Mississippi River Investigations
Annual Performance Report
Project No. F-109-R-4

Iowa Dept. of Natural Resources
Larry J. Wilson, Director
March 1989

Mississippi River Investigations

Study No. 1. An Evaluation of Largemouth Bass Populations in the Upper Mississippi River

Job 1. Largemouth bass stock assessment
Job 2. Sport fishery and largemouth bass harvest
Job 3. Largemouth bass habitat requirements

Study No. 2. An Evaluation on the Effect of a Change in Commercial Harvest Regulations on the Channel Catfish Population Inhabiting the Upper Mississippi River

Job 1. Channel catfish population assessment
Job 2. Assessment of young-of-the-year channel catfish abundance

Prepared by:

John Pitlo Jr.

Division of Fish and Wildlife

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FEDERAL AID TO FISH RESTORATION

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Prepared By: John Pitlo Jr.
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ANNUAL PERFORMANCE REPORT
RESEARCH PROJECT SEGMENT

STATE: Iowa

NAME: An Evaluation of Largemouth Bass Populations in the Upper Mississippi River

PROJECT NO.: F-109-R

STUDY NO.: 1

JOB NO.: 1

TITLE: Largemouth Bass Stock Assessment

Period Covered: 1 January, 1988 through 31 December, 1988

ABSTRACT: Over 4,140 largemouth bass were measured, weighed and floy tagged during this project segment. Largemouth bass population estimates, relative weights (W_r's), PSD's, weight-length relationships, standing stocks, length-frequency distributions and estimates of total mortality were obtained for five study areas. Scales were analyzed from 255 largemouth bass sampled in Sunfish Lake and Lainesville Slough-Lower Brown's Lake and an additional 400 scales were collected from three other study areas for analysis during the next study segment. Floy tag loss was estimated at 47%. Voluntary return of floy tags by anglers was 4.9%.

JOB 1 OBJECTIVES

To estimate the abundance, standing stock, age, growth and total mortality of largemouth bass in selected areas of Pools 9, 10, 12 and 13.

INTRODUCTION

Largemouth bass is an important game fish inhabiting Upper Mississippi River backwater complexes and is highly sought by anglers. The mean weight of largemouth bass creeled by Upper Mississippi River anglers in 1962 and 1967 was 1.22 and 1.3 lbs, respectively (Nord 1964 and Wright 1970). In contrast, Ackerman (1978) found the mean weight of harvested bass was 0.7 lbs in Pool 10 while Van Vooren (1983) found the mean weight was 0.65 lbs for bass harvested from Pool 17. These figures suggest a 50% reduction in the mean weight of bass harvested by anglers. The decrease in mean weight, an 88% increase in angler preference for largemouth bass between 1975 and 1981 (Anonymous, 1982), and the nearly 40% angler exploitation rate reported by Van Vooren (1983) caused concern relative to possible over-exploitation of the species. High angler pressure on largemouth bass was also reflected in fishing diaries submitted annually by Iowa's organized bass anglers. One-third of their entire fishing effort was expended on the Mississippi River and Pools 9-12 received 73% of that effort (Iowa Conservation Commission, unpublished data). Presently, information on the population dynamics of largemouth bass in Pools 9-15 is insufficient to make management decisions. A better understanding of natural mortality, angler exploitation and growth of largemouth bass inhabiting Pools 9-15 is needed to determine if various management strategies would significantly benefit the size structure of largemouth bass populations.

METHODS AND PROCEDURES

Largemouth bass were collected September, October and November with pulsed DC and AC electrofishing gear. All largemouth bass $\geq$ 9 inches were measured for total length to the nearest 0.1 inch and weighed to the nearest 0.1 lb. A serialized Floy tag was inserted below the dorsal fin and the left pelvic fin was excised to determine tag loss. The Schumacher-Eschmeyer estimator (Ricker 1975) was used to analyze the mark recapture data and obtain numerical population estimates of bass $\geq$ 9 inches. Lengths of bass smaller than 9 inches were also recorded to derive proportional stock density (PSD) values.

In each study area, scale samples were removed from the first 12 fish in each one inch length group. Scale samples were taken from bass 5.0 inches and larger. Scales were mounted on gummed paper and heat pressed on acetate cards. A microprojector was used to magnify scale imprints 40X and annuli were counted and measurements made through the anterior scale margin. Scales were collected in the fall; thus an annulus was assumed on the scale edge.

Weight-length relationships were computed independently for each study area by the transformed linear regression model:

$$\log_{10} W = a + b \log_{10} TL$$

where W = weight in 0.1 lbs
TL = total length in 0.1 inches
a & b = mathematical constants

The number of largemouth bass in each age group was estimated by extrapolation of aged subsamples in proportion to the length-frequency distribution. Instantaneous mortality was estimated directly from age structure from the modal age in the catch curve to the oldest age group containing four or more individuals (Ricker 1975), where:

$$Z = \frac{(\log_e N_{t+1} - \log_e N_t)}{t}$$

where Z = instantaneous mortality rate
N = number of fish
t = age group

The equation measured the geometric change in the number of fish in two successive age groups. Annual mortality (A) was obtained directly from a table of exponential functions (Ricker 1975). A second mortality estimate was obtained by plotting numerical age composition on age. A straight line was fitted to the data by simple linear regression where the slope (b) represented instantaneous mortality:

$$\log_e Y = a + bX$$

where Y = the number of fish in an age group
X = age
a = mathematical constant
b = instantaneous mortality

Population biomass of fish $\geq$ 9 inches was determined by multiplying the mean weight of fish in a length group by the estimated numerical abundance of fish in that length group. The abundance of fish in each length group was obtained from proportions established in the length frequency distribution.

Relative weight (W_r) was computed as described by Wege and Anderson (1978):

$$W_r = \frac{W}{W_s} X 100$$

where W = actual weight
W_s = standard weight
$\log_{10} W_s = -3.4893 + 3.191 \log_{10} L$

THE STUDY AREAS

Minnesota Slough, the study area in Pool 9, is bounded on the north by the Iowa-Minnesota state line and on the south by the mouth of the Upper Iowa River (River mile 671.3-673.9). Minnesota Slough is a large backwater slough that has low to moderate current velocities and several connected side channels and shallow lakes (Figure 1). The habitat consists of logs and brush in the slough and weed beds in the shallow lakes. The study area is about 3.1 miles long, 0.25-0.40 miles wide and encompasses approximately 525 acres.

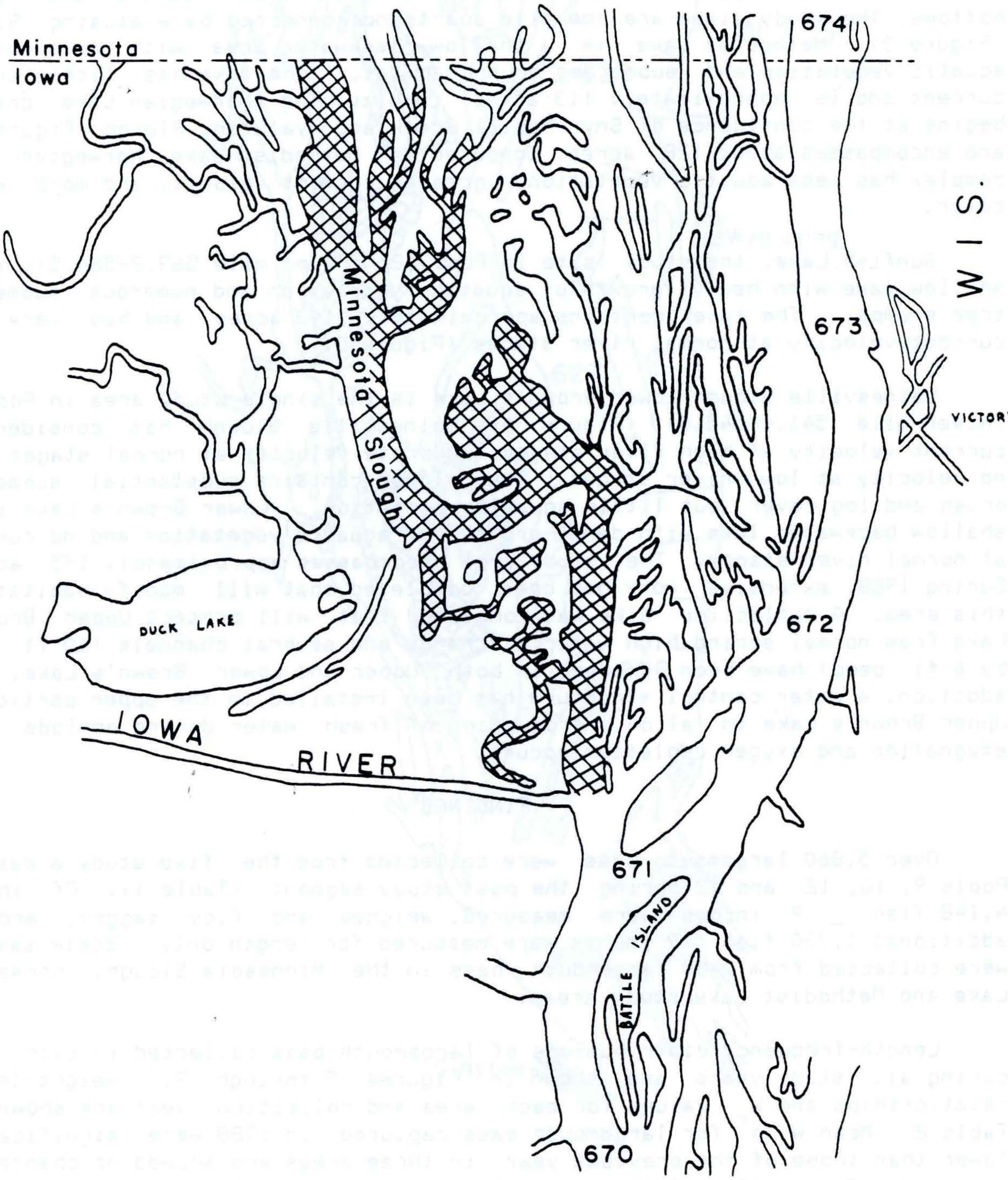

Figure 1. The Minnesota slough area (cross hatched) Pool 9, Upper Mississippi River.

Two sites were selected in Pool 10, Methodist Lake and Norwegian Lake (River mile 626.0-628.0). Both are in an area known as the Sny Magill bottoms. The study sites are one mile apart and connected by Wyalusing Slough (Figure 2). Methodist Lake is a shallow backwater area with considerable aquatic vegetation and submerged brush habitat. The lake has little or no current and is approximately 113 acres in size. The Norwegian Lake complex begins at the confluence of Sny Magill Creek and Wyalusing Slough (Figure 2) and encompasses about 128 acres. Compared to Methodist Lake, Norwegian Lake complex has less aquatic vegetation, greater current velocity and more woody cover.

Sunfish Lake, the study site in Pool 12 (River mile 563.2-564.5), is a shallow lake with heavy growth of aquatic vegetation and numerous submerged tree stumps. The lake contains approximately 143 acres and has very low current velocity at normal river stages (Figure 3).

Lainesville Slough-Lower Brown's Lake is the single study area in Pool 13 (River mile 541.0-545.0) (Figure 4). Lainesville Slough has considerable current velocity at high river stages, moderate velocity at normal stages and no velocity at low river stages. The slough contains substantial submerged brush and log cover but little aquatic vegetation. Lower Brown's Lake is a shallow backwater lake with dense growths of aquatic vegetation and no current at normal river stages. The study area encompasses approximately 195 acres. During 1988, extensive work had been completed that will modify habitat in this area. A deflection dike was completed that will protect Upper Brown's Lake from normal spring high water discharge and several channels (60 ft wide by 6 ft deep) have been dredged in both Upper and Lower Brown's Lake. In addition, a water control structure has been installed in the upper portion of Upper Brown's Lake to allow introduction of fresh water during periods when stagnation and oxygen depletion occurs.

FINDINGS

Over 5,860 largemouth bass were collected from the five study areas in Pools 9, 10, 12 and 13 during the past study segment (Table 1). Of these, 4,148 fish $\geq$ 9 inches were measured, weighed and floy tagged, and an additional 1,720 fish < 9 inches were measured for length only. Scale samples were collected from 400 largemouth bass in the Minnesota Slough, Norwegian Lake and Methodist Lake study areas.

Length-frequency distributions of largemouth bass collected in each area during all study years are shown in Figures 5 through 9. Weight-length relationships and W_r values for each area and collection year are shown in Table 2. Mean W_r's for largemouth bass captured in 1988 were significantly lower than those of the previous year in three areas and showed no change in two areas (Figure 10). A general pattern has emerged showing similar trends for W_r values for bass populations sampled from Minnesota Slough, Norwegian Lake and Methodist Lake and a different trend for those sampled from Sunfish Lake and Lainesville Sl.-Lower Brown's Lake (Figure 10). Generally, mean W_r's for largemouth bass sampled in four study areas in 1988 were not significantly different; the exception was Sunfish Lake where mean W_r for 1988 was significantly higher than other areas.

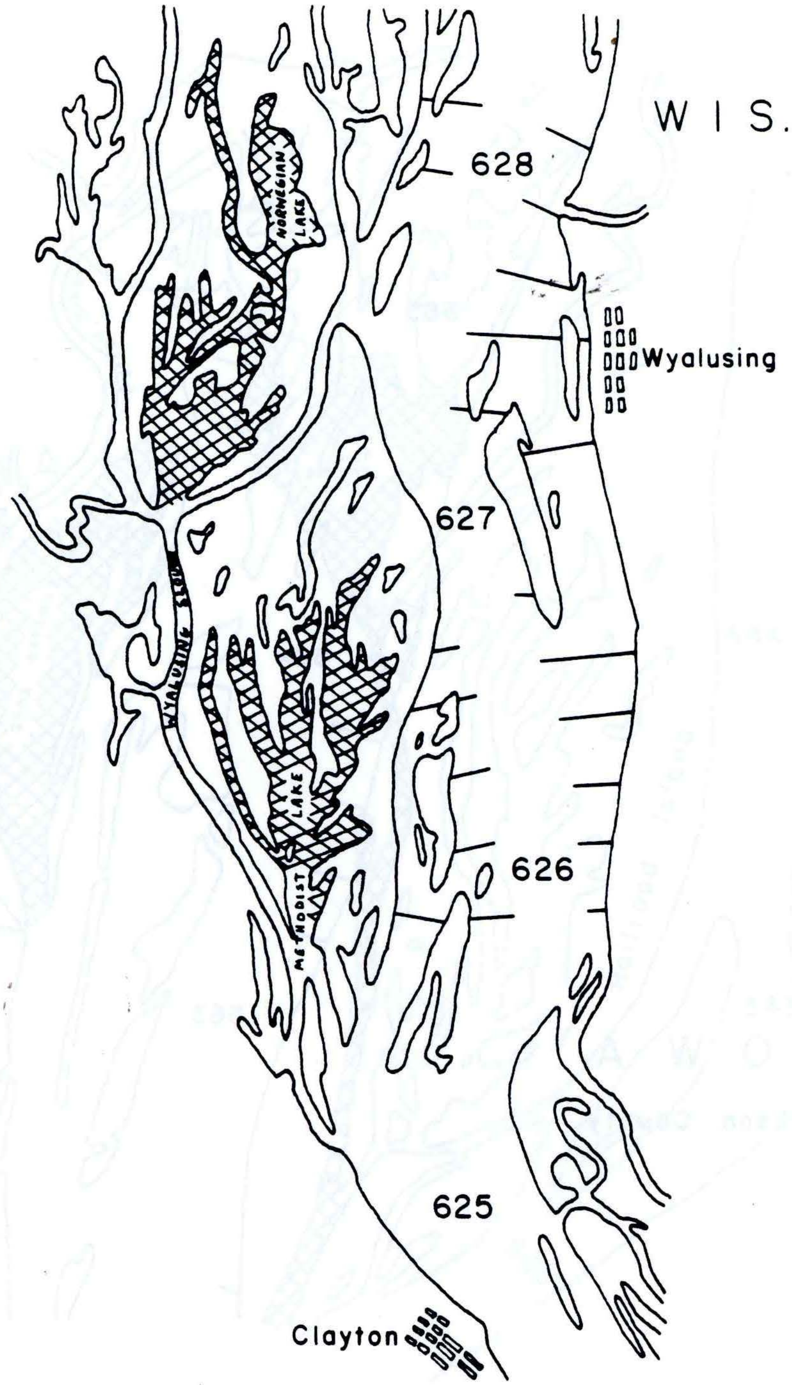

Figure 2. Methodist Lake and the Norwegian Lake study areas (cross hatched) Pool 10, Upper Mississippi River.

