

Weithman, S.A., and S.K. Katti. 1979. Testing of fishing quality indices. Trans. Am. Fish. Soc. 108:320-325.

DNR SH 511 .N44 1983
Nelson, Kit K.
A Qualitative and
quantitative roving creel

BACK COVER.....

FISH MANAGEMENT REPORTS

No. 17 A Quantitative Creel Census of Upper Red Lake, Minnesota, 1977-78, by Dennis C. Johnson and Tracy L. Close. August 1979.

No. 18 A Creel Census and Water Use Study of Waconia Lake, Carver County, by Bruce Gilbertson. January 1980.

No. 19 A Quantitative Creel Census of Upper Red Lake, Minnesota, 1978 and 1979, by Dennis C. Johnson. April 1980.

No. 20 Effects of an Extended Winter Season on the Fishery of Stream Trout Lakes in Northeastern Minnesota, by C. Mark Heywood. May 1980.

No. 21 An Electrofishing Survey of a Portion of Pool 2 Mississippi River from Lock and Dam No. 2 (R.M. 8150 to Upper Grey Cloud Island R.M. 827), by Edward L. Feiler. July 1980.

No. 22 A Water Surface Use Study of Twenty One Metro Area Lakes, by Bruce Gilbertson. July 1980.

No. 23 A Quantitative Roving Creel Census and Angler Profile of the 1979-80 Winter Fishing Season on the St. Louis Estuary, by Jeff Crosby. July 1980.

No. 24 A Water Surface Use Study of Forty-Eight Metro Area Lakes, May 16-September 19, 1980, by Bruce Gilbertson. July 1980.