STUDY PERFORMANCE REPORT

State: Michigan **Project No.:** F-35-R-23

Study No.: 668 **Title:** Guidelines for the interpretation of lake surveys.

Period Covered: April 1, 1997 to March 31, 1998

Study Objective: Relative to sampling fish in lake surveys, to: (1) evaluate gear selectivity and provide guidelines for the interpretation of fish catches; (2) develop standards for interpreting population and community attributes such as length-frequency, age-frequency, percent legal/acceptable size, catch-per-effort (CPE), percent species composition, etc.; (3) develop concepts and databases to facilitate comparison of key attributes among lakes statewide and among lakes of the same type; (4) develop, in conjunction with (2) and (3), guidelines for diagnosing fishery problems; (5) develop, if feasible, and index of biotic integrity (IBI) or a similar system for evaluating Michigan lakes which will serve as an indicator of environmental quality and change; and (6) guide application of the above as an interactive computer tool.

Summary: This study was amended to extend for another year. Originally, only Job 4 was scheduled for this year. However, all jobs were extended, so this report includes work done on all jobs. Analysis focused on the relationships among population size, catch-per-unit-effort (CPE) and angling quality. Selected data sets from lakes with intensive population studies culminating in mark-recapture population estimates were the preferred and primary sources of information. The most extensive search was made for walleye data. Generally, mark-recapture population estimates were not closely or proportionally related to trap net CPE. Most graphs had considerable scatter, indicating trap net CPE is not a very good predictor of population size. The best regressions were obtained for walleye and bluegill. The limited angling data indicate even weaker relationships to population size and CPE except for bluegill.

Job 1. Title: Gear selectivity.

Findings: Selectivity of fishing gear and resulting biases in perceptions of community composition and population size structure were reviewed in last year's report. That analysis included comparison of catches for nine gear types and seven species of warm- and cool-water fishes to "known" abundance based on mark-recapture estimates. No additional analysis was made this year.

Job 2. Title: Develop standards.

Findings: Standards are needed for evaluating and comparing species populations and communities. Analysis this year focused on the utility of catch-per-unit-effort (CPE). CPE represents the combined effects of population density, gear selectivity, and daily and seasonal variation in catchability. If CPE is a close correlate to population density—given type of gear and season—then CPE data can be converted to density estimates and standards for interpretation are potentially useful.

The relationship between density of fish and CPE was examined by comparing mark-recapture population estimates for larger (exploitable) sizes to CPEs of trap nets. The bulk of the data was provided by long-term studies at Manistee Lake and Jewett Lake (Laarman 1980; Laarman and Ryckman 1980; Laarman and Schneider 1986; Schneider 1995 and unpublished data). One data set was also available for fyke nets. The relationship between angling quality and CPE of trap nets was also examined. Angling quality was measured in terms of number of fish harvested per acre and catch per hour. Angling data came mostly from on-site creel census directed by research personnel; some data came from the "general creel census', which was a less random method of interviewing conducted by conservation law enforcement officers in the 1930s-1950s.

Walleye.—Pertinent Michigan data falls into three groups (Tables 1-3). Table 1 lists some very old trap net data collected during sucker harvesting operations by commercial fishermen from 1937 to 1956. They used large Great Lakes nets, lifted at irregular intervals of several days, in a variety of seasons. Thus those walleye CPEs are difficult to compare to CPEs of typical surveys (Tables 2 and 3). Note that angling quality, as measured by walleye catch/hour in the general creel census, generally increased along with net CPE, but not proportionately.

Table 2 lists some catch data from Lake Gogebic (spawning run) and miscellaneous other waters. These are not easily compared to data in the other tables.

Table 3 lists better quality data obtained from lakes in which intensive population studies were conducted over several to many years. The data for Manistee Lake, a large lake with a small to modest walleye population, indicate a proportional linear relationship between trap net CPE and mark-recapture population estimates, with modest scatter (Figure 1). However, angling quality in terms of walleye caught/hour (and also walleye caught/acre—not shown) did not closely relate to trap net CPE. The data for Jewett Lake, a very small lake in which walleye density has varied from zero to very high, also indicate a linear relationship between trap net CPE and mark-recapture population estimates (Figure 1). However, that regression line extrapolates through the Y-axis at a population of 4.0 walleye/acre instead of zero. The reason for that is not understood. Fishing quality was not predictable from trap net CPE, but the lake does not attract many walleye anglers and the walleye are usually difficult to catch. (The exceptionally high catch of 0.62 walleye per hour at Jewett Lake occurred the first time walleyes were exposed to angling).

Pooling all the data in Table 3 produced the logarithmic regression line in the top panel of Figure 2. This figure indicates neither trap net CPE nor angling success are linearly related to population size. This contrasts with Beard *et al*. (1977) who reported a nearly proportional relationship between walleye population density and angling catch/hour for a large set of Wisconsin lakes.