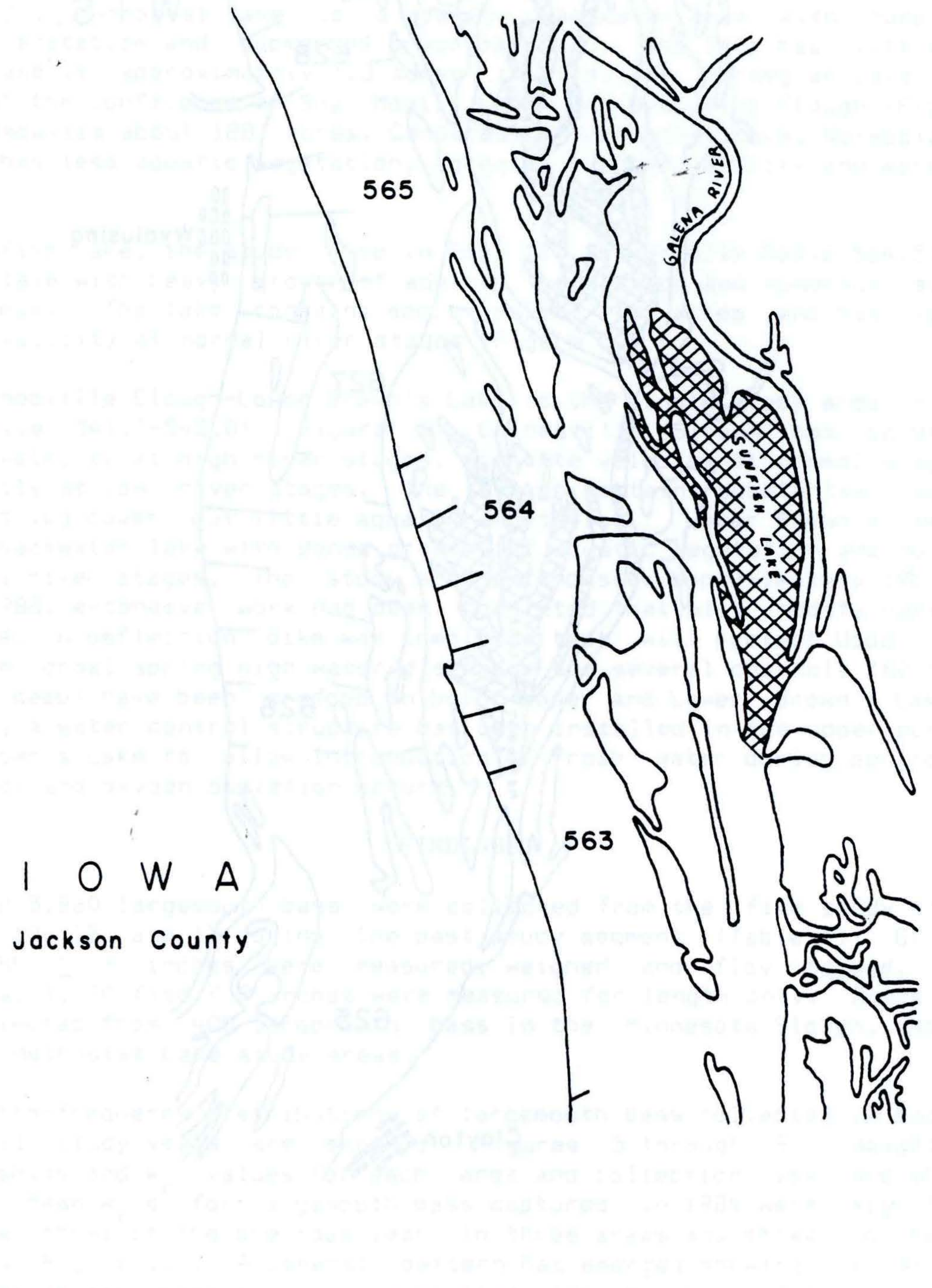

Figure 3. The Sunfish Lake study site (cross hatched area), Pool 12, Upper Mississippi River.

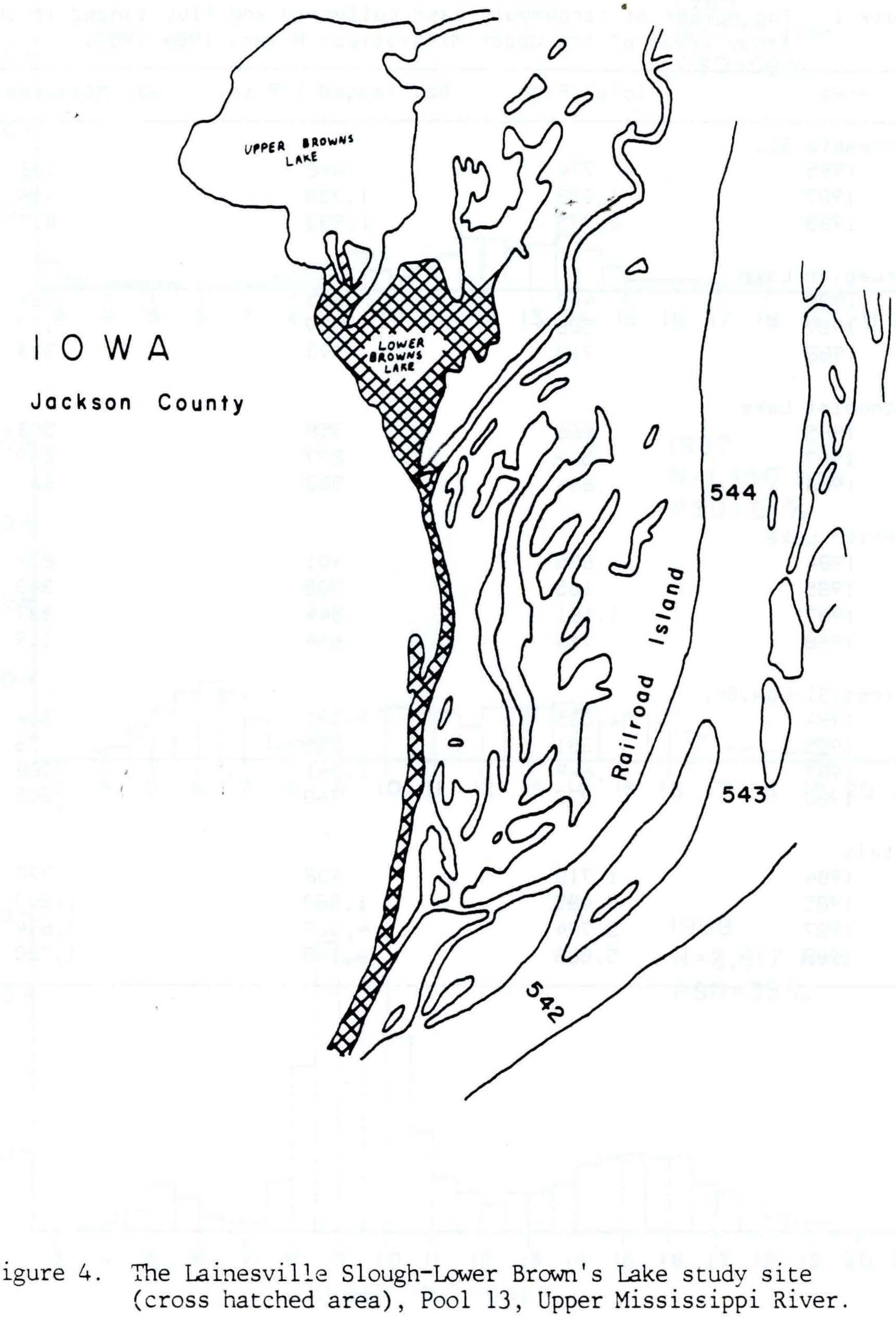

Figure 4. The Lainesville Slough-Lower Brown's Lake study site (cross hatched area), Pool 13, Upper Mississippi River.

Table 1. The number of largemouth bass collected and floy tagged in the five study areas of the Upper Mississippi River, 1984-1988.

Area	Total Fish	No. Tagged ≥ 9 in.	No. Measured < 9 in.
Minnesota Sl.			
1985	774	642	132
1987	1,852	1,358	494
1988	2,775	1,958	817
Norwegian Lake			
1985	449	325	124
1987	526	329	197
1988	713	395	318
Methodist Lake			
1985	866	358	508
1987	546	277	269
1988	644	383	261
Sunfish Lake			
1984	675	401	274
1985	665	302	363
1987	1,181	844	337
1988	763	644	119
Laines.Sl-Low.Br.			
1984	1,035	531	504
1985	331	255	76
1987	1,649	1,261	388
1988	973	768	205
Totals			
1984	1,710	932	778
1985	3,085	1,882	1,203
1987	5,734	4,069	1,684
1988	5,868	4,148	1,720

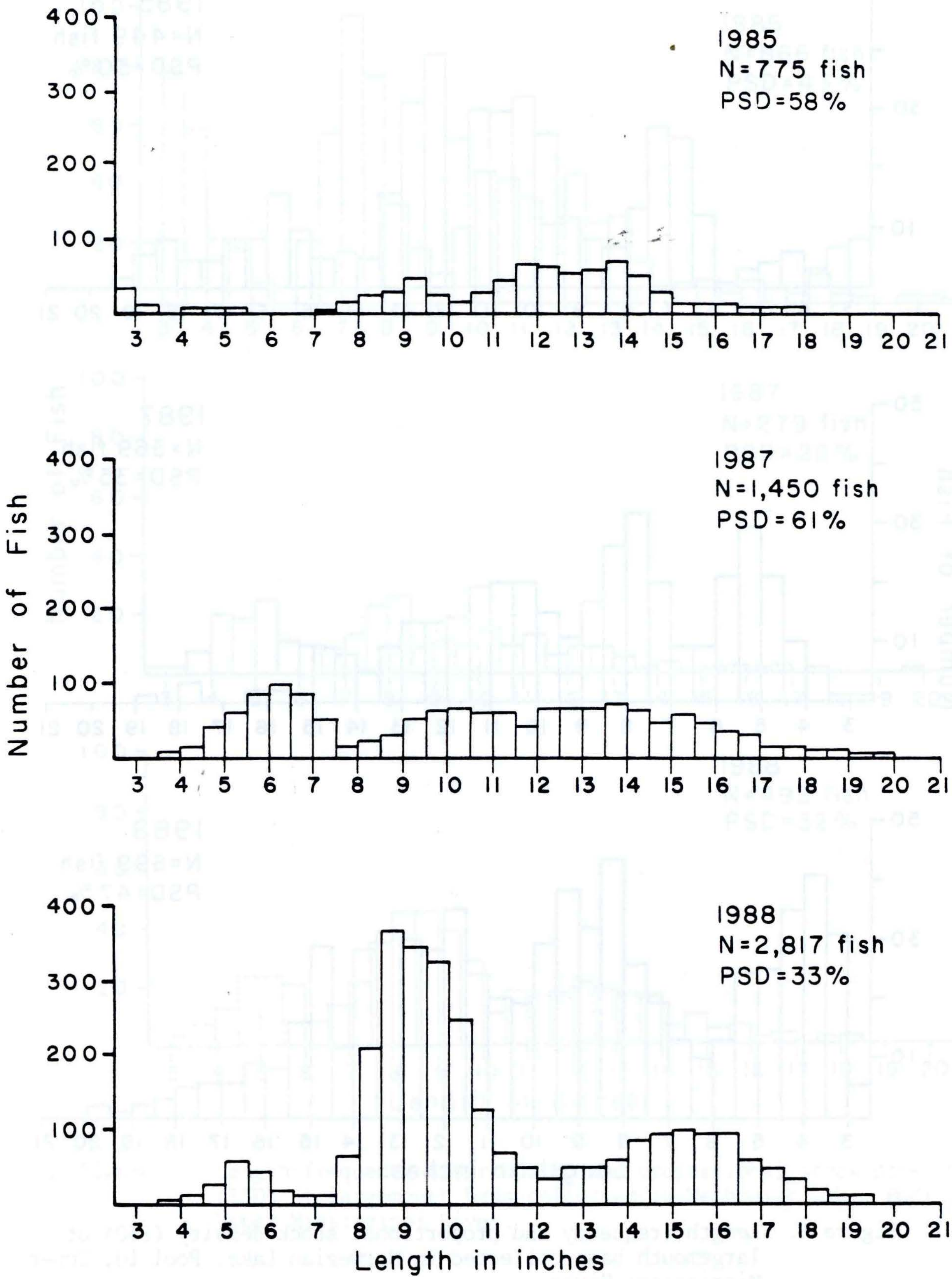

Figure 5. Length-frequency distribution and proportional stock density (PSD) of largemouth bass collected in Minnesota Slough, Pool 9, Upper Mississippi River.

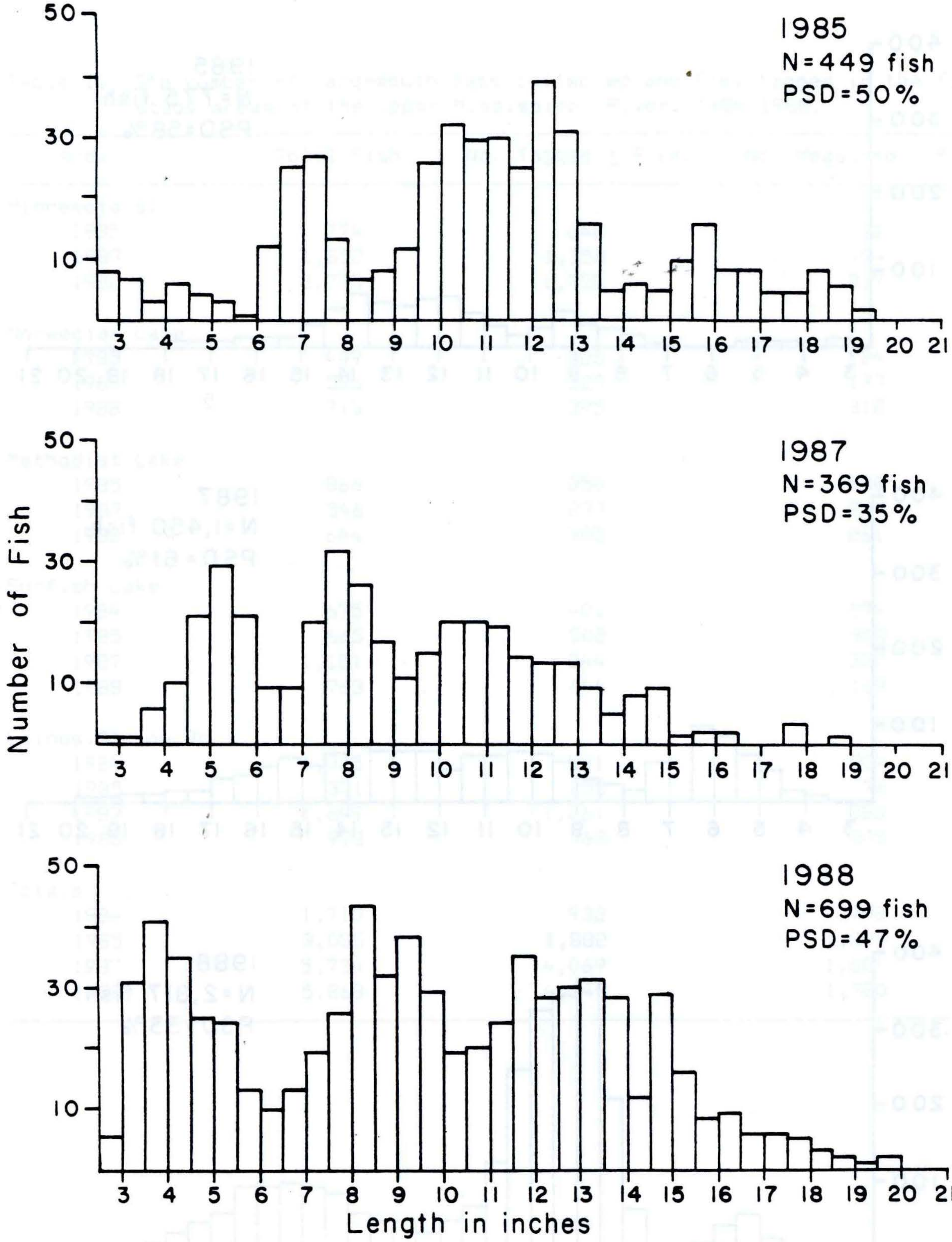

Figure 6. Length-frequency and proportional stock density (PSD) of largemouth bass collected in Norwegian Lake, Pool 10, Upper Mississippi River.

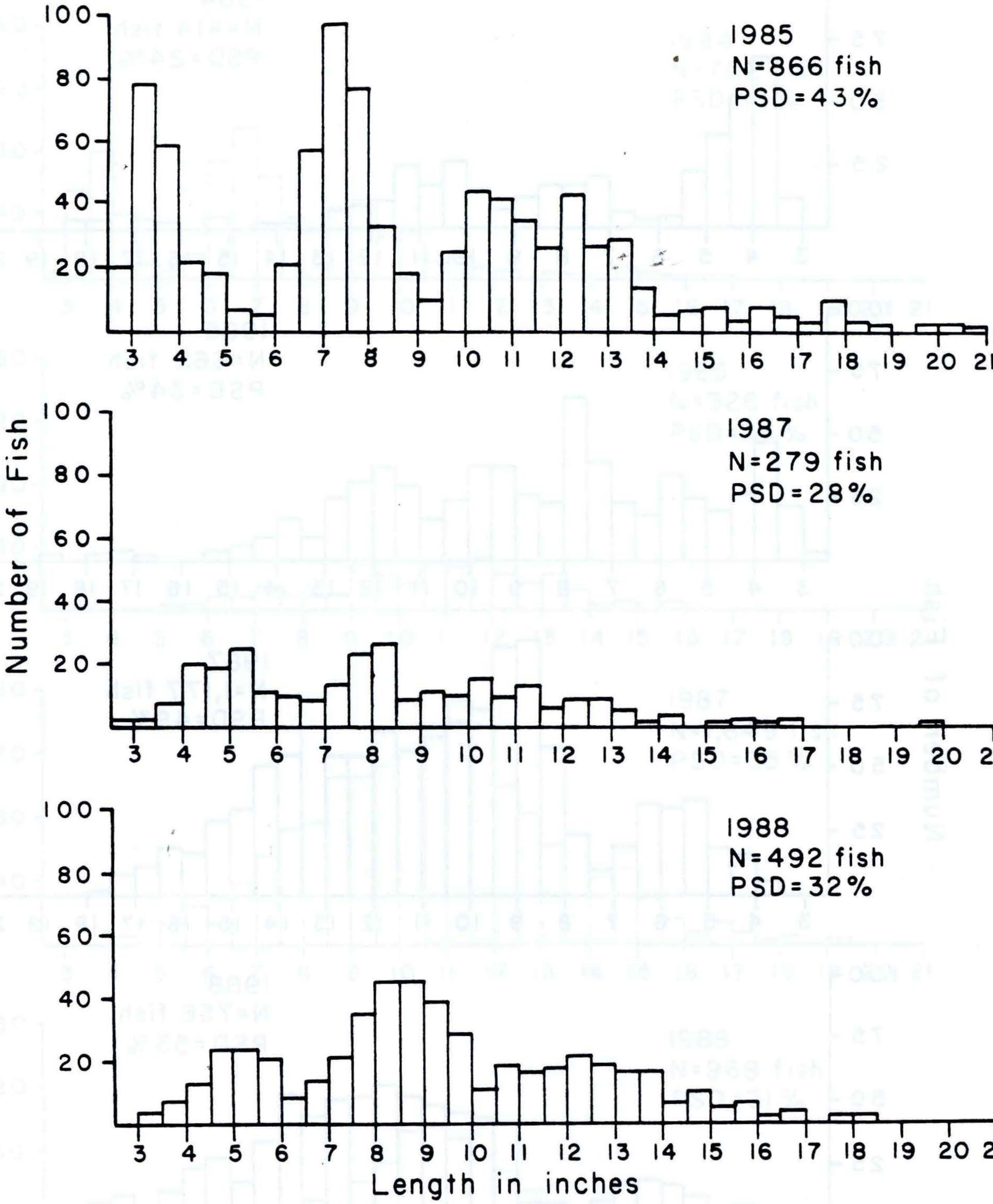

Figure 7. Length-frequency distribution and proportional stock density (PSD) of largemouth bass collected in Methodist Lake, Pool 10, Upper Mississippi River.

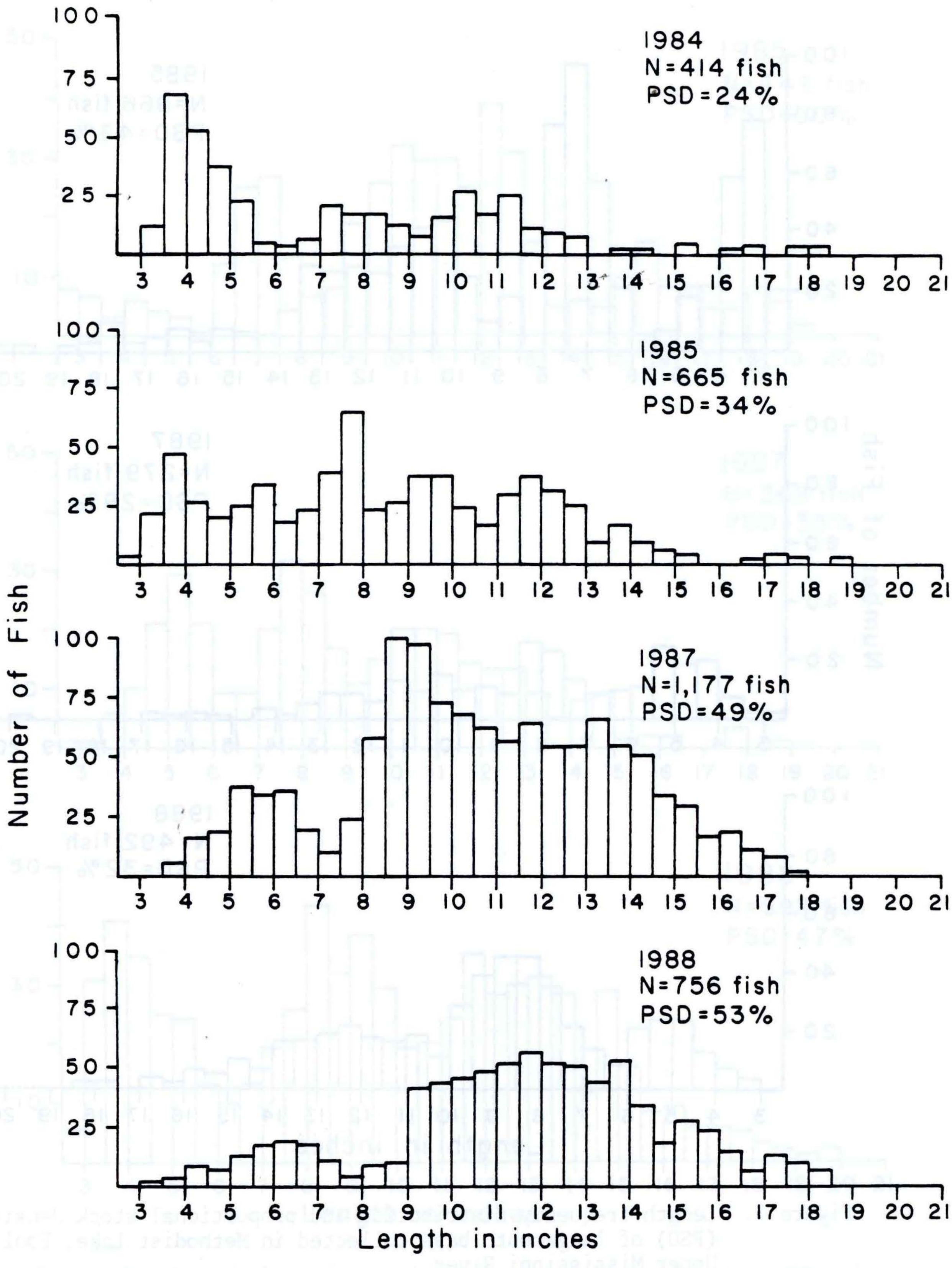

Figure 8. Length-frequency distribution and proportional stock density (PSD) of largemouth bass collected in Sunfish Lake, Pool 12, Upper Mississippi River.

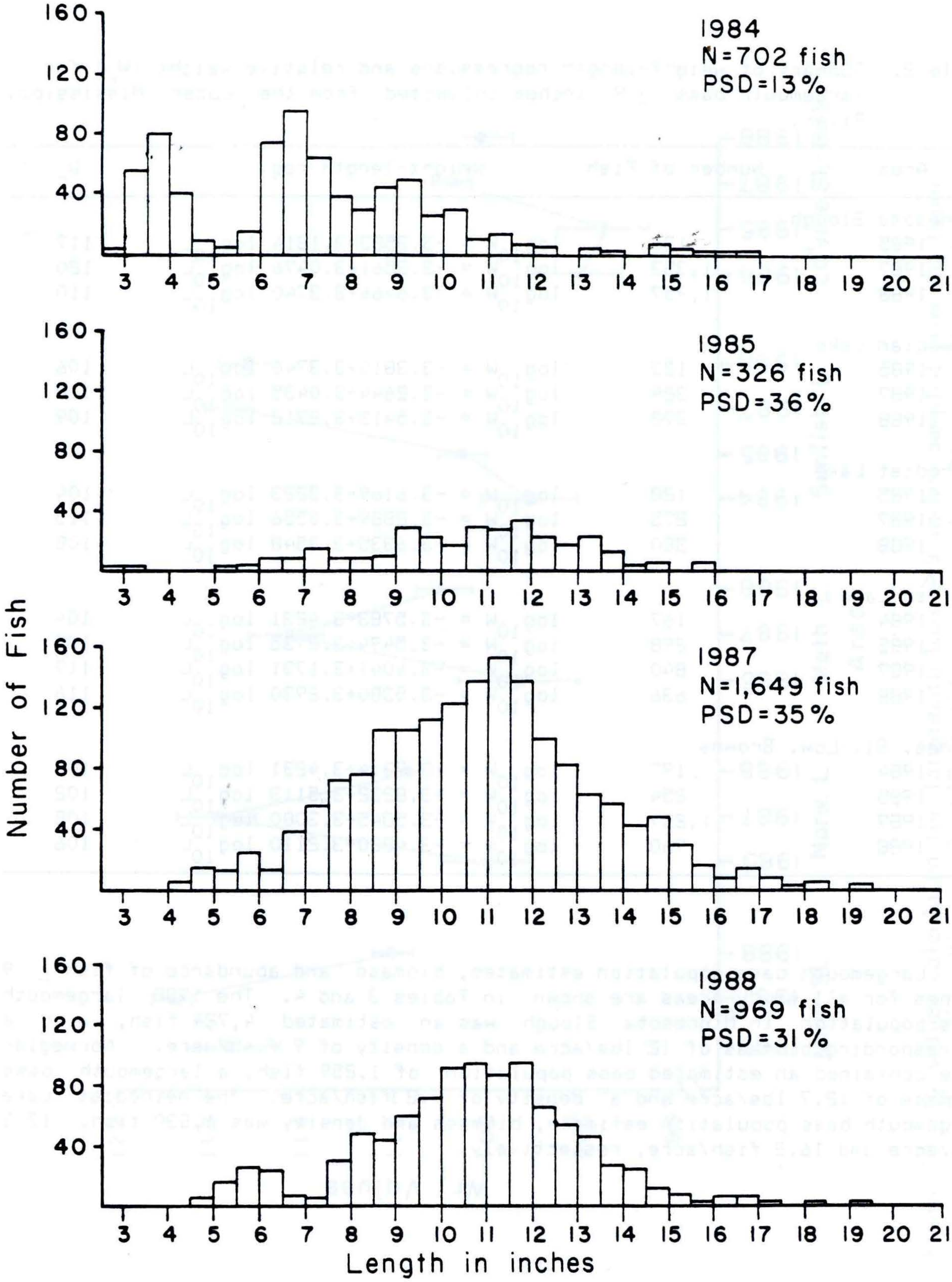

Figure 9. Length-frequency distribution and proportional stock density (PSD) of largemouth bass collected in Lainesville Slough-Lower Brown's Lake, Pool 13, Upper Mississippi River.

Table 2. Summary of weight-length regressions and relative weight (W_r) for largemouth bass $\geq$ 9 inches collected from the Upper Mississippi River.

Area	Number of Fish	Weight-length reg.	W_r
Minnesota Slough			
1985	136	$\log_{10}W = -3.3583+3.1314 \log_{10}L$	117
1987	1,353	$\log_{10}W = -3.2561+3.0476 \log_{10}L$	120
1988	1,957	$\log_{10}W = -3.6466+3.3740 \log_{10}L$	110
Norwegian Lake			
1985	123	$\log_{10}W = -3.3810+3.3740 \log_{10}L$	106
1987	329	$\log_{10}W = -3.2644+3.0435 \log_{10}L$	118
1988	372	$\log_{10}W = -3.5413+3.2712 \log_{10}L$	109
Methodist Lake			
1985	128	$\log_{10}W = -3.6169+3.3223 \log_{10}L$	104
1987	275	$\log_{10}W = -3.2889+3.0556 \log_{10}L$	115
1988	380	$\log_{10}W = -3.6335+3.3548 \log_{10}L$	108
Sunfish Lake			
1984	167	$\log_{10}W = -3.5783+3.4231 \log_{10}L$	104
1985	298	$\log_{10}W = -3.5494+3.2735 \log_{10}L$	107
1987	840	$\log_{10}W = -3.4041+3.1731 \log_{10}L$	117
1988	636	$\log_{10}W = -3.5380+3.2930 \log_{10}L$	116
Laines. Sl.-Low. Browns			
1984	197	$\log_{10}W = -3.7314+3.4231 \log_{10}L$	102
1985	254	$\log_{10}W = -3.8232+3.5113 \log_{10}L$	102
1987	1,257	$\log_{10}W = -3.5845+3.3080 \log_{10}L$	108
1988	760	$\log_{10}W = -3.4880+3.2110 \log_{10}L$	106

Largemouth bass population estimates, biomass and abundance of fish $\geq$ 9 inches for all study areas are shown in Tables 3 and 4. The 1988 largemouth bass population in Minnesota Slough was an estimated 4,724 fish, with a corresponding biomass of 12 lbs/acre and a density of 9 fish/acre. Norwegian Lake contained an estimated bass population of 1,259 fish, a largemouth bass biomass of 12.7 lbs/acre and a density of 9.8 fish/acre. The Methodist Lake largemouth bass population estimate, biomass and density was 1,830 fish, 17.3 lbs/acre and 16.2 fish/acre, respectively.

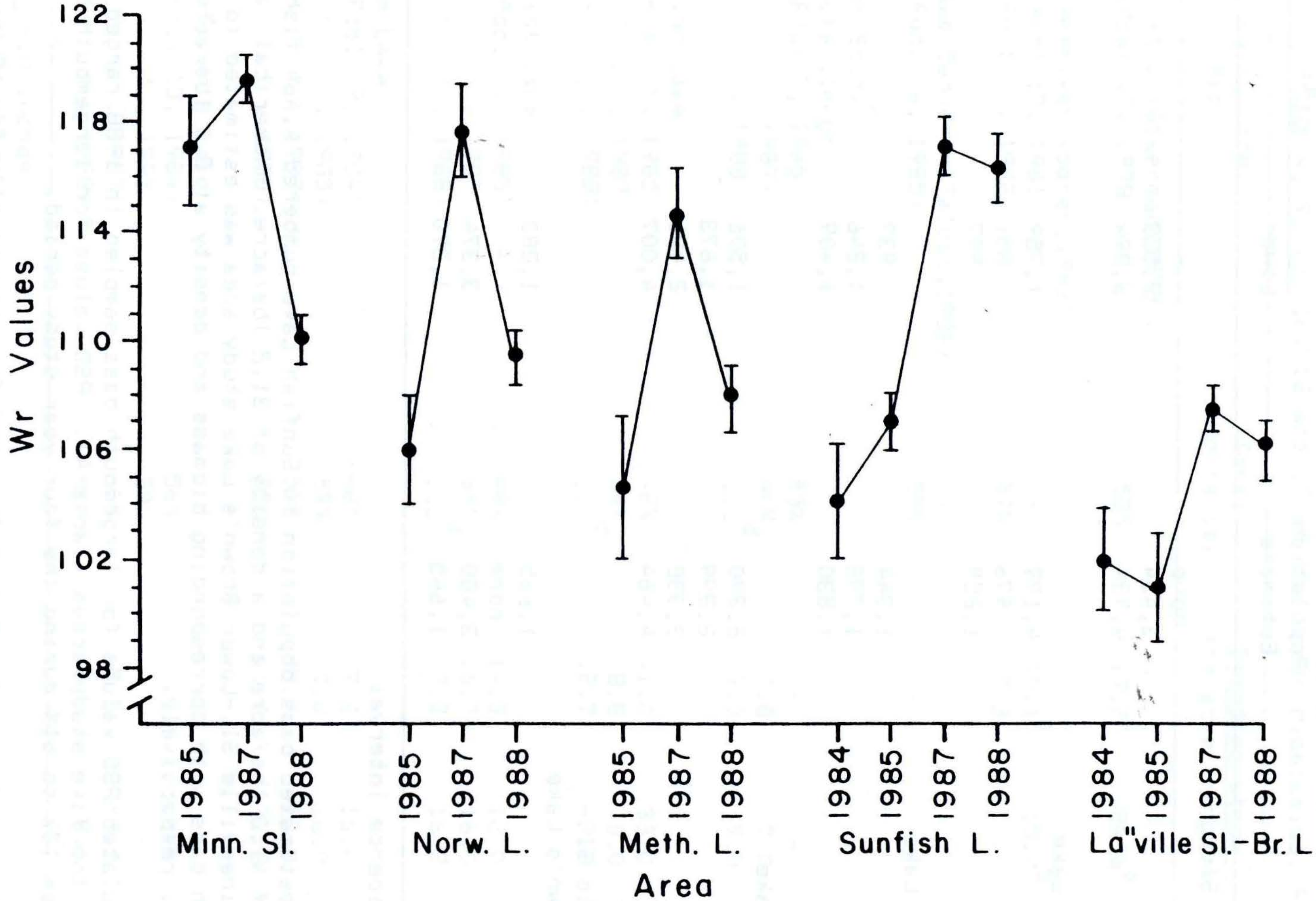

Figure 10. W_r values calculated for largemouth bass ≥ 9 inches sampled from the Upper Mississippi River. The 95% confidence interval of the estimate is also provided.

Table 3. Population estimates of largemouth bass ≥ 9 inches in total length in five study areas of the Upper Mississippi River.

Area	Population Estimate	CI[a] Lower	CI[a] Upper
Minnesota Slough			
1985	none	-	-
1987	3,434	2,528	5,348
1988	4,724	3,894	6,004
Norwegian Lake			
1985	4,199	1,759	inf
1987	976	851	1,145
1988	1,259	997	1,709
Methodist Lake			
1985	1,344	937	2,375
1987	1,792	1,246	3,191
1988	1,830	1,409	2,607
Sunfish Lake			
1984	2,290	1,506	4,783
1985	2,299	1,673	3,677
1987	3,338	2,406	5,449
1988	4,464	4,007	5,040
Lainesville Sl.-Lower Brown's Lake			
1984	1,665	1,283	2,368
1985	none	-	-
1987	3,488	3,374	3,609
1988	1,645	1,390	2,015

[a]95% confidence interval

The estimated bass population in Sunfish Lake numbered 4,464 fish with a biomass of 41.0 lbs/acre and a density of 31.2 lbs/acre. Numerical abundance in the Lainesville Sl.-Lower Brown's Lake study area was estimated to be 1,645 largemouth bass with corresponding biomass and density at 8.0 lbs/acre and 8.4 fish/acre, respectively.

Calculated PSD values for largemouth bass sampled in 1988 ranged from 31% to 53% in the five study areas (Table 4). PSD values for largemouth bass have ranged from 13% to 61% during the four year study period.

Total mortality estimates calculated for Lainesville Sl.-Lower Brown's Lake and Sunfish Lake largemouth bass populations for 1988 were 68% and 53%, respectively. Estimates of total mortality for largemouth bass in Methodist Lake, Norwegian Lake and Minnesota Slough will be calculated after scales are aged. Total mortality estimates for largemouth bass in all study areas and during all study year ranged from 42% to 68% (Table 4).

Table 4. A summary of total mortality, standing stocks and proportional stock density (PSD) reported for largemouth bass sampled from sites in Pools 4, 9, 10, 12, 13 and 17 of the Upper Mississippi River.