Smallmouth bass.—A small population occurred in Manistee Lake. It was not accurately estimated by either nets or creel census. No relationship between mark-recapture population estimates and trap net CPE or angling quality was evident in those data (Figure 3).

Northern pike.—A small population occurred in Manistee Lake. There was a weak relationship between the population estimate and trap net CPE (Figure 3).

Pumpkinseed.—The population varied extensively in Manistee Lake and a strong relationship between mark-recapture population estimates and trap net CPE was evident (Figure 4).

Black crappie.—A small adult population varied between 1 and 5 fish/acre in Manistee Lake. A positive relationship between population estimates and trap net CPE occurred (Figure 4).

Bluegill.—The populations in both Jewett and Manistee lakes varied widely. Strong linear relationships are evident between mark-recapture population estimates and both trap net CPE and angling catch/hour are evident (Figure 5).

Yellow perch.—The populations in both Jewett and Manistee lakes varied considerably. Mark-recapture population estimates were strongly related to trap net CPE, even though perch are relatively difficult to net in many lakes (Figure 6).

Rock bass.—A small population lived in Manistee Lake. Surprisingly, trap net catch was not a good predictor of population size, even though rock bass seem to net readily. Their recapture rate is usually high.

Job 3. Title: Develop IBI.

Some pertinent life history information were summarized and a tentative organizational scheme was developed. A meeting with other ecologists working on lake classification is scheduled for July 1998.

Job 4. Title: Prepare reports.

This progress report was prepared.

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Date: March 31, 1998

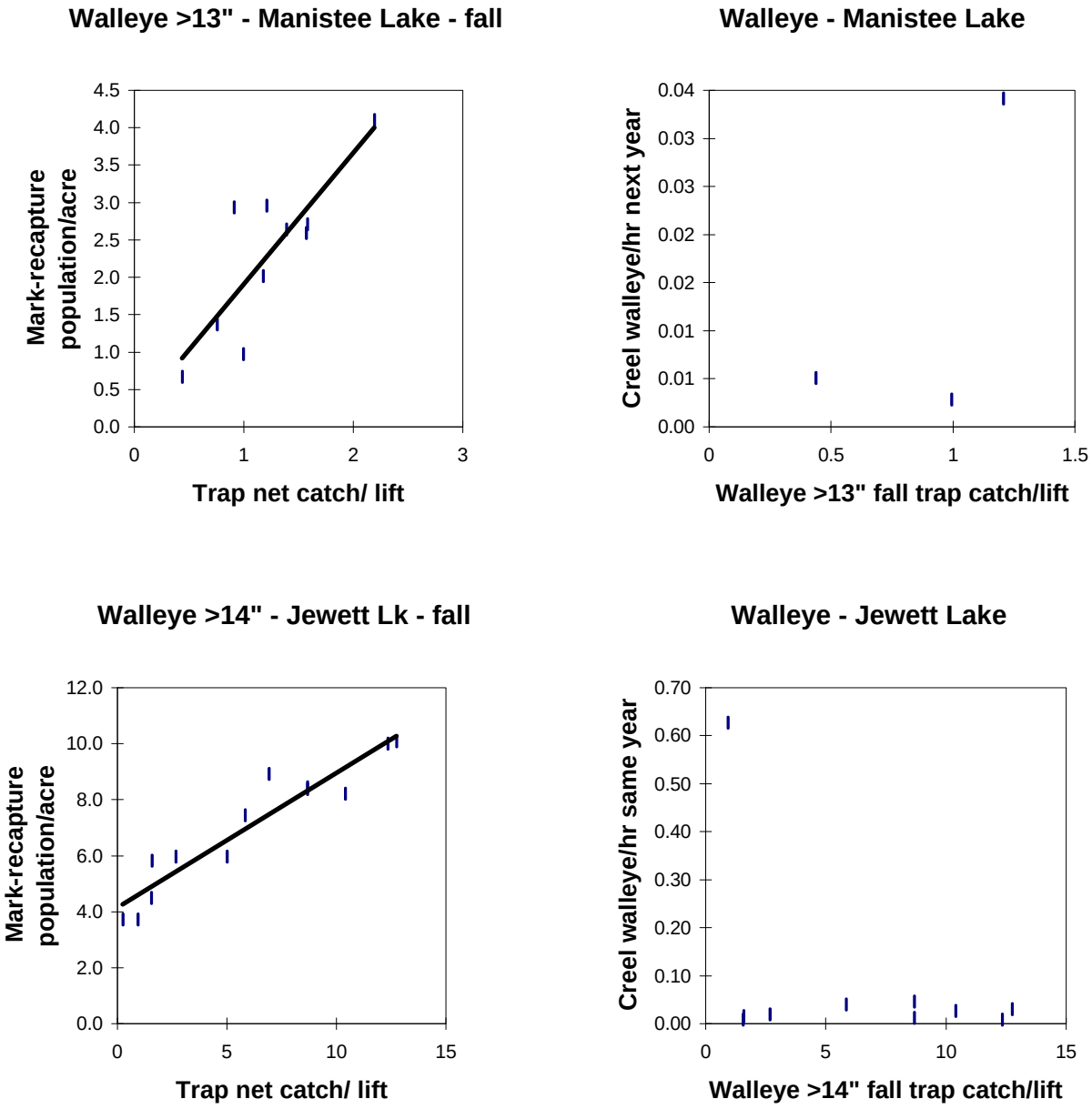
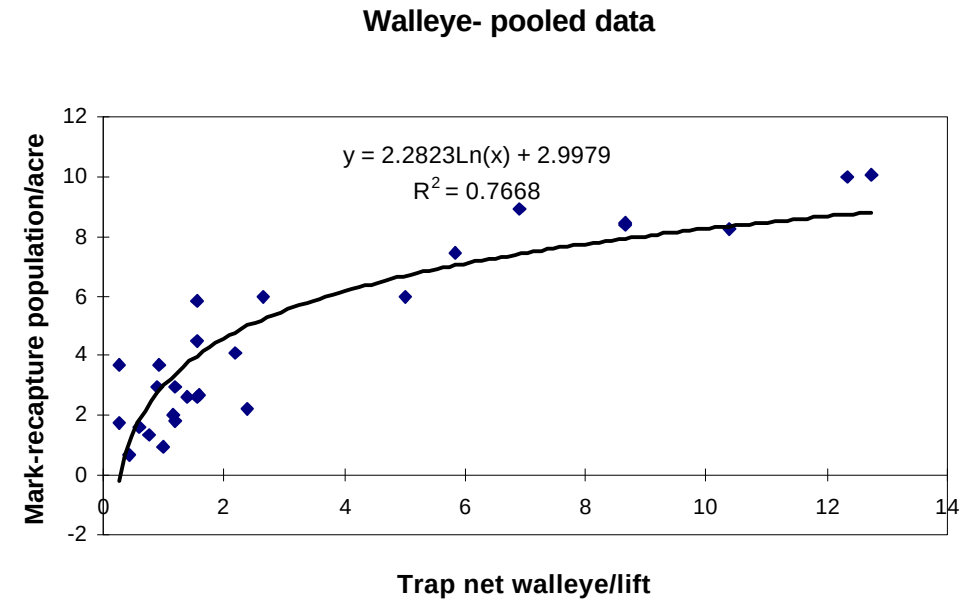


Figure 1.--Relationships for walleye among trap net CPE, mark-recapture estimates of population density, and creel census estimates of walleye angling quality at Manistee Lake and Jewett Lake. (Data from Table 3).



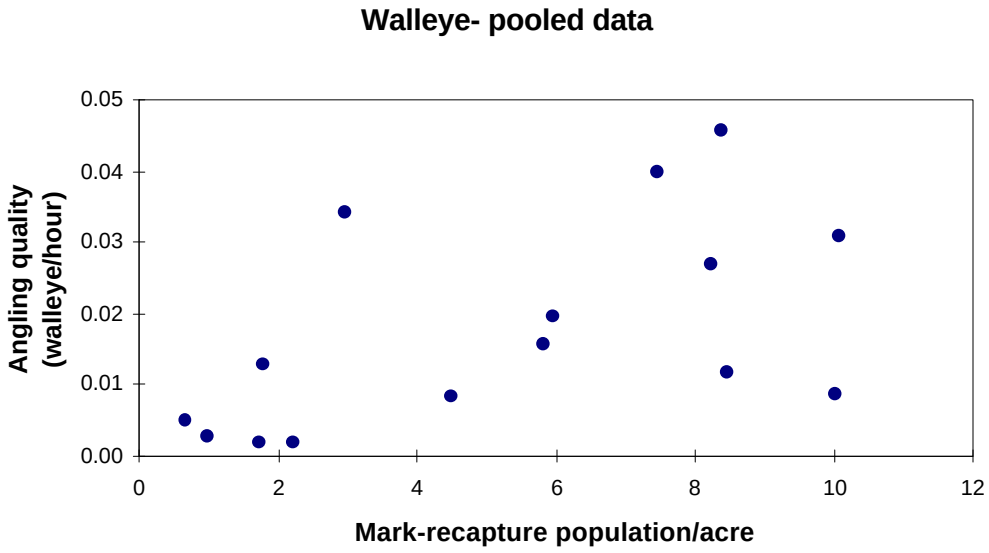


Figure 2.—Relationship for pooled walleye data (Table 3) of mark-recapture estimates of density to trap net CPE and angling quality as catch per hour.