Area (Source) (Pool)	Total Mortality	Standing stock		PSD
		lbs/acre	no/acre	
Methodist L.(Ackerman,1978)				
(Pool 10, 1978)	53%	17.2[a]	24.6[a]	46%
Big Timber(Van Vooren,1983)				
(Pool 17, 1981)	-	10.1[b]	15.0[b]	25%
(Pool 17, 1982)	57%	9.3	7.7	33%
Big Lake(Benjamin&Talbot,1986)				
(Pool 4, 1985)	55%	-	-	43%
Present Study[c]				
Minnesota Slough				
(Pool 9, 1985)	55%	-	-	58%
(" ", 1987)	40%	10.8	7.0	61%
(" ", 1988)	---[d]	12.0	9.0	33%
Norwegian Lake				
(Pool 10, 1985)	42%	41.0	33.0	50%
(" " , 1987)	64%	8.8	8.0	35%
(" " , 1988)	---[d]	12.7	9.8	47%
Methodist Lake				
(Pool 10, 1985)	48%	14.3	12.0	43%
(" " , 1987)	66%	16.7	16.0	28%
(" " , 1988)	---[d]	17.3	16.2	32%
Sunfish Lake				
(Pool 12, 1984)	48%	17.2	16.0	24%
(" " , 1985)	59%	17.0	16.0	33%
(" " , 1987)	51%	28.7	23.0	49%
(" " , 1988)	53%	41.0	31.2	53%
Lains.-Brown's Lake				
(Pool 13, 1984)	56%	7.0	8.6	13%
(" " , 1985)	59%	-	-	36%
(" " , 1987)	63%	18.5	18.0	35%
(" " , 1988)	66%	8.0	8.4	31%

[a] Fish ≥ 6.0 inches.
[b] Fish ≥ 9.8 inches.
[c] Fish ≥ 9.0 inches.
[d] Will be determined later.

Floy tag loss was estimated for all sampling areas by examining largemouth bass tagged and fin clipped during 1987. Two hundred twenty-five fin clipped largemouth bass were collected from the five study areas and 122 had attached floy tags (Table 5). Floy tag retention rate averaged 53% (range, 33% to 60%).

Table 5. A summary of floy tag retention data obtained from largemouth bass marked at five sites on the Upper Mississippi River.

Area	Number of marked fish recaptured	Tags present No. (%)	Tags absent No. (%)
Minnesota Slough			
1987	9	3 (33)	6 (67)
1988	40	22 (55)	18 (45)
Norwegian Lake			
1987	10	5 (50)	5 (50)
1988	45	22 (49)	23 (51)
Methodist Lake			
1987	5	2 (40)	3 (60)
1988	30	18 (60)	12 (40)
Sunfish Lake			
1985	30	18 (60)	12 (40)
1987	11	5 (45)	6 (55)
1988	35	17 (49)	18 (51)
Laines.-Brown's Lake			
1985	6	3 (50)	3 (50)
1987	10	5 (50)	5 (50)
1988	75	43 (57)	32 (43)
Totals			
1985	36	21 (58)	15 (42)
1987	45	21 (44)	25 (56)
1988	225	122 (54)	103 (46)
	306	163 (53)	143 (47)

Voluntary return of floy tags by anglers was low and ranged from 2% to 11.7% (Table 6). The average rate of voluntary floy tag return for 6,882 largemouth bass tagged during 1984, 1985 and 1987 was 4.9% (Table 6).

Scales collected from largemouth bass during the 1987 sample period were analyzed during this project segment. Analysis of 121 largemouth bass scales sampled from Lainesville Sl.-Lower Brown's Lake resulted in growth estimates of 4.2, 8.3, 11.4, 13.9, 15.5, 16.8, 18.1 and 19.1 inches for ages I through VIII, respectively (Table 7). Mean growth derived from 134 largemouth bass scales collected from Sunfish Lake resulted in estimates of 4.2, 8.1, 11.2, 13.5, 15.1, 16.3, 17.2, 18.2, 19.1, 19.7 inches for ages I through X, respectively (Table 8).

Table 6. A summary of floy tags returned voluntarily by anglers who fished the Upper Mississippi River.

Area	No. Tagged	Reported Recaptures					Total
		1984	1985	1986	1987	1988	No. (%)
Minnesota Slough							
1985	642		6	31	10	1	48 (7.4)
1987	1,358					56	56 (4.1)
1988	1,958					-	-
Norwegian Lake							
1985	325		1	26	11	0	38 (11.7)
1987	329					14	14 (4.3)
1988	395					-	-
Methodist Lake							
1985	358			21	6	0	27 (7.5)
1987	277					16	16 (5.8)
1988	374					-	-
Sunfish Lake							
1984	400		11	6	0	0	17 (4.3)
1985	302		1	14	1	0	16 (5.3)
1987	844					42	42 (5.0)
1988	644					-	-
Laines.-Brown's Lake							
1984	531	3	14	7	2	0	26 (4.9)
1985	255			7	4	0	11 (4.3)
1987	1,261					25	25 (2.0)
1988	768					-	-
Totals							
1984	931	3	25	13	2	0	43 (4.6)
1985	1,882		8	99	32	1	140 (7.4)
1986	---					-	-
1987	4,069					153	153 (3.7)
	6,882	3	33	112	34	153	336 (4.9)

Table 7. A summary of average calculated lengths and increments for each year of life for largemouth bass collected in October, 1987 from Lainesville-Sl.-Lower Brown's Lake, Pool 13, Upper Mississippi River.

Age	N	Calculated lengths at annulus (inches)							
		I	II	III	IV	V	VI	VII	VIII
I	8	5.6							
II	39	4.2	8.4						
III	21	3.8	7.8	11.2					
IV	20	4.2	8.2	11.1	13.6				
V	13	3.8	8.5	11.5	13.8	15.3			
VI	12	4.0	8.7	11.8	14.1	15.4	16.5		
VII	4	4.6	8.5	12.1	14.1	15.8	16.9	17.8	
VIII	4	4.1	8.6	12.4	14.5	16.0	17.5	18.4	19.1
	121								
$\bar{X}$ Length		4.2	8.3	11.4	13.9	15.5	16.8	18.1	19.1
$\bar{X}$ Increment		4.2	4.1	3.1	2.4	1.6	1.3	1.3	1.1

Table 8. A summary of average calculated lengths and increments for each year of life for largemouth bass collected in October, 1987 from Sunfish Lake, Pool 12, Upper Mississippi River.

Age	N	Calculated lengths at annulus (inches)									
		I	II	III	IV	V	VI	VII	VIII	IX	X
I	14	5.7									
II	33	3.6	8.1								
III	32	3.9	7.8	11.0							
IV	19	4.1	8.0	11.2	13.6						
V	13	4.2	7.7	10.8	13.3	15.2					
VI	12	4.4	8.8	11.3	13.2	14.8	16.2				
VII	8	4.7	8.6	11.6	13.7	15.0	16.1	17.1			
VIII	1	5.2	9.4	11.2	13.5	15.0	15.8	16.4	17.3		
IX	1	4.6	10.6	12.8	14.6	16.3	17.7	18.3	18.7	19.2	
X	1	4.4	10.9	13.2	14.7	16.5	17.3	18.1	18.6	19.0	19.7
	134										
$\bar{X}$ length		4.2	8.1	11.2	13.5	15.1	16.3	17.2	18.2	19.1	19.7
$\bar{X}$ increment		4.2	3.9	3.1	2.3	1.6	1.2	0.9	1.0	0.9	0.6

DISCUSSION OF FINDINGS

Relative weights (W_r) of largemouth bass populations continue to fluctuate. Compared to 1987 results, significantly lower W_r values were calculated for three study areas and no change was noted in two study areas (Figure 10). Computation of W_r values for one inch length groups for all study areas (Figures 11 and 12) indicated which length group of the largemouth bass population contributed to observed changes in population mean W_r's. For example, bass in Minnesota Slough in the 9-13 in range had significantly lower mean W_r values during 1988 compared to 1987 (Figure 12). Reasons for changes in body condition are somewhat speculative, however, extremely low water conditions may have contributed, resulting in excessive movements, stress and disruption or reduction of normal food production. Large scale bass movement was documented when anglers returned floy tags to show 85% of the recaptured fish were located out of the study area (Job 2). Mass movement of largemouth bass was also documented by Job 3, when all radio tagged fish moved out of the Sunfish Lake study area. Backwater areas are the most productive components of the Upper Mississippi River ecosystem (Eckblad 1986). Severe reductions of this habitat by low water during 1988 may have reduced food production and contributed to lower W_r values for largemouth bass. As with 1987 results, differences were still noted for mean W_r values for fish of the same length but from different study sites and also between collection years (Figures 11 and 12).

Largemouth bass population estimates obtained during 1988 compared favorably with previous results (Figure 13). The exception was the Lainesville Sl.-Lower Brown's Lake study area where the population estimate was significantly lower than the 1987 estimate, however, the estimate was similar to that made in 1984.

PSD values remained relatively stable in Lainesville Sl.-Lower Brown's Lake, Sunfish Lake and Methodist Lake; values increased in Norwegian Lake but decreased in Minnesota Slough. Part of the decrease observed in Minnesota Slough was due to the strong 1987 year class of fish which recruited to the stock (8-11 in) size (Figure 5). Most PSD values however, fell within or close to the 31-50% range recommended by Paragamian (1982) for largemouth bass in Iowa.

Standing stock estimates ranged from 8.0 to 41 lbs/acre and reflect changes documented by population estimates. Standing stock estimates in Sunfish Lake nearly doubled in 1988 compared to 1984 and 1985. Length-frequency (Figure 8) indicated a large part of the increase was due to the number of fish in the 8-12 inch range, probably reflecting the 12 inch minimum length limit. This has probably resulted in a reduction in angler mortality for fish in the 8-12 inch range. However, standing stocks have not responded in a similar manner in Lainesville Sl.-Lower Brown's Lake where a 12 inch minimum length limit is also in effect. Standing stocks increased from 7.0 to 18.5 lbs/acre in Lainesville Sl.-Lower Brown's Lake from 1984 to 1987, then decreased to 8.0 lbs/acre during 1988. Length-frequency distributions (Figure 9) show good numbers of fish in the 8-12 inch range, however, the total abundance of fish has decreased.

The 68% estimated total mortality rate for largemouth bass in Lainesville Sl.-Lower Brown's Lake was the highest recorded during the 4 years of the

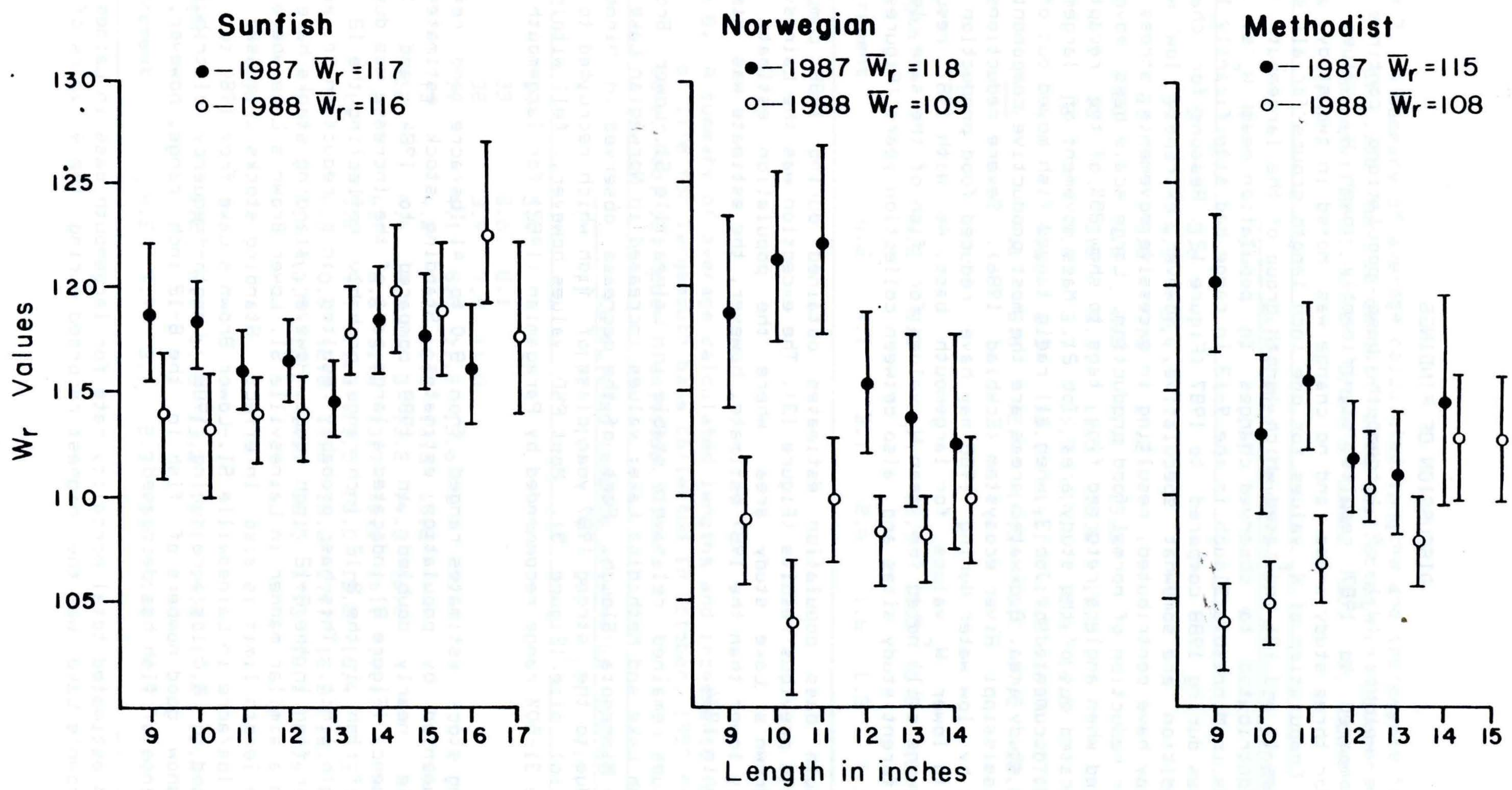

Figure 11. Mean W_r values calculated for largemouth bass sampled from three backwater areas on the Upper Mississippi River, 1987. The 95% confidence interval of the means are also provided.

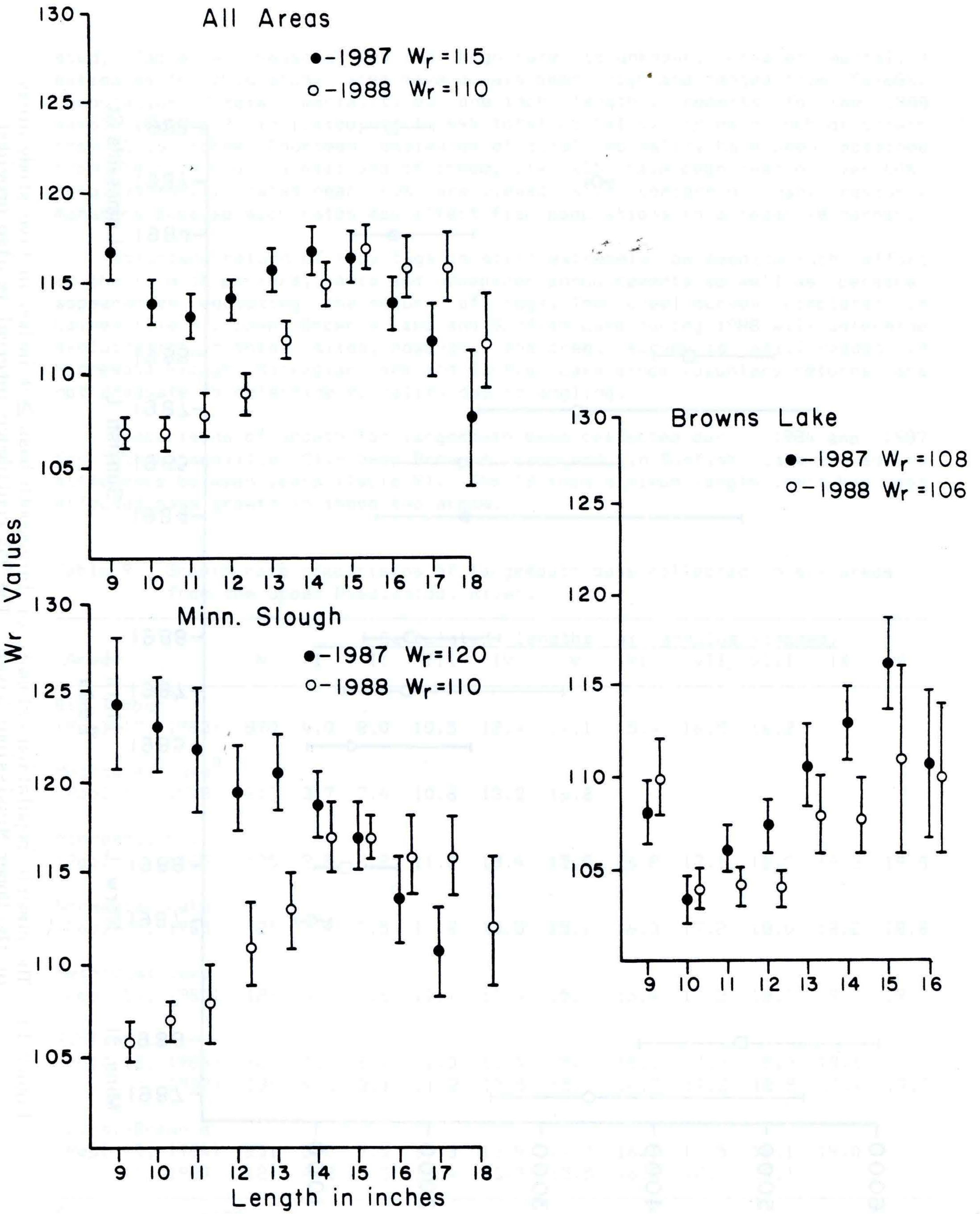

Figure 12. Mean W_r values for largemouth bass sampled from two slough areas and the combined W_r values for the study areas on the Upper Mississippi River, 1987. The 95% confidence interval of means are also provided.

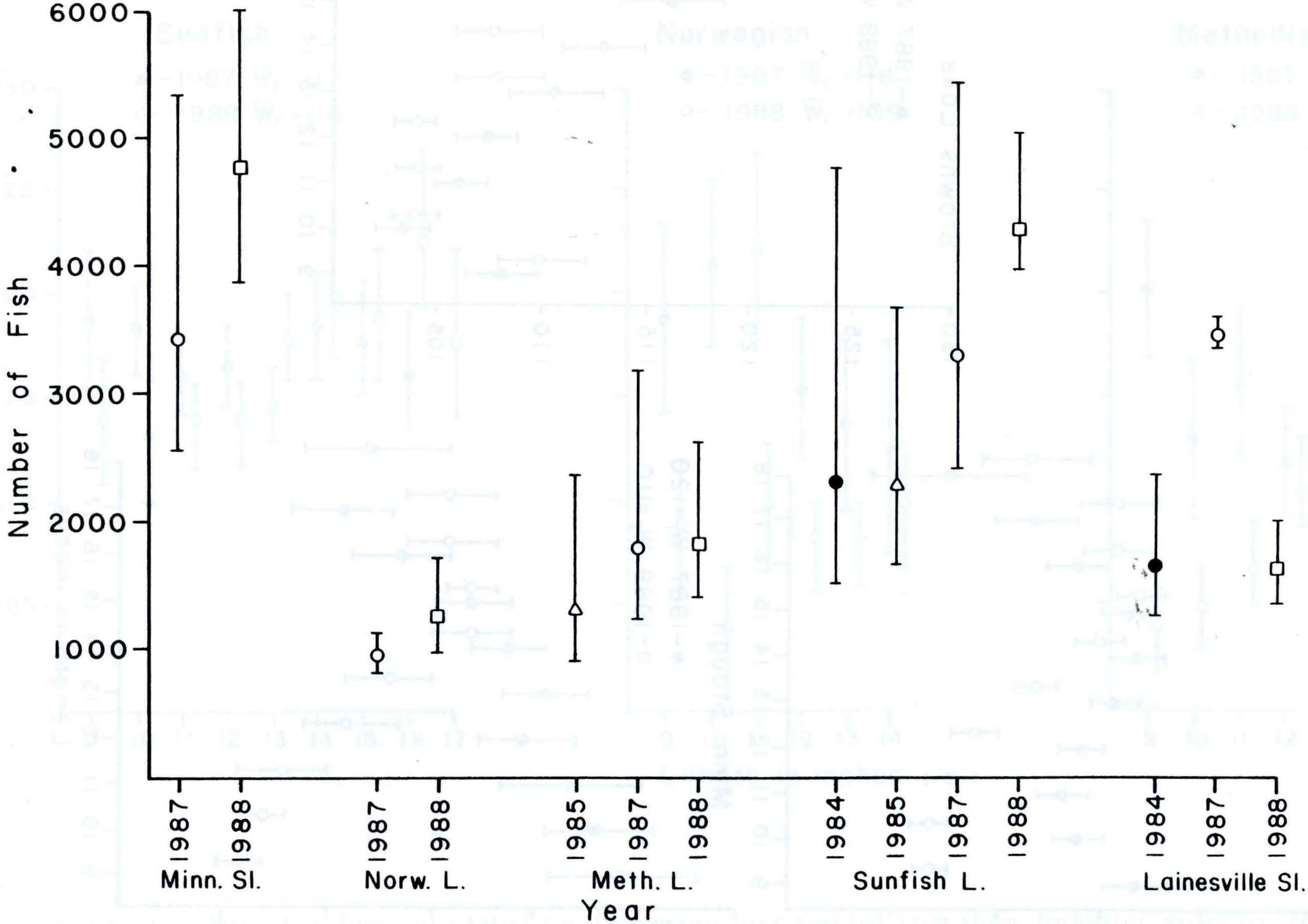

Figure 13. The numeric population estimate of largemouth bass ≥ 9 inches in five study areas of the Upper Mississippi River. The 95% confidence interval is also provided.

study (Table 4). Reasons for the high rate is unknown, however mortality estimates for this study area have always been high and ranged from 56-68%. Computation of total mortality by one inch length increments for the 1988 sample (Figure 9) indicated nearly 44% total mortality for each inch of growth from 12-16 inches. Fourteen estimates of total mortality have been obtained from the five study areas; and of these, six (43%) have been near or over 60%. Total mortality rates near 60% are viewed with concern by many resource managers because such rates may affect fish populations in a negative manner.

Voluntary return of floy tags is still extremely low despite much effort in the form of posters, radio and newspaper announcements as well as personal appearances requesting the return of tags. The creel survey completed in Lainesville Sl.-Lower Brown's Lake and Sunfish Lake during 1988 will determine exploitation in these sites, however, the creel survey is still needed in Minnesota Slough, Norwegian Lake and Sunfish Lake since voluntary returns are not adequate to determine mortality due to angling.

Comparisons of growth for largemouth bass collected during 1984 and 1987 for both Lainesville Sl.-Lower Brown's Lake and in Sunfish Lake showed no difference between years (Table 9). The 12 inch minimum length limit has not affected bass growth in these two areas.

Table 9. Growth rate comparisons of largemouth bass collected in six areas from the Upper Mississippi River.

Area	N	Calculated lengths at annulus (inches) I	II	III	IV	V	VI	VII	VIII	IX	X
Big Timber[a]											
(Pool 17, 1983)	890	4.0	8.0	10.5	12.4	14.1	15.4	16.5	16.2		
Methodist Lake[b]											
(Pool 10, 1978)	213	3.7	7.4	10.6	13.3	16.2					
Minnesota Sl.											
(Pool 9, 1985)	135	3.8	8.2	11.2	13.4	15.0	16.2	17.1	18.0	19.3	19.8
Norwegian Lake											
(Pool 10, 1985)	121	3.4	7.5	10.8	13.3	15.1	16.3	17.2	18.0	18.2	18.8
Methodist Lake											
(Pool 10, 1985)	128	3.4	7.6	11.1	13.4	15.1	16.4	17.3	18.1	19.0	19.7
Sunfish Lake											
(Pool 12, 1984)	221	3.8	8.1	11.3	13.5	15.0	16.1	17.3	18.0	18.1	
(" ", 1987)	134	4.2	8.1	11.2	13.5	15.1	16.3	17.2	18.2	19.1	19.7
Lains.-Brown's											
(Pool 13, 1984)	251	3.8	7.5	10.3	12.9	14.7	16.1	17.5	18.1	19.0	
(" ", 1987)	121	4.2	8.3	11.4	13.9	15.5	16.8	18.1	19.1		

[a] Van Vooren, 1983
[b] IA. Cons. Comm., unpublished data, 1978

RECOMMENDATIONS

1. Largemouth bass scales collected from Minnesota Slough, Norwegian Lake and Methodist Lake will be analyzed and reported in the next project segment.

2. Largemouth bass population modeling should be initiated using total mortality rates that range from 40-60% and exploitation rates of 30-45% (Job 2).

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ANNUAL PERFORMANCE REPORT
RESEARCH PROJECT SEGMENT

STATE: Iowa

NAME: An Evaluation of Largemouth Bass Populations in the Upper Mississippi River

PROJECT NO.: F-109-R

STUDY NO.: 1

JOB NO.: 2

TITLE: Sport Fishery & Largemouth Bass Harvest

Period Covered: 1 January, 1988 through 31 December, 1988

ABSTRACT: A creel survey at two study areas showed bluegill, crappie sp., bullhead sp., and largemouth bass dominated the harvest. Overall harvest rates ranged from 0.42 to 0.77 fish/hr, fishing pressure ranged from 17.6 to 52.6 hrs/acre and harvest was 14.7 and 5.4 lbs/acre in the two study areas. Largemouth bass were harvested at the rate of 2.3 and 2.5 lbs/acre from two areas. Largemouth bass catch rates were five fold higher than harvest rates which indicated an 80% release of angler caught bass. Exploitation of floy tagged largemouth bass was estimated at 32% and 46% for the two areas.

JOB 2 OBJECTIVES

To determine harvest and estimate exploitation of largemouth bass.

INTRODUCTION

The importance of largemouth bass as a component of the Upper Mississippi River sport fishery has been described in the introduction to Job 1. An understanding of largemouth bass population dynamics is needed to make intelligent management decisions. Information about largemouth bass total mortality rates and its two components, natural mortality and exploitation are key elements in determining management strategies. Total mortality rates were estimated in Job 1 while exploitation will be estimated in this segment of the project through use of an expandable creel survey.

METHODS AND PROCEDURES

Angler catch and harvest from Lainesville Slough-Lower Brown's Lake and Sunfish Lake study areas were estimated by an expandable creel survey from May 1, 1988 through October 30, 1988. A 12 hr survey period (7:00 a.m. to 7:00 p.m.) was subdivided into two 6 hr periods, 7:00 a.m. to 1:00 p.m. (designated as an "A" day) and 1:00 p.m. to 7:00 p.m. (designated as a "B" day). Further stratification was achieved by division into week days and weekend days and random assignment of "A" or "B" days to each. Holidays were assigned weekend day status. Generally, 10 days were surveyed in each study area per month, four weekend days and six week days. Completed angler trips were used to determine mean trip length and both incomplete and completed angler trips were used to estimate harvest statistics. During a survey period, the creel clerk made hourly counts of all anglers in the study area. Between hourly counts, the creel clerk interviewed anglers, especially those leaving the study area so that completed trip results could be obtained. Creel data were expanded by "A" or "B" days, by week day or weekend day, by month and by study area. Totals for a month, area or study period were derived by adding expanded creel components. Expansion of creel survey information was accomplished by the following formulas:

1) $$TE = TD \times H \times \frac{TA}{TC}$$

where: TE = total effort in hours
TD = the number of days in a period (month) (i.e. 8 weekend days per month or 21-23 week days per month)
TA = total number of anglers counted during the period
TC = total number of hourly counts during the period
H = number of hours in survey period (6 hrs)

2) $$MTL = \frac{HF}{A}$$

where: MTL = mean trip length
A = number of anglers interviewed (only completed trips)
HF = hours fished (only completed trips)

3) $ETA = \frac{TE}{MTL}$

where: ETA = estimated total number of anglers for the period

4) $C/E = \frac{F}{TH}$

where: C/E = catch per hour (fish/hr)
F = total fish creeled (from all interviews)
TH = total hours fished to catch F

5) ETH = C/E x TE

where: ETH = estimated total numerical harvest

Harvest statistics for individual species were obtained by multiplying the percent contribution of each species for the survey period by the estimated total harvest (ETH). Weights for each species was obtained by expanding the species average weight by the estimated numerical harvest.

Exploitation was estimated by two procedures:

1) $\frac{\text{largemouth bass harvested (from creel)}}{\text{largemouth bass population estimate (Job 1)}}$

2) $\frac{\text{floq tagged largemouth bass in the creel}}{\text{total floy tagged largemouth bass in study area}}$

The total floy tagged largemouth bass available to anglers in the study areas was adjusted for:

1. Floy tag loss as determined in Job 1.

2. Emigration from the study site. Voluntary floy tag returns by anglers was used to estimate that portion of the tagged fish that moved out of the study area.

In addition, the ratio of tagged bass in the creel to the total bass in the creel was used to estimate the number of floy tagged bass that were caught and released. A 10% hooking mortality was applied to caught and released floy tagged bass. For example:

the number of bass released	1000
# floy tagged bass in the creel (15) / total # harvested bass in creel (100)	x .15
	150
10% hooking mortality	x .10
Mortality of floy tagged bass due to catch and release	15

Voluntary floy tag returns were used to estimate the proportion of exploitation that occurred during the creel survey period (May-October) and the period not surveyed (November-April). The percent of voluntary tags returned during the creel survey period (May-October) was equated to the exploitation rate and the resulting ratio was used to estimate exploitation during the November-April period.

For example:

a) % floy tags returned (May-Oct.) 80%
b) estimated exploitation rate during May-Oct. from the creel survey 30%
c) % floy tags returned (Nov.-April) 20%

$$\frac{.8}{.3} = \frac{.2}{x} \qquad x = 0.075$$

d) x = estimated exploitation (Nov.-April) 7.5%
e) total estimated exploitation = 30%+7.5% = 37.5%

FINDINGS

Nearly 1,200 anglers were interviewed during the survey period (Table 1). Nearly three times as many anglers utilized the Lainesville Slough-Lower Brown's Lake area compared to the Sunfish Lake area. The highest number of anglers were interviewed during May (286), followed by September (238) (Table 1).

Table 1. The number of anglers interviewed in two study areas in the Upper Mississippi River, 1988.

	Area		
	Lainesville Sl.-Browns L.	Sunfish Lake	
Month	No. anglers	No. anglers	Total
May	240	46	286
June	123	44	167
July	168	53	221
August	85	38	123
September	156	82	238
October	120	41	161
Totals	892	304	1,196

An estimated 4,771 anglers expended 10,260 hrs harvesting 7,911 fish in the Lainesville Sl.-Lower Brown's Lake study area during the creel survey period (Table 2). Harvest rate was 0.77 fish/hr while 1.7 fish were harvested per fishing trip. Fish harvest was estimated at 14.7 lbs/acre and fishing pressure was 52.6 hrs/acre. An additional 1,850 fish were caught and released.

An estimated 2,328 anglers fished for 2,521 hrs to harvest 1,061 fish in the Sunfish Lake area during the study period (Table 2). Harvest rate was

0.42 fish/hr and 0.5 fish were kept per fishing trip. Pressure was 17.6 hrs/acre and there were 5.4 lbs of fish harvested per acre of water. An additional 899 fish were caught and released.

Table 2. Sport fishery statistics for Lainesville Sl.-Lower Brown's Lake, Pool 13 and Sunfish Lake, Pool 12, Upper Mississippi River, May through October, 1988.

Parameter	Lainesville Sl.-Lower Brown's L.	Sunfish L.
Anglers	4,771	2,328
Effort (hrs)	10,260	2,521
Estimated total catch	9,771	1,960
Catch rate (fish/hr)	0.95	0.78
Estimated total harvest	7,911	1,061
Harvest rate (fish/hr)	0.77	0.42
Estimated total weight harvested (lbs)	2,862	778
Fish harvested per trip	1.7	0.5
Mean trip length (hrs)	2.1	1.1
Harvest (lbs/acre)	14.7	5.4
Fishing pressure (hrs/acre)	52.6	17.6

Bluegill dominated the numeric catch in the Lainesville Sl.-Lower Brown's Lake study area followed by crappie spp., bullhead spp. and largemouth bass (Table 3). Bluegill, largemouth bass and channel catfish contributed 93% of the total catch in the Sunfish Lake study area. Largemouth bass contributed 16% to the total weight of fish harvested in the Lainesville Sl.-Lower Brown's Lake study area and 47% of the fish harvested in the Sunfish Lake area (Table 3).

Anglers preferred crappie, bluegill and largemouth bass when fishing in the Lainesville Sl.-Lower Brown's Lake study area (Table 4). Largemouth bass, bluegill and crappie were preferred by anglers fishing the Sunfish Lake study area.

Table 3. Species composition of the sport fish caught from Lainesville Sl.-Lower Brown's Lake, Pool 13 and Sunfish Lake, Pool 12, Upper Mississippi River, May through October, 1988.

Species	Lainesville Sl.-Lower Brown's Lake Number	Lainesville Sl.-Lower Brown's Lake Weight(lbs)	Sunfish Lake Number	Sunfish Lake Weight(lbs)
Bluegill	4,326	1,075	714	213
Crappie spp.	2,808	975	20	11
Bullhead spp.	355	280	-	-
Largemouth bass	334	450	212	363
(# tagged)	(64)		(19)	
Channel catfish	18	24	67	110
Yellow perch	21	9	-	-
Northern pike	-	-	10	30
White bass	40	14	-	-
Other	8	35	38	52
Totals	7,911	2,862	1,061	779
Largemouth bass released	1,271		832	
Other fish released	589		67	
Totals	1,860		899	

Table 4. Species of fish preferred by anglers while fishing in Lainesville Sl.-Lower Brown's Lake, Pool 13 and Sunfish Lake, Pool 12, Upper Mississippi River, May through October, 1988.

Species	Lainesville Sl. Lower Brown's Lake	Sunfish Lake
Crappie	38%	17%
Bluegill	36%	21%
Largemouth bass	22%	58%
Bullhead	2%	-
Channel catfish	1%	3%
Anything	1%	1%

Largemouth Bass Harvest Statistics

Anglers reported over 2,600 largemouth bass were caught in the two study areas during the survey period (Table 5). Nearly 80% (2,103) were released.

The length-frequency distribution of harvested bass (Figure 1) indicated 13% of the harvested fish were less than the 12 inch minimum length limit in the Lainesville Sl.-Lower Brown's Lake study area. Bass less than the minimum length limit were not obseved by the survey clerk in the Sunfish Lake study area.

Table 5. Largemouth bass harvested and released from the Lainesville Sl.-Lower Brown's Lake and the Sunfish Lake study areas, May through October, 1988, Upper Mississippi River.

	Area			
	Lainesville Sl. Lower Brown's Lake		Sunfish Lake	
Month	Harvested	Released	Harvested	Released
May	152	241	47	184
June	45	395	9	85
July	16	232	0	12
August	56	257	26	89
Sept.	55	122	36	228
Oct.	11	24	94	224
Total	335 (21%)	1,271 (79%)	212 (20%)	832 (80%)

Largemouth bass harvest was estimated to be 2.3 and 2.5 lbs/acre for the Lainesville Sl.-Lower Brown's Lake and the Sunfish Lake study areas, respectively (Table 6). Harvest rates were 0.03 and 0.08 bass/hr for the same areas, respectively. Total exploitation for largemouth bass was estimated to be 32% for the Lainesville Sl.-Lower Brown's Lake study area and 46% for the Sunfish Lake study area (Table 7).