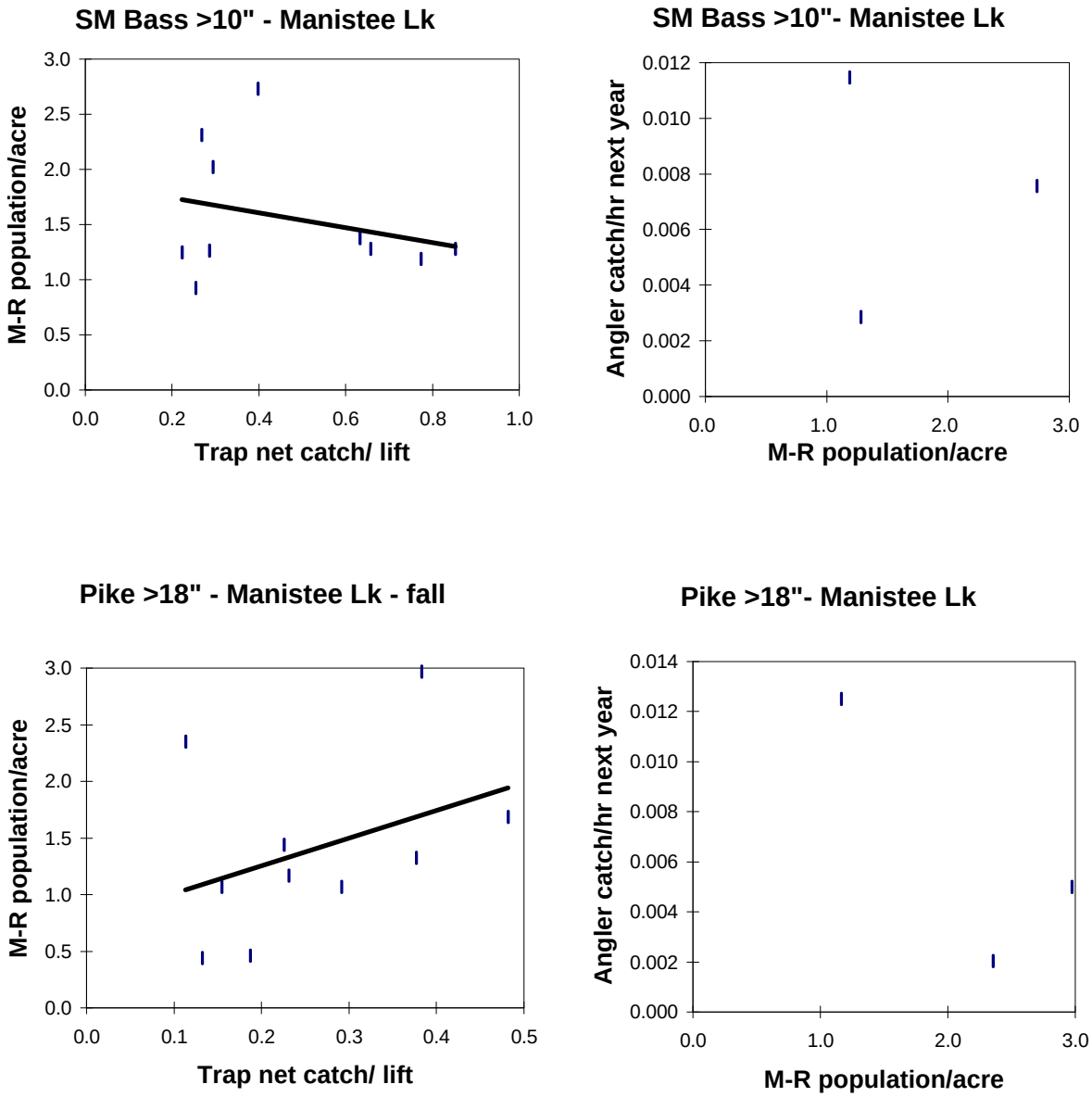


Figure 3.—Relationships for smallmouth bass and northern pike among trap net CPE, mark-recapture estimates of population density, and creel census estimates of angling quality at Manistee Lake.