Table 6. Harvest statistics for largemouth bass as determined by creel survey from two study areas of the Upper Mississippi River, May through October, 1988.

	Area	
	Lainesville Sl.-Lower Brown's Lake	Sunfish Lake
Harvest (lbs/acre)	2.3	2.5
Catch rate (bass/hr)	0.16	0.41
Harvest rate (bass/hr)	0.03	0.08
$\bar{X}$ weight harvested (lb)	1.3	1.7
Bass harvested/trip	0.07	0.09

Emigration of tagged fish from respective study areas as determined by floy tags returned by anglers ranged from 38% for Minnesota Slough to 85% for Sunfish Lake (Table 8). The average emigration of tagged fish from study areas during 1988 was 56%.

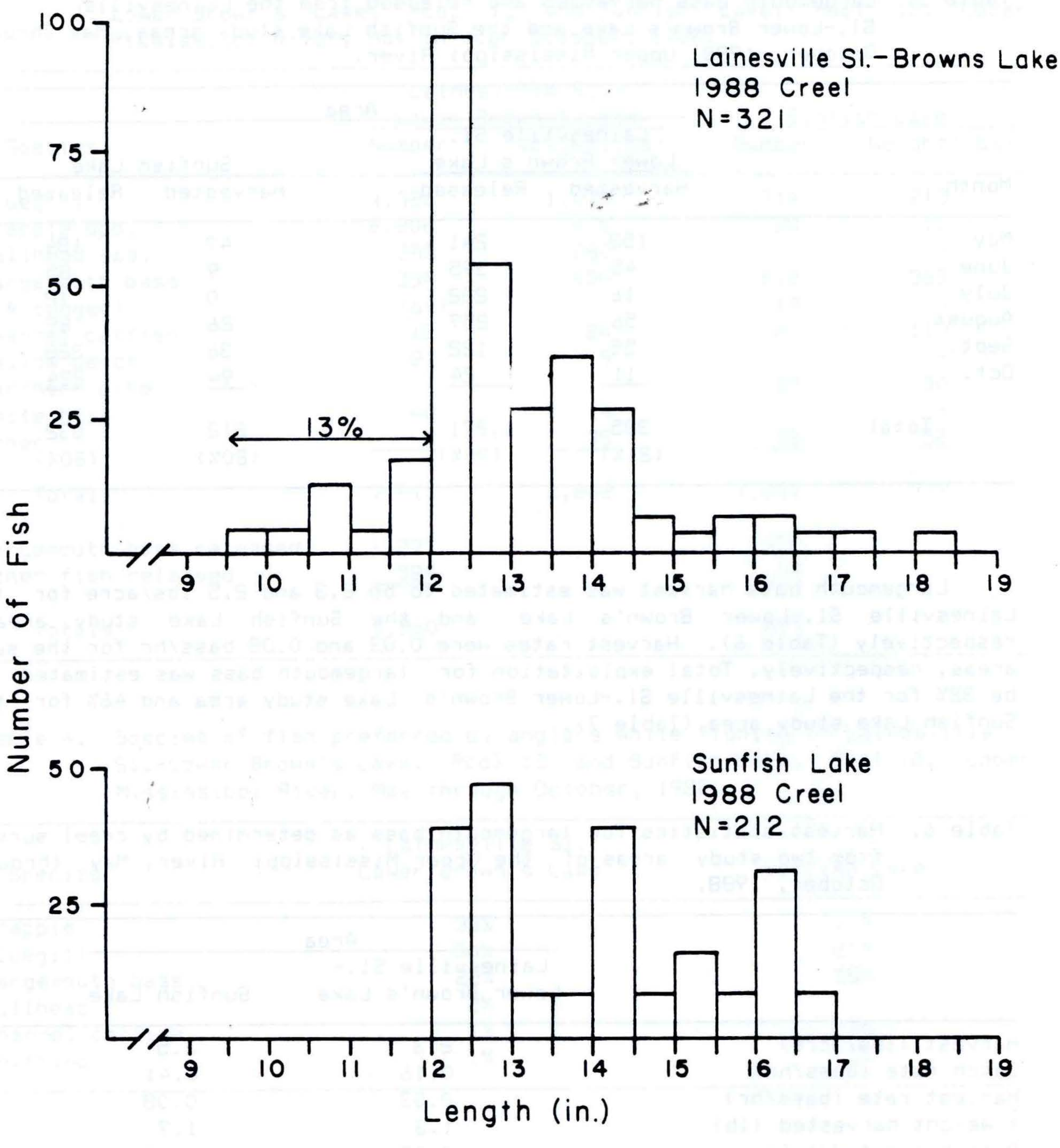

Figure 1. Length-frequency distribution of largemouth bass harvested from two study areas of the Upper Mississippi River, May through October, 1988.

Table 7. Estimated exploitation of largemouth bass in Lainesville Sl.-Lower Brown's Lake, Pool 13, and Sunfish Lake, Pool 12, Upper Mississippi River, 1988.

	Area			
	Lainesville Sl.-Lower Brown's L.		Sunfish L.	
Total bass tagged (1987)	1,261		844	
- Floy tag loss (Table 5, Job 1)		47%		47%
- Emigration loss (Table 8)		50%		85%
Total tagged bass available	334		67	
a- tagged bass in creel (Table 3)		64		19
b- 10% hooking mortality due catch and release of tagged fish		24		8
Total death of tagged fish due angling		88		27
Exploitation (May-Oct.)		26%		40%
Exploitation (Nov.-April) (18% of total, from Table 8)		6%		6%
Total Exploitation		32%		46%
Z (4-yr avg., Table 4, Job 1)		0.97		0.76
F		0.39		0.62
M		0.58		0.14
A (total annual mortality)		0.62		0.53
u (exploitation rate: u=A-v)		0.32		0.46
v (natural mortality: v=A-u)		0.30		0.07

DISCUSSION OF FINDINGS

Extremely low water levels during the summer period reduced the number of anglers utilizing the Sunfish Lake study area. Anglers could not gain access because of shallow water depths, dense vegetation and the danger of striking submerged stumps and logs. The same low water conditions probably increased angler use of Lainesville Sl.-Lower Brown's Lake complex because Upper Brown's Lake was devoid of water.

Low water levels were also responsible for the extensive movement of largemouth bass from areas in which tagging and release occurred (Table 8). This movement was collaborated in Job 3 when all radio tagged fish moved out of the Sunfish Lake study area during the summer period before beginning to return in mid-October. The movement of largemouth bass due to low water conditions resulted in the inability to estimate anlger exploitation as determined by estimates of bass harvest and bass population parameters. Although the number of bass moving out of the study area was estimated by voluntary tag return, no valid estimate could be made of bass immigration. During normal water regimens, it was anticipated that emigration would equal immigration resulting in stable largemouth bass populations.

Table 8. A summary of the floy tags removed from largemouth bass and returned by anglers fishing the Upper Mississippi River, 1988.

	Area									
	Minn. Sl.		Norwegain L.		Meth. L.		Sunfish L.		Lain-Br. L.	
Month	I[a]	O[b]	I	O	I	O	I	O	I	O
Jan.									1	
Feb.	2								1	
March	1	3		1	9					
April	2	1		1	2			2		1
May	18	5	1	3		1	5	12	5	2
June	8	6		2		2		5	4	2
July	1	1	1	1		2		6		4
Aug.		3				1		3	1	
Sept.			1					1		3
Oct.	1	1		2			1	5		
Nov.										
Dec.										
Totals	33	20	3	10	11	6	6	34	12	12
(%)	(62)	(38)	(23)	(77)	(65)	(35)	(15)	(85)	(50)	(50)

[a] fish recaptured in the study area
[b] fish recaptured outside of the study area

RECOMMENDATIONS

1. Because of the extremely low water conditions and extensive movements of bass, the reliability of angler exploitation estimates are questionable. The creel survey will be repeated to ensure reliable estimates of exploitation rates are obtained.

ANNUAL PERFORMANCE REPORT
RESEARCH PROJECT SEGMENT

STATE: Iowa
NAME: An Evaluation of Largemouth Bass Populations in the Upper Mississippi River

PROJECT NO.: F-109-R

STUDY NO.: 1

JOB NO.: 3
TITLE: Largemouth Bass Habitat Requirements

Period Covered: 1 January, 1988 through 31 December, 1988

ABSTRACT: Forty-three radio tagged largemouth bass were located over 700 times during this study segment. Mean water depth occupied by radio tagged largemouth bass was 3.2 ft, 2.7 ft, 2.6 ft, and 3.2 ft during 1985, 1986, 1987, and 1988, respectively. Tagged largemouth bass associated with cover over 80% of the time and dense growths of aquatic vegetation were used most often. Radio tagged largemouth bass moved up to 9 miles to overwinter in protected backwater areas and inhabited the same widely separated summer and winter areas in consecutive years. Forty-two percent of the radio tagged fish were lost to angling. No largemouth bass spawning beds were located.

JOB 3 OBJECTIVES

To determine largemouth bass habitat requirements, response to low oxygen conditions, spawning nest depth and response to water level fluctuations.

INTRODUCTION

Sedimentation has been identified as one of the major causes of habitat degradation of backwater complexes of the Upper Mississippi River (Brietenbach and Peterson 1980). Water depths are reduced and nuisance growths of aquatic vegetation are encouraged by sedimentation. These, in turn, result in stagnation and oxygen depletion. Largemouth bass inhabiting such backwater areas must move or die; however, tolerance to low oxygen concentrations, movements, distance moved and secondary habitat selections are unknown. Knowledge of these parameters will provide baseline information needed in the selection and development of backwater rehabilitation projects.

Water flow in the Mississippi River is regulated by the 29 locks and dams operated by the U.S. Army Corps of Engineers. Water levels are manipulated to maintain commercial tow passage and flood control; however, water level fluctuations during spawning of largemouth bass and other nest building species can be devastating. Information is needed to determine largemouth bass spawning bed location, depth and response of the species to water level fluctuations. This information, when included in a water level management plan, will benefit not only largemouth bass but also other nest building species.

METHODS AND PROCEDURES

Radio transmitters were implanted into largemouth bass captured from Sunfish Lake (Pool 12) and Lainesville Sl.-Lower Brown's Lake (Pool 13) study areas. Additional fish were also captured and radio tagged from other areas in Pool 12 to determine the extent of movement into the Sunfish Lake overwintering area. Electrofishing gear was used to capture most of the largemouth bass, however, several fish caught by participants in fishing tournaments were also used to help determine movement patterns from angler caught fish. Implantation or radio transmitters were similar to those described by Pitlo (1983). Captured largemouth bass were anesthetized by immersion in a tub of water containing 12 ppm MS-222. Anesthetized fish were weighed, measured and scales removed for age determination. Fish were then placed on a field surgical table (Courtois 1981) and the gills bathed with water containing the anesthetic. All surgical equipment and transmitters were placed in a mixture of sterilant (Novalsan) and distilled water prior to use. Transmitters were inserted anteriorly into the abdominal cavity through a 1.25 inch incision which was placed approximately 2 inches anterior the anal opening and 0.50 to 0.75 inches to the side of the mid-ventral line. The flexible whip antenna was attached to a needle and a small hole made so the antenna exited the body wall approximately 1.5 inches posterior and slightly dorsal the incision. Four sutures were used to close the incision. The suture material was a non-absorbable surgical suture made of multifilament nylon threads twisted and encased in a smooth nylon casing. A single suture was made over the antenna wire at the point of exit from the body wall to reduce movement and abrasion. Oxytetracycline hydrachloride was injected (20 mg/ 1 lb of body weight) into the body cavity of the fish to combat infection.

After surgery, fish were placed in a tub of fresh water which contained 10 ppm Furacin. A numbered Floy tag was inserted below the dorsal fin of each fish for external identification. After complete recovery, radio tagged fish were released in quiet water at the capture location.

Transmitters, receivers and antennas were obtained from Advanced Telemetry Systems Inc., Isanti, Minnesota. The transmitters operated on the 48-49 MHz band and individual frequencies were spaced 10-15 KHz apart. Various frequencies and pulse rates were used to distinguish between individual fish. Transmitters were single stage, weighed 0.92 ounce (air weight), measured 2.3 inches in length, 0.8 inches in diameter and had an expected life of 275-310 days. Transmitters were activated by a magnetic reed switch embedded in the potting material. Ross and McCormick (1981) recommended transmitter weight (in water) not exceed 1.5% of the air weight of fish. This guideline was followed and the minimum weight of fish used in this study was 2.1 lbs.

Receivers were portable, programmable and contained a manual/automatic scan function. Desired transmitter frequencies were programed into the receiver and the 48-49 MHz bands automatically scanned. Rates for the automatic scan mode ranged from 2 seconds to 16 minutes per channel.

Two types of receiving antennas were used, a large Yagi type and a smaller hand held loop antenna. The 48-49 MHz, 4 element Yagi boom antenna measured 10 ft by 12 ft and was mounted vertically on a tracking boat. The boom rotated and telescoped to allow maximum extension and signal reception distance. The hand held antenna was diamond shaped, 22 inches wide and 24 inches high. The hand held loop antenna was tunable which helped determine signal strength and direction.

Search for a radio tagged fish commenced at the point the fish was last located. A search pattern for lost fish was conducted one mile upstream and downstream of this point. When lost fish were not relocated in the smaller search area, the entire pool was searched, starting in the tailwaters and proceeding along the Iowa side of the main channel to the next lock and dam. The search included backwaters and running side channels. A similar search was made on the return trip along the Illinois side of the channel. Once a tagged fish was located, the date, time, water depth, water temperature and Secchi disc transparency were recorded. Landmarks and a Rangematic 1000 rangefinder were used to plot the locations of fish on navigation maps.

To aid in evaluating largemouth bass habitat selection, the study year was divided into 4 distinct periods: 1) winter (ice over to ice out, usually mid-November through March); 2) spring (ice out to June, to account for pre-, post-, and spawning habitat and movement); 3) summer (July to September); and, 4) fall (October to ice over).

FINDINGS

Movement and habitat selection was determined by radio telemetry for 43 largemouth bass during the 1988 study segment. Individual tagging or retagging dates, weights, lengths, number of observations per fish, days at large and disposition of radio tagged fish are shown in Appendix Table A.

Twenty six radio tagged largemouth bass carried operational transmitters from study segment 3 (1987) into study segment 4 (1988). The disposition of these 26 fish were: angler mortality - 11 (42%); expired battery - 2 (8%); disappeared - 3 (12%); died - 4 (15%); and 6 (23%) were retagged with new transmitters (Table 1). In addition, eight of the 26 radio tagged largemouth bass were caught and released by anglers during the study period.

Table 1. A summary of the disposition of radio tagged largemouth bass in Pool 12 of the Upper Mississippi River.

Parameter	1987	1988
No. radio tagged	26	17
Angler mortality	11 (42%)	2 (12%)
Battery expired	2 (8%)	-
Disappeared	3 (12%)	1 (6%)
Died	4 (15%)	-
Retagged	6 (23%)	-
Operational as of 1-1-89	6 (23%)	14 (82%)
Angler caught and released	8	4

In addition to the 6 retagged largemouth bass, 17 fish were radio tagged for the first time between July 8 and September 7, 1988 (Appendix Table A). Three of these 17 fish were lost (angling and disappearance) so that 20 radio tagged fish remained to be monitored as of 1-1-1989 (Table 1). Over 700 observations were obtained from radio tagged fish during 1988 (Appendix Table A). Several fish (#1 and #2, Appendix Table A) carried 3 different transmitters and over 90 individual observation were obtained from each before the fish died or disappeared. Most observations on radio tagged largemouth bass were collected during the spring and summer periods (Table 2). Fewer observations were collected during the fall and winter periods because of safety considerations due to weather and unstable ice conditions and commitments to other sampling (Job 1 and 2).

The mean water depth occupied by radio tagged largemouth bass during 1988 was 3.2 ft (Figure 1). This compared to 3.2 ft, 2.7 ft, and 2.6 ft during 1985, 1986, and 1987, respectively. Radio tagged largemouth bass were found in water depths that ranged from 1.5 to 4.0 ft nearly 80% of the time.

Specific habitats selected by largemouth bass continued to show a strong association with cover. Aquatic vegetation, either emerged or submerged, was found at 60% of the locations of radio tagged largemouth bass (Table 2). Radio tagged largemouth bass were found in open water (no apparent cover in the form of vegetation or wood) 18% of the time. Woody cover in the form of logs, stumps or brush piles were present at 15% of the bass locations. Flooded bottomland timber became a viable largemouth bass habitat only during periods of high water. Since spring flooding did not occur during 1987 and 1988, the overall use of this habitat type declined to 3% during the study period (Table 2).

Table 2. A summary of observations of radio tagged largemouth bass relative to specific habitats and seasons in Pool 12, Upper Mississippi River, 1986-1988.