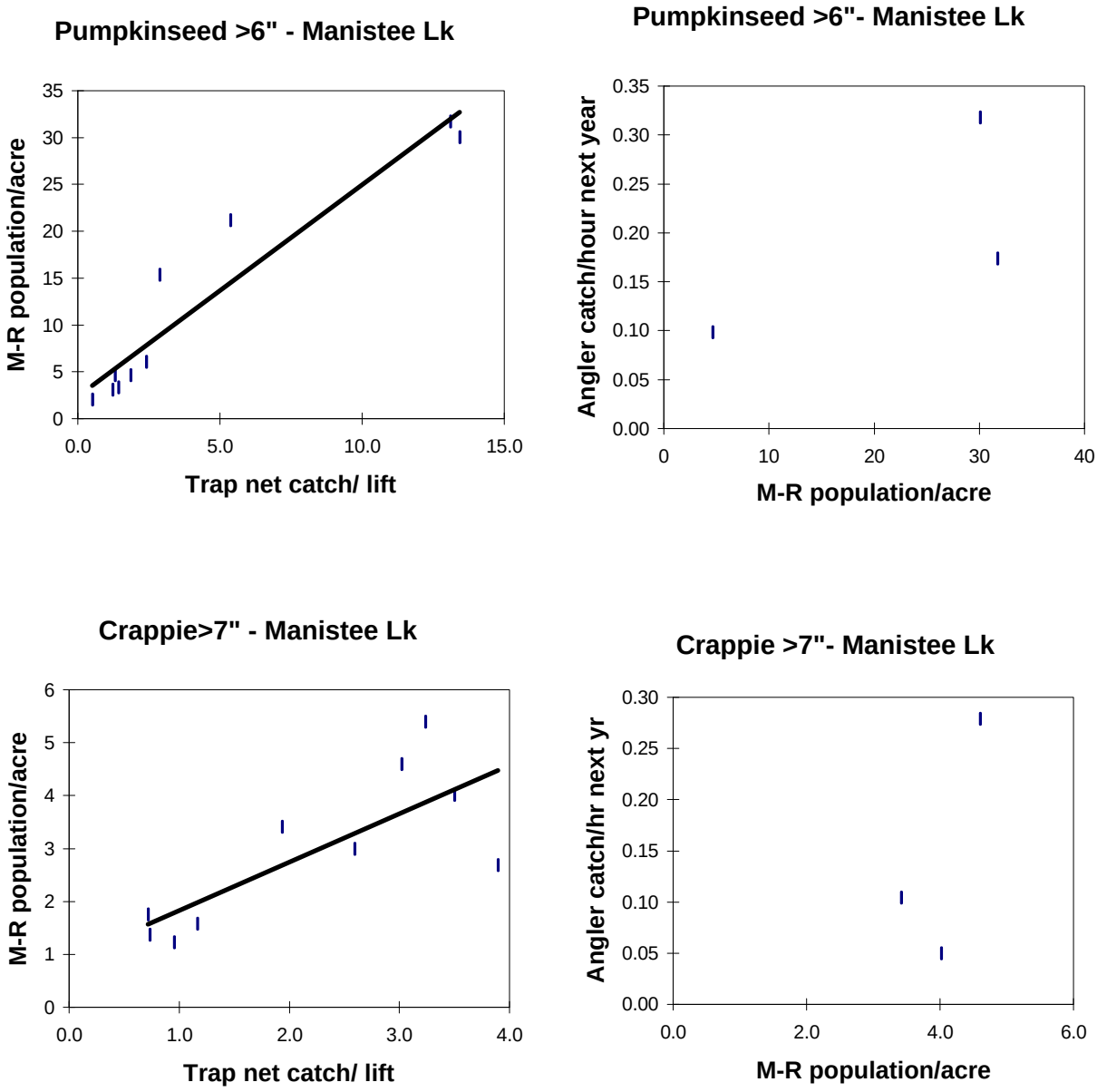
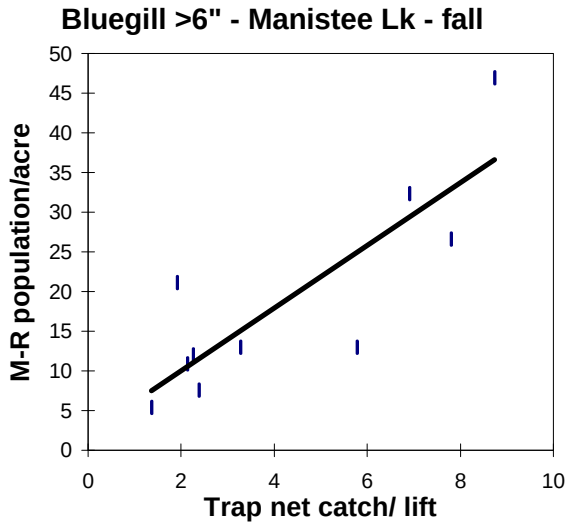
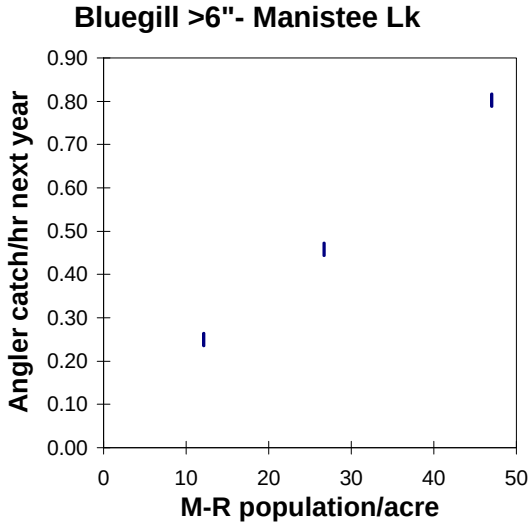
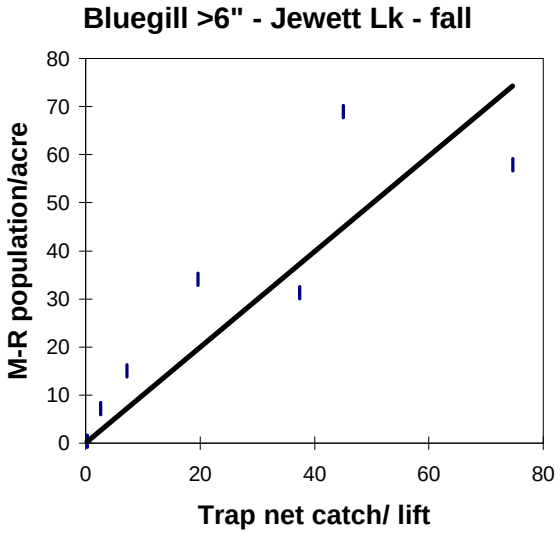


Figure 4.—Relationships for pumpkinseed and black crappie among trap net CPE, mark-recapture estimates of population density, and creel census estimates of angling quality at Manistee Lake.







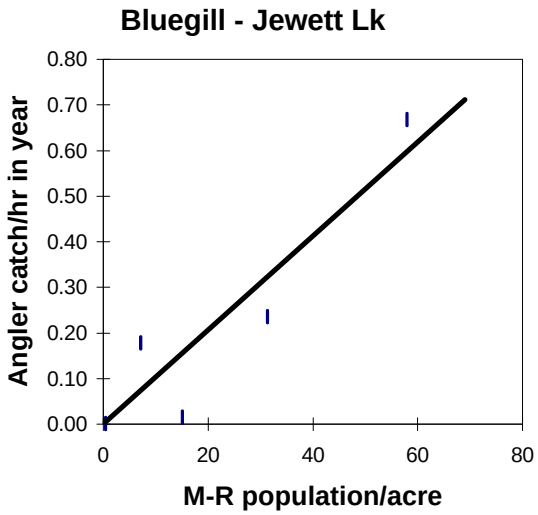


Figure 5.—Relationships for bluegill among trap net CPE, mark-recapture estimates of population density, and creel census estimates of angling quality at Manistee and Jewett lakes.