Habitat type	Season: Winter '86	Winter '87	Winter '88	Spring '86	Spring '87	Spring '88	Summer '86	Summer '87	Summer '88	Fall '86	Fall '87	Fall '88	Total (%)
Emerged aq. vegetation				18	60	1	143	140	170	-	38	1	571 (31)
Submerged aq. vegetation				39	20	74	70	86	88	3	65	84	529 (29)
Open water	79	5	51	25	13	36	3	3	41	4	43	25	328 (18)
Single/stump or log	-	1	17	37	52	35	44	49	50	1	14	9	279 (15)
Brush or log pile	-	-	2	10	-	1	38	4	9	1	-	-	65 (4)
Flooded timber				45	-	-	1	-	-				46 (3)
Docks	-	5	-				2	2	1	-	-	1	11 (1)
Rip-rap				1	-	1	1	-	-				3 (<1)
Totals	79	11	70	175	145	148	302	284	359	9	160	120	1832
Total for Season (%)		160 (9)			468 (25)			945 (51)			289 (16)		

Partitioning of habitat use by seasons indicated open water areas were occupied by radio tagged largemouth bass about 80% of the time during the winter period when fish moved away from shorelines to occupy the middle (and deeper) portions of backwater overwintering areas (Figure 2). Ice depths of 1-2 ft isolated shallow shoreline woody cover and precluded fish use. Habitat occupied by radio tagged largemouth bass during the spring period was diverse, probably reflecting changing environmental conditions and spawning needs. Woody cover was used extensively (28%) after ice out and provided the cover needed until new vegetative growth became important (45%) later in the period (Figure 2). The spring period was the only time flooded timber habitat was used (10%), while emerged and submerged vegetation accounted for nearly three-fourths of habitats selected by radio tagged bass during the summer period. Submerged aquatic vegetation accounted for 53% of the fall bass locations and many of these observations were in dying beds of what once was emerged vegetation.

Movement of radio tagged fish during this project segment was similar to previous study segments (Pitlo, 1987 and 1988). The longest documented

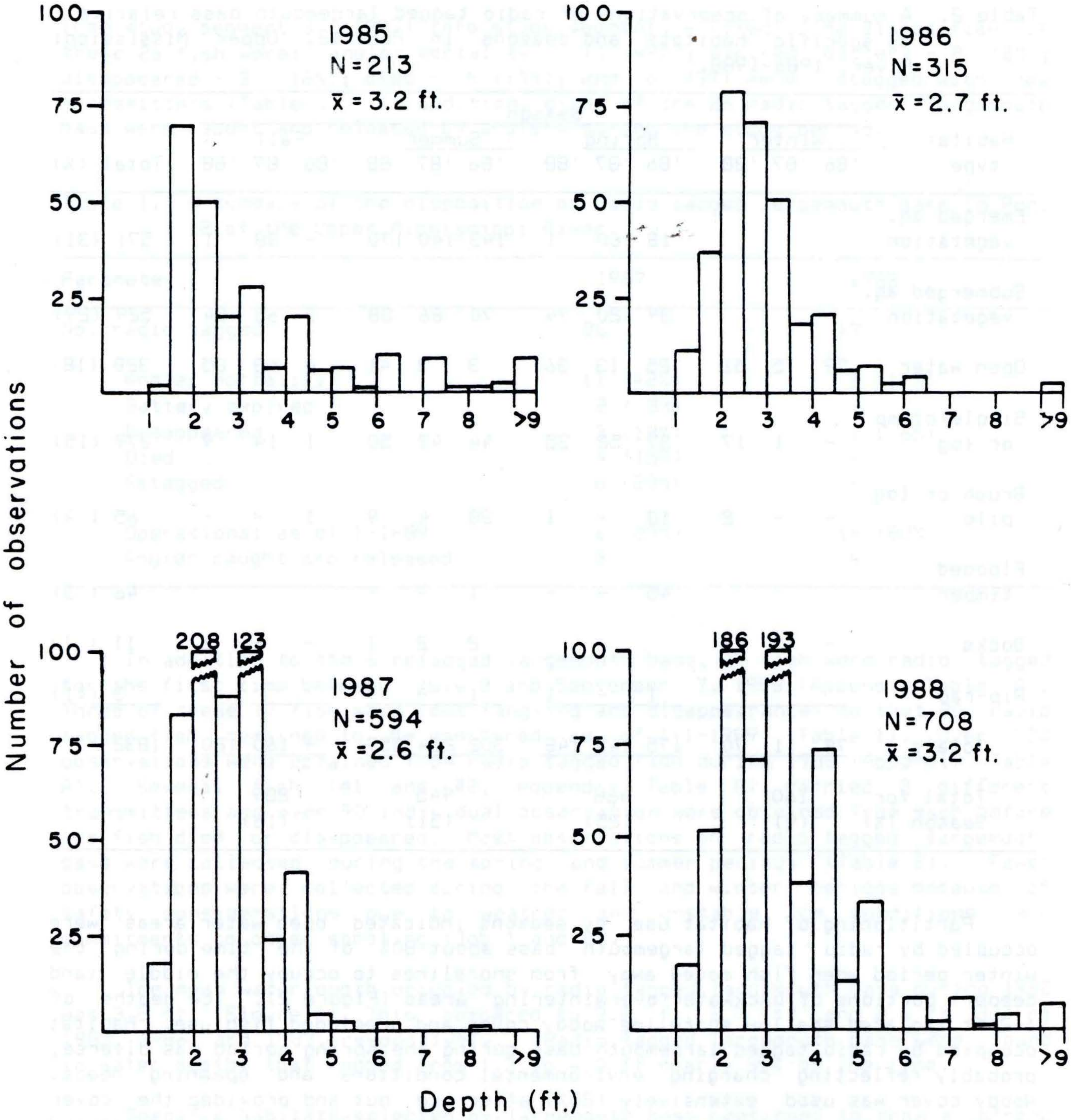

Figure 1. Depth of water inhabited by radio tagged largemouth bass in Pool 12 of the Upper Mississippi River, 1985-1988.

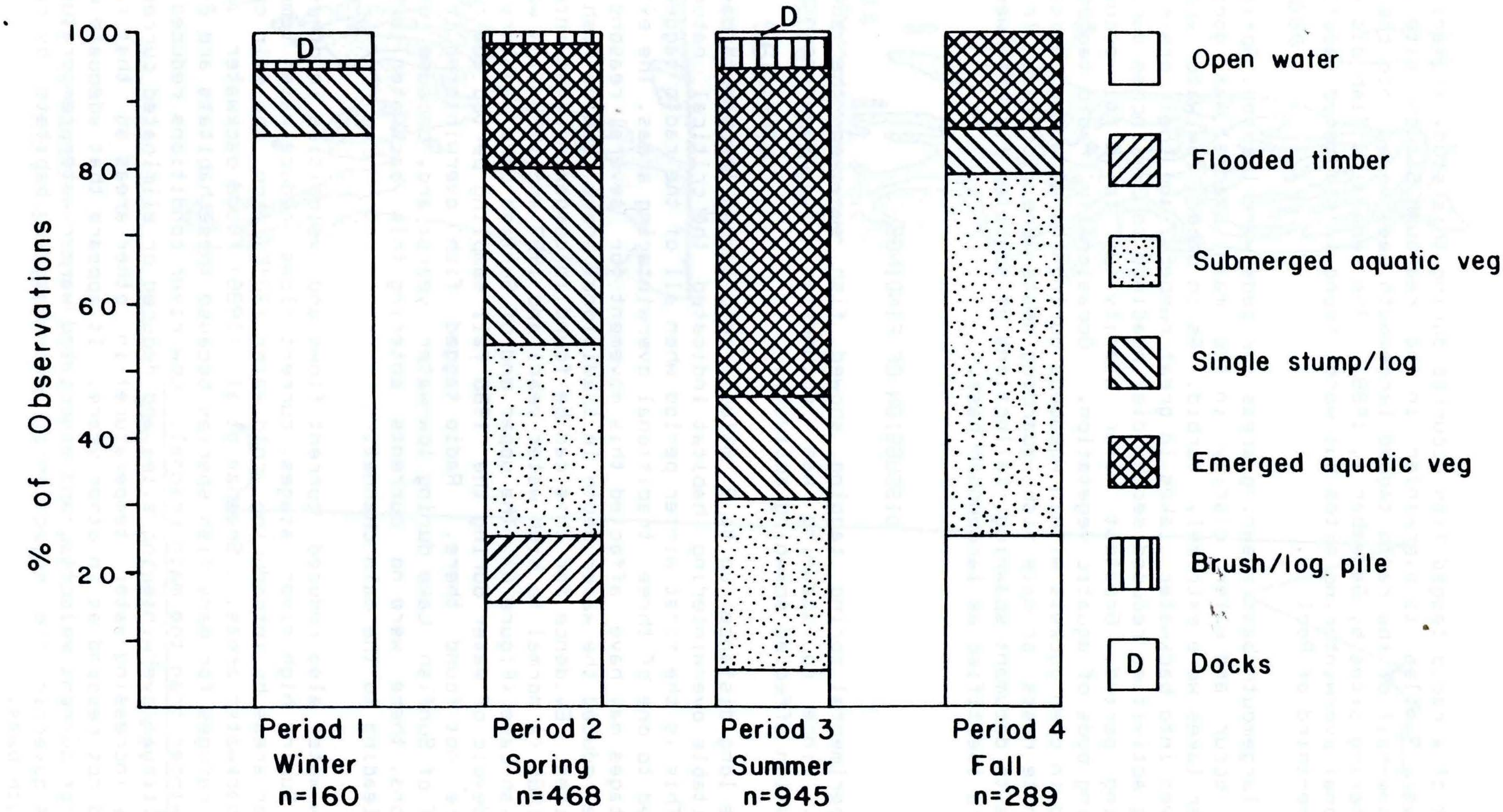

Figure 2. A summary of seasonal habitat occupied by radio tagged largemouth bass in Pool 12 of the Upper Mississippi River, 1985-1988.

movement of a radio tagged fish occurred during this study segment when a fish moved over 9 miles to overwinter in the Keehough Slough site (Figure 3). Nearly one-half of the radio tagged largemouth bass moved into the three known overwintering sites by December 1, 1988. The remaining fish did not move to traditional overwintering sites but were found in scattered locations in the lower one-third of Pool 12.

No largemouth bass spawning areas or beds were located. Spring flooding did not occur and water clarity in the main channel was good, however, backwater lakes were extremely turbid. As in other low water years, common carp moved into backwater lakes in great numbers and their pre-spawning and spawning activities reduced secchi disk readings to 3-4 inches during most of the spring period. Greatest water clarity (up to 2 ft) occurred within developing beds of aquatic vegetation. Occasionally, radio tagged fish were observed in open pockets within weedbeds during the spawning period, however, no definite nests or male fish guarding nests were located. In additional attempts to document spawning, collections of schooled fish fry were made but none were identified as largemouth bass.

DISCUSSION OF FINDINGS

Experimental spring tagging showed fish survived the surgery well, however, since no spawning was documented, it is unknown if spring implantation affected spawning activity.

The long distance (up to 9 miles) radio tagged largemouth bass moved to find suitable overwintering habitat indicated the critical nature of these areas. This is the first winter period when all of the radio tagged bass have not moved to one of three traditional overwintering areas. The extremely low river stages may have affected this movement for several reasons. Low water may have reduced the water depth in traditional areas causing fish to shift to other sites. Evidence for this can be found in comparing overwinter locations during 1986 (a normal to high water year) and 1987 and 1988 (low water years) in Sunfish Lake (Figure 4). The upper end of Sunfish Lake was very shallow and nearly devoid of water during the 1988 fall sampling period and radio tagged fish were not found there. Radio tagged fish overwintered in the lower one-half of Sunfish Lake during low-water years; and, because of low water conditions, there were no currents entering this backwater lake from the chutes leading to the main channel.

Low water also reduced current flows and velocities in other backwater areas. During high river stages, current flows reduce water temperature in backwater areas by introducing cold water (32°F) from the main channel into warmer backwater areas. Sheehan et al (1988) found backwater lakes act as thermal refuges for many fish species because these habitats are 2-4°F warmer during winter than the main channel. Low river conditions reduced water depth in traditional overwintering sites and reduced or eliminated current velocity (thereby increasing water temperature) in other areas so that radio tagged fish did not respond as in other years. It appears that adequate water depth, absence of current velocity, and associated warmer water temperatures are key elements governing the selection of overwintering habitats by radio tagged largemouth bass.

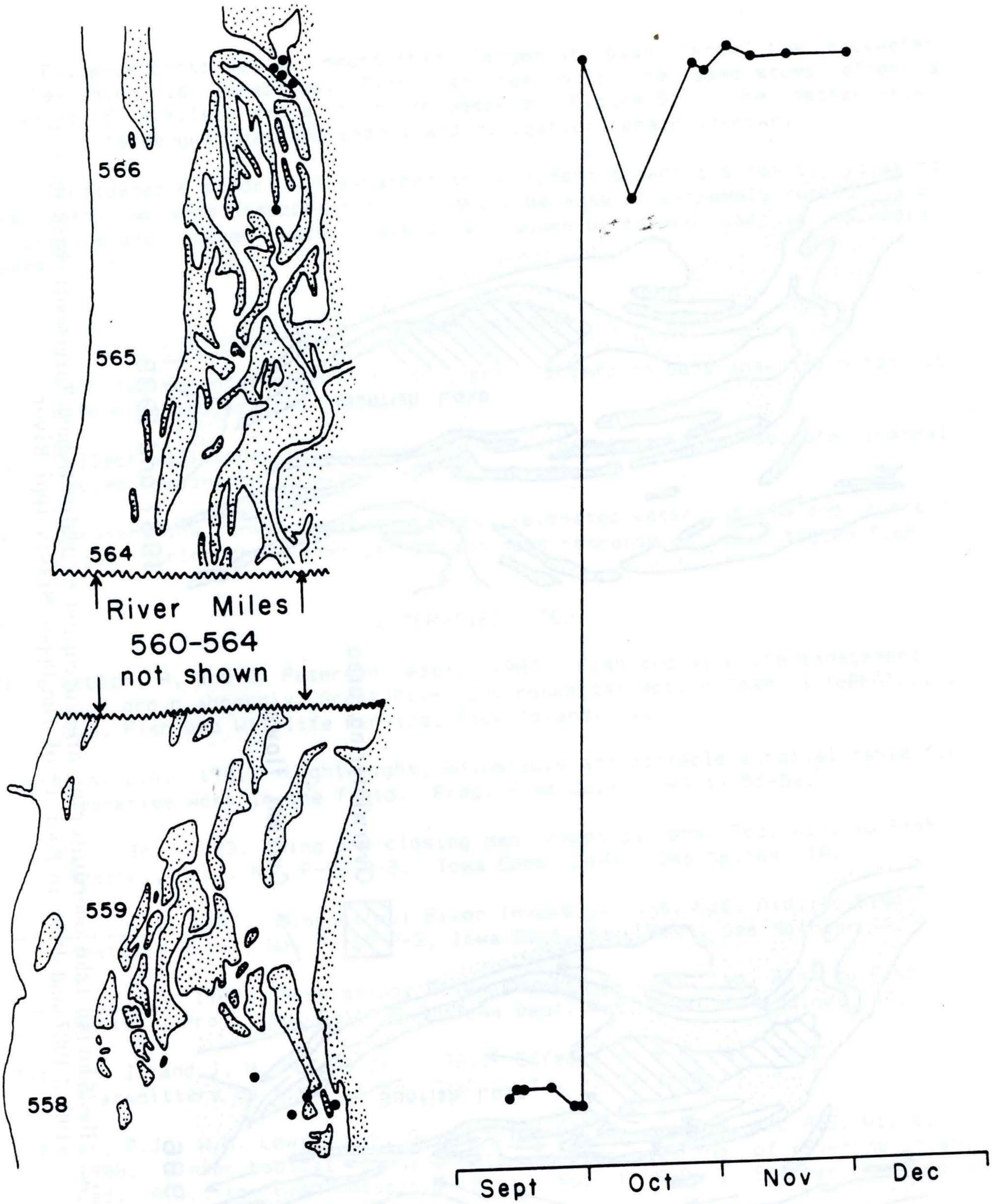

Figure 3. A summary of the locations of largemouth bass #1593 in Pool 12 of the Upper Mississippi River, 1988.

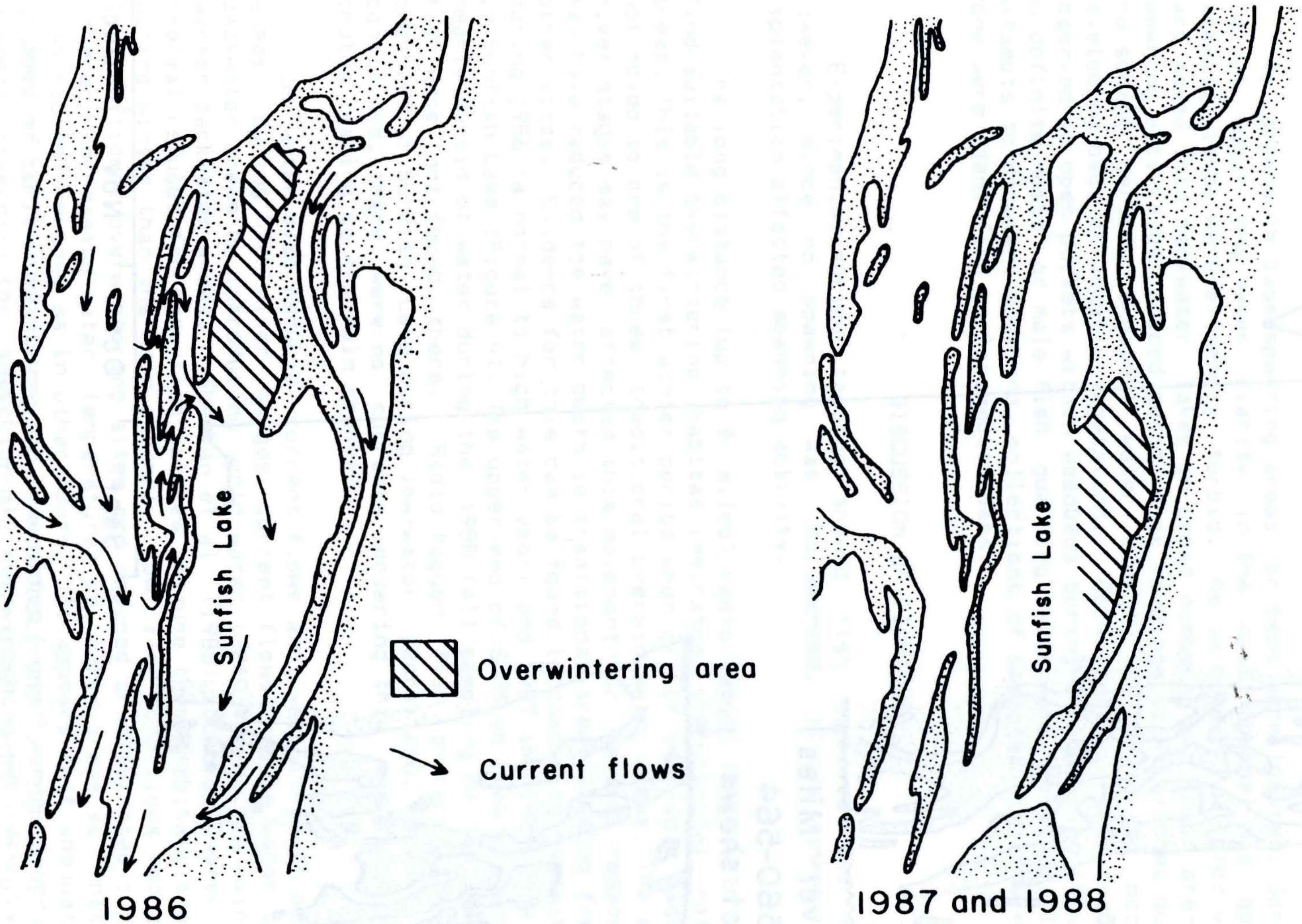

Figure 4. The Sunfish Lake overwintering area occupied by radio tagged largemouth bass during 1986, 1987 and 1988 in Pool 12 of the Upper Mississippi River.