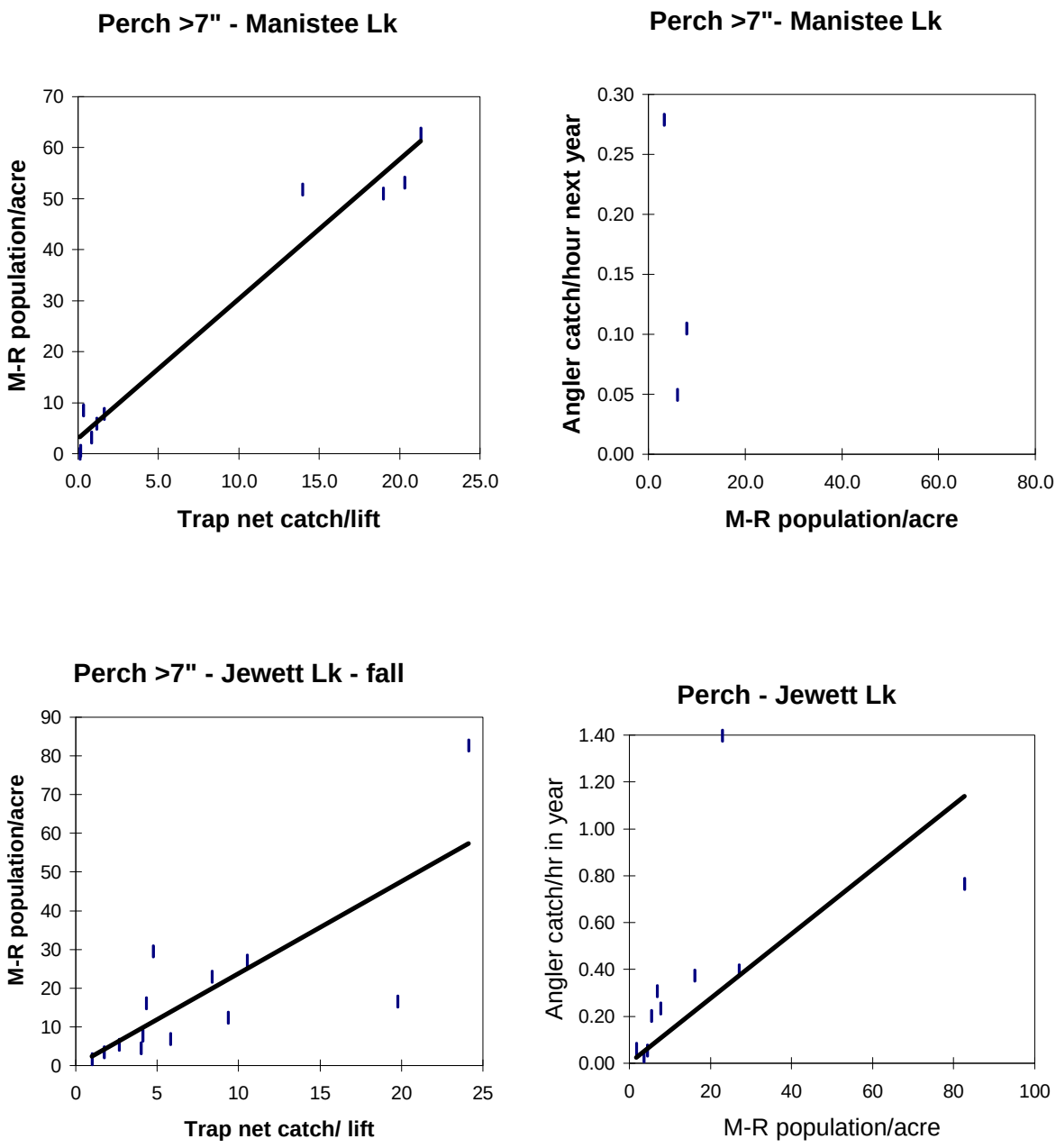


Figure 6.—Relationships for yellow perch among trap net CPE, mark-recapture estimates of population density, and creel census estimates of angling quality at Manistee and Jewett lakes.

Table 1.--Catch of walleye during commercial sucker netting in 1940s-60s.
Lift frequency varied from 4-7 days. Trap nets were Great Lake commercial subs, usually double pot with 2.5-3" stretch mesh, 4' x 6' x 10'.

Lake	Date	No./lift	General creel walleye/hr	Reference
Long	8/48	0.3	…	rr1843
Hubbard	4/5-29/48	0.7	…	rr1843
West Twin	11/14-2/27/37	0.9	…	File letter 1937
Hubbard	4/18-5/22/47	1.4	…	rr1843
Crooked	1939-56	4.0	0.043	rr1534
Black	1939-56	14.0	0.059	rr1534
Black River	1939-56	23.0	0.077	rr1534
Burt	3/21-5/13/47	20.4	…	rr1226
Burt	1939-56	27.0	0.136	rr1534
East Twin	11/14-1/30/37	36.2	…	File letter 1937
Mullett	1939-56	37.0	0.035	rr1534
Burt	3/22-5/10/48	56.2	…	rr1226

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Table 2.--Walleye net CPE and other data for non-research lakes.

	Netting						Mark-recapture		Angling				
Lake	Date	Type[a]	Net-night	No. fish	Size	CPE	Population	Legals/ac	Catch	Catch/ac	Date	C/tot hr	Reference[b]
Gogebic	8/1-7/55	t 3'x2"	…	…	…	35.0	…	…	…	…	…	…	RR 1471
Gogebic	spr 76	f 4'x1.5"	109	4532	spawners	41.6	56,000	4.10	1814	0.133	5/15-10/10/76	0.087	TR 86-9
Gogebic	spr77	f 4'x1.5"	58	6063	spawners	104.5	38,000	2.80	4744	0.349	5/15-10/30/77	0.228	TR 86-9
Gogebic	spr84	f 4'x1.5"	83	7413	spawners	89.3	125,000	9.20	…	…	…	…	TR 86-9
Fife	6/7-11/93	f 2"	16	22	11-22	1.4	…	…	…	…	…	…	Lake file
EastTwin	6/21-8/15/39	t 4'x4'x2.5"	336?	2717	…	8.1	4,179	4.3	…	…	…	…	RR 590
Cass	4/1-9/87	t 3'x1.5"	…		…	3.3	…	…	246	0.270	1-11/86	…	TR 88-2, District
Houghton	5/17-6/18/55	t 3'x1.5"	133	1111	…	8.4	…	…	…	…	…	…	RR 1471
Houghton	5/7-8/83	t 3x1-2"	20	53	12-27	4.9	…	…	…	…	…	…	Lake file
Big Manistique	9/26-9/30/55	t 3'x2"	12 lifts	…	…	34.0	…	…	…	…	…	…	RR 1843
Big Manistique	5/25-27/65	…	16	92	15-22	5.8	…	…	…	…	…	…	Lake file

[a] t=trap net; f=fyke net; first number is net height and last number is stretched mesh size in pot.