Evidence continues to mount that largemouth bass "know" the backwater complex which is inhabited. Fish can return to the same stump after a movement of 4 miles and a 5 month absence (Figure 5). The mechanism(s) governing largemouth bass movements and navigation remain unknown.

Considerable effort was expanded to document spawning sites by locating bass nest. We were unsuccessful primarily because of extremely turbid water conditions and reduced water visibility caused by common carp in backwater lakes.

RECOMMENDATIONS

1. Continue expanded efforts to document largemouth bass spawning sites by extending project two years.

2. Collect additional water temperature information to collaborate thermal regime components of overwintering habitat.

3. Document the environmental changes (elevated water levels and current flows) during the winter period and note response of radio tagged fish.

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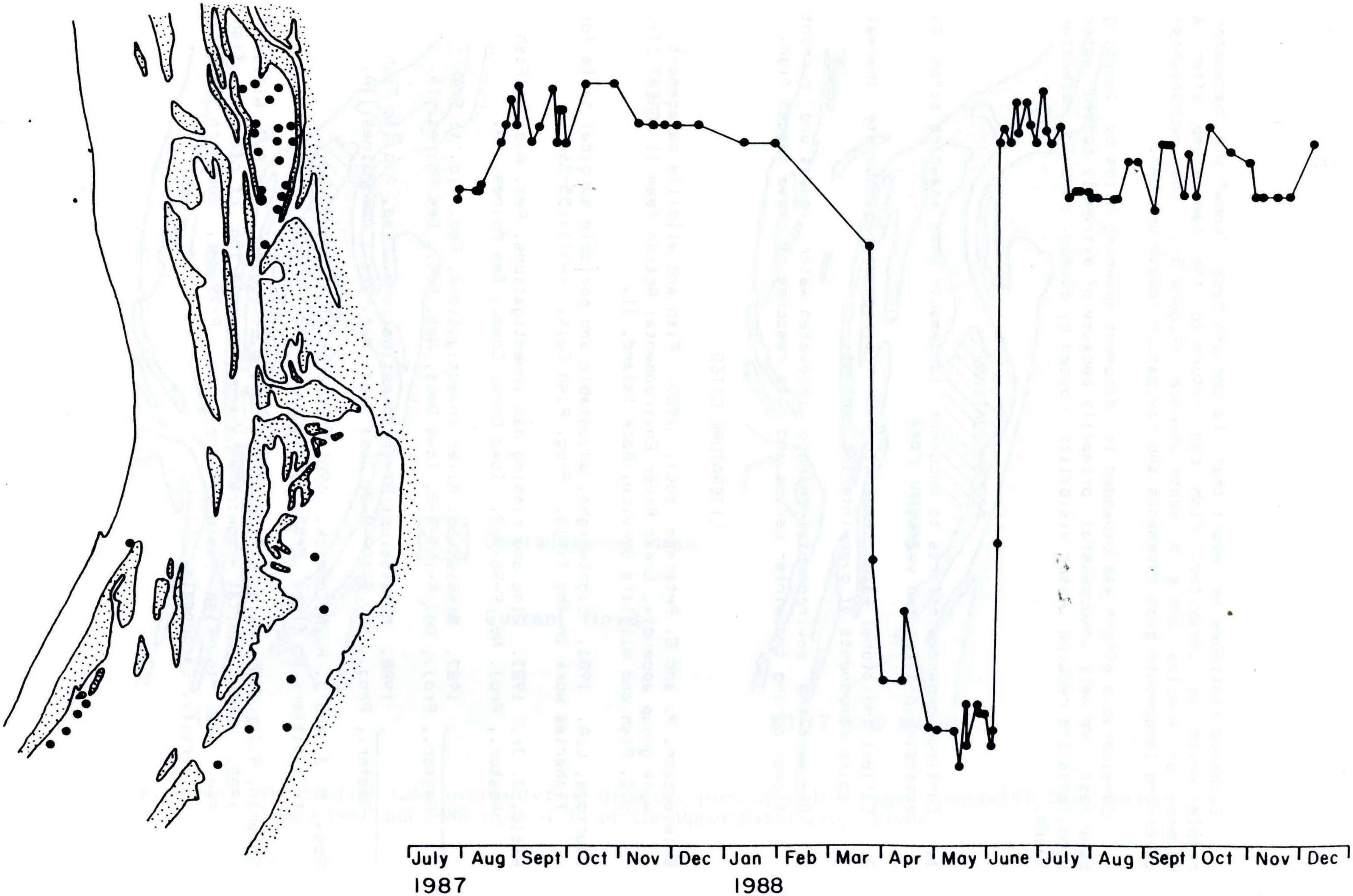

Figure 5. A summary of the locations of largemouth bass #1416 in Pool 12 of the Upper Mississippi River as determined by radio telemetry during 1987 and 1988.

Appendix Table A. Vital statistics of radio tagged largemouth bass inhabiting Pools 12 and 13 of the Upper Mississippi River, 1988.

Fish No.	(radio)	Date Tagged	Wt. (lbs)	Length (in)	No. of Observations	Days Out	Disposition
1	(49.532)	6-15-86	2.5	16.5	38	317	retagged
	(49.732)	4-28-87	-	-	34	158	retagged
	(48.450)	9- 8-87	2.7	16.6	19	234	died 4-29-88
2	(49.692)	6-15-86	3.1	17.1	51	315	retagged
	(49.834)	4-24-87	-	17.7	37	158	retagged
	(48.280)	9- 8-87	3.9	18.4	9	90	dis. 1-11-88
3	(49.253)	8-10-86	2.2	14.8	57	345	retagged
	(48.030)	7-21-87	1.9	14.9	27	300	dis. 5-12-88
4	(49.593)	6-19-87	2.1	15.3	14	111	retagged
	(48.320)	9- 8-87	2.5	15.5	14	90	died 1-11-88
5	(49.772)	6-30-87	2.2	15.6	19	84	retagged
	(48.880)	9-24-87	2.4	16.0	12	216	an re 5-15-88
6	(49.942)	6- 9-87	-	16.5	37	330	retagged
	(49.750)	5-10-88	2.4	16.5	32	120	retagged
	(48.903)	9-14-88	2.5	16.7	13	105	oper 1- 1-89
7	(49.302)	7-10-87	5.3	21.1	37	335	retagged
	(49.623)	6- 8-88	-	-	36	210	oper 12- 5-88
8	(49.406)	7-28-87	2.4	15.7	39	345	retagged
	(49.420)	7- 8-88	2.5	16.0	47	172	oper 1- 1-89
9	(49.112)	8-23-87	2.4	15.0	50	315	retagged
	(49.261)	7- 8-88	2.2	14.8	36	172	oper 1- 1-89
10	(48.595)	8-23-87	2.7	16.0	30	242	an re 5- 2-88
11	(48.050)	8-23-87	2.8	15.7	16	221	died 4-13-88
12	(48.475)	8-23-87	5.3	19.4	24	252	an re 5-12-88
13	(48.010)	8-23-87	2.2	15.8	15	123	an re 12-26-87
14	(49.560)	8-23-87	3.3	17.4	25	250	an re 5- 7-88
15	(49.219)	8-23-87	3.0	17.1	22	138	died 1-11-88
16	(48.340)	8-31-87	2.1	15.1	14	270	b.exp 7- 4-88
17	(48.360)	8-31-87	2.1	14.9	10	42	dis 10-12-87
18	(48.400)	8-31-87	2.5	16.3	18	131	an re 1-13-88
19	(48.172)	8-31-87	2.5	16.3	54	339	retagged
	(49.601)	8- 5-88	2.7	16.7	17	145	oper 1- 1-89
20	(49.692)	8-31-87	2.7	16.3	17	215	an re 3- 5-88
21	(49.923)	8-31-87	2.1	15.1	34	323	an re 7-29-88
22	(48.070)	9- 2-87	3.6	17.2	22	273	an re 6- 5-88
23	(48.100)	9- 2-87	2.6	16.2	22	258	b.exp 5-17-88
24	(48.318)	9- 2-87	4.3	18.9	33	265	an re 5-24-88
25	(48.900)	9- 2-87	3.0	16.4	11	159	an re 2- 9-88
26	(49.671)	9- 2-87	3.0	17.3	41	331	retagged
	(49.481)	7 28-88	3.2	17.3	27	148	oper 11- 5-88
27	(49.300)	7- 8-88	2.5	15.8	25	148	oper 12- 5-88
28	(49.580)	7- 8-88	2.6	16.8	28	148	oper 12- 5-88
29	(49.012)	7-11-88	2.4	15.4	11	32	an re 8-13-88
30	(49.390)	7-11-88	2.7	16.1	28	144	oper 12- 5-88
31	(49.082)	7-12-88	2.9	16.5	28	143	oper 12- 5-88
32	(49.736)	7-12-88	3.6	18.5	27	143	oper 12- 5-88
33	(49.350)	7-12-88	2.4	16.2	28	143	oper 12- 5-88
34	(49.500)	7-14-88	2.9	16.9	29	142	oper 12- 5-88

Appendix Table A. (continued)

Fish No.	(radio)	Date tagged	Wt. (lbs)	Length (in)	No. of Observations	Days Out	Disposition
35	(49.460)	7-14-88	2.6	16.5	29	142	oper 12- 5-88
36	(49.281)	8- 4-88	3.4	16.9	13	54	an re 9-30-88
37	(49.692)	9- 7-88	2.5	15.2	7	41	l.l. 10-18-88
38	(49.710)	9- 7-88	2.4	15.5	14	74	oper 11-21-88
39	(48.880)	9- 7-88	2.5	15.6	11	67	oper 11-14-88
40	(49.593)	9- 7-88	3.6	17.4	15	88	oper 12- 5-88
41	(49.406)	9- 7-88	2.3	15.7	15	88	oper 12- 5-88
42	(49.302)	9- 7-88	2.6	16.0	10	88	oper 12- 5-88
43	(49.112)	9- 7-88	2.5	15.7	14	88	oper 12- 5-88

retagged = a new transmitter was placed in the fish
died = fish died on/near indicated date
dis = the fish disappeared on/near the indicated date
an re = angler recapture and reduced to bag on indicated date
oper = transmitter operating in normal manner as of indicated date
b.exp = battery expired on/near indicated date
l.l. = fish was last located on indicated date

ANNUAL PERFORMANCE REPORT
RESEARCH PROJECT SEGMENT

STATE: Iowa

PROJECT NO.: F-109-R

STUDY NO.: 2

JOB NO.: 1

NAME: An Evaluation of the Effect of a Change in Commercial Harvest Regulations on the Channel Catfish Populations Inhabiting the Upper Mississippi River

TITLE: Channel Catfish Population Assessment

Period Covered: 1 January, 1988 through 31 December, 1988

ABSTRACT: Over 13,000 channel catfish were captured with 140 net days of effort during this study segment. Catch per unit of effort (CPUE) ranged from 0.2 to 356.3 fish/net day in Pools 16 and 11, respectively. Mean W_r values for channel catfish from several pools were significantly different during all study years. Mean W_r values decreased north to south in 1986; reversed this trend in 1987; and no trend was apparent in 1988. The 1987 total annual reported commercial harvest for channel catfish in Pools 9-19 showed a sharp increase, the fifth highest reported harvest in the last 33 years.

JOB 1 OBJECTIVES

To determine length-weight relationships, length-frequency distributions, harvest rates and relative abundance of channel catfish.

INTRODUCTION

Channel catfish are valuable to Iowa fishermen and consistently rank number one in preference of sport anglers (Anonymous 1975, 1982 and 1986). To commercial fishermen fishing the Mississippi River, the channel catfish is among the top three species in economic value and yield (Pitlo 1979). Commercial catfish harvest is intense and has resulted in over exploitation of the species (Schoumacher 1965, Helms 1967 and 1969, and Pitlo 1979). The increase in the minimum legal length limit from 13 to 15 inches for commercially harvested channel catfish was recommended as a method of reducing overharvest (Helms 1969). The increase in the minimum length limit was initiated to: 1) increase and stabilize year class abundance; 2) reduce the numeric harvest but increase the weight of fish harvested; and, 3) increase the number of fish available to sport anglers. Legislation to change the legal length limit on commercially harvested catfish became effective January 1, 1984. The channel catfish population will be monitored to determine if the change in minimum legal length will achieve the predicted and desired changes in the population.

METHODS AND PROCEDURES

Adult channel catfish were collected with hoop nets baited with soybean cake during August and September in Pools 9, 11, 16, and 18. Hoop nets were of two designs. The first net was made of 0.75 inch web (bar measure) and seven hoops each 2 ft in diameter; the second net was made of 1.25 inch web (bar measure) and seven hoops, each 3.5 feet in diameter. One large and one small net were fished in tandem and termed a set. Six sets were made per pool and sample site locations were similar to those described by Helms (1967 and 1969). Each set was fished for 48 hrs between lifts. Nets were fished a minimum of 24 net days (576 net hrs) per pool; however, 48 net days (1,152 net hrs) were fished per pool if a 300 fish quota was not achieved during the first netting period. All channel were measured for total length to the nearest 0.1 inch and weighed to the nearest 0.1 lb unless nets captured an extremely high number of fish in which case a subsample of 100 fish were weighed, however, all fish were measured. Ages were assigned to length-frequency distributions for channel catfish from tables prepared by Pitlo (1979). The harvest of commercial fish was obtained from the monthly reports prepared by fishermen.

Relative weight (W_r) was computed as described by Wege and Anderson (1978) and the values for the standard (W_s) were a = -3.7493 and b = 3.243. Confidence intervals were calculated for means as described by Snedecor and Cochran (1967).

FINDINGS

One hundred forty net days of fishing effort resulted in the capture of 13,105 channel catfish during the 1988 study period (Table 1). Catch per unit of effort (CPUE) for small mesh hoop nets during 1988 ranged from 25.0

fish/net day in Pool 16 to 356.3 fish/net day in Pool 11. The 1988 channel catfish CPUE for large mesh hoop nets ranged from 0.2 fish/net day in Pool 16 to 22.7 fish/net day in Pool 9. Overall, CPUE values for small mesh hoop nets have been variable, with low values in 1985 and 1986 and higher values in 1987. The highest catch rates during the study was documented during 1988 (Table 1). The large mesh hoop net catches have generally increased from 1984 through 1987; however, catch then declined sharply in Pools 11, 16 and 18, but increased in Pool 9 (Table 1). Overall, the large mesh hoop net CPUE has increased steadily from 1.0 fish/net day in 1984 to 8.4 fish/net day in 1988.

Table 1. A summary of fishing effort and channel catfish caught in baited hoop nets fished in the Upper Mississippi River.

Pool (Year)	Small Mesh Hoop Nets Net Days	Small Mesh Hoop Nets Fish Caught	Small Mesh Hoop Nets Fish/ Net Day	Large Mesh Hoop Nets Net Days	Large Mesh Hoop Nets Fish Caught	Large Mesh Hoop Nets Fish/ Net Day
Pool 9						
1984	24	536	22.3	24	4	0.2
1985	24	304	12.7	24	20	0.8
1986	24	12	0.5	24	26	1.1
1987	24	1,296	54.0	24	320	13.3
1988	24	4,055	168.9	24	544	22.7
Pool 11						
1985	24	194	8.1	24	60	2.5
1986	24	37	1.5	24	109	4.5
1987	24	169	7.0	24	192	8.0
1988	12	4,276	356.3	12	12	1.0
Pool 16						
1984	48	213	4.4	48	70	1.5
1985	24	68	2.8	24	10	0.4
1986	24	35	1.5	24	29	1.2
1987	24	42	1.8	24	43	1.8
1988	12	300	25.0	12	2	0.2
Pool 18						
1984	24	270	11.3	24	22	0.9
1985	24	142	5.9	24	19	0.8
1986	24	89	3.7	24	38	1.6
1987	24	658	27.4	24	139	5.8
1988	22	3,883	176.5	22	33	1.5
Totals						
1984	128	2,073	16.2	128	131	1.0
1985	96	708	7.4	96	109	1.1
1986	96	173	1.8	96	202	2.1
1987	96	2,165	22.6	96	694	7.2
1988	70	12,514	178.8	70	591	8.4

Age frequency distributions of channel catfish inhabiting each pool during the 1985-1988 study years are shown in Table 2. Length-weight relationships and mean relative weight (W_r) values calculated for channel