[b] RR=MDNR Research Report; TR=MDNR Technical Report; Lake file and District are MDNR data files.

Table 3.--Intensive research studies of walleye with size-stratified estimates.

Lake	Netting						Mark-recapture		Creel survey					
	Date	Type	Net-lift	No. fish	Size (in)	CPE	Population	No./ac	Catch	Catch/ac	tot hrs	c/tot hr	Date	References[a]
Manistee	9-10/73	t 1.5"	300	273	13+	0.9	2523	2.93						RR 1881
Manistee	9-10/74	t 1.5"	348	263	13+	0.8	1178	1.37						RR 1938
Manistee	9-10/75	t 1.5"	344	150	13+	0.4	578	0.67	62	0.07	12214	0.005	12/1/75-11/30/76	Lake file
Manistee	9-10/76	t 1.5"	320	318	13+	1.0	838	0.97	16	0.02	5614	0.003	12/1/76-11/30/77	Unpublished
Manistee	9-10/77	t 1.5"	312	376	13+	1.2	2545	2.96	713	0.83	20884	0.034	12/1/77-11/30/78	
Manistee	9-10/78	t 1.5"	324	512	13+	1.6	2328	2.71						
Manistee	9-10/81	t 1.5"	324	710	13+	2.2	3529	4.10						
Manistee	9-10/82	t 1.5"	316	371	13+	1.2	1736	2.02						
Manistee	9-10/83	t 1.5"	324	508	13+	1.6	2229	2.59						
Manistee	9-10/84	t 1.5"	324	449	13+	1.4	2273	2.64						
Jewett	fall 75	t 1.5"			14+									RR 2020
Jewett	fall 76	t 1.5"			14+									Unpublished
Jewett	fall 77	t 1.5"	8	2	14+	0.3	48	3.7						RR 2020
Jewett	fall 78	t 1.5"	14	13	14+	0.9	48	3.7	74	5.74	118	0.627	7/26-27/78	Unpublished
Jewett	fall 79	t 1.5"	9	24	14+	2.7	77	6.0	20	1.55	1021	0.020	7/9-9/2/79	
Jewett	fall 80	t 1.5"	15	130	14+	8.7	109	8.4	10	0.78	850	0.012	7/9-8/31/80	
Jewett	fall 81	t 1.5"	28	44	14+	1.6	75	5.8	18	1.40	1136	0.016	5/15-9/17/81	
Jewett	fall 82	t 1.5"			14+				7	0.54	675	0.010	5/15-9/5/82	
Jewett	fall 83	t 1.5"	9	14	14+	1.6	58	4.5	9	0.70	1086	0.008	5/15-2/21/83-4	
Jewett	fall 87	t 1.5"	8	102	14+	12.8	130	10.1	18	1.40	585	0.031	5/15-2/9/87-8	
Jewett	fall 88	t 1.5"	18	156	14+	8.7	108	8.4	15	1.16	328	0.046	4/30-2/28/88-9	
Jewett	fall 89	t 1.5"	5	52	14+	10.4	106	8.2	17	1.32	633	0.027	4/29-3/14/89-0	
Jewett	fall 90	t 1.5"	15	185	14+	12.3	129	10.0	7	0.54	808	0.009	4/28-1/2/90-1	
Jewett	fall 91	t 1.5"	12	70	14+	5.8	96	7.4	24	1.86	600	0.040	4/27-10/13/91	
Jewett	fall 92	t 1.5"	12	60	14+	5.0	77	6.0						
Jewett	fall 93	t 1.5"	12	83	14+	6.9	115	8.9						
Fife	6/11-7/2/64	t 1.5" & 2"	138	330	14.5-29.8	2.4	1397	2.22	54	0.09		0.002	1964	RR 1753
Fife	4/27-6/15/65	t 1.5" & 2"	318	80	16.4-22.2	0.3	1087	1.73	51	0.08		0.002	1965	RR 1753
Fife	5-13-6/11/74	t 1.5" & 2"	162	196	13.5-25	1.2	1129	1.80	350	0.56		0.013	5/15-8/16/74	Pettengill (1975)
Six Mile	6/81-5	f 1"			~14+	0.6	119	1.6						

[a]RR=MDNR Research Report; TR=MDNR Technical Report; Lake file and District are MDNR data files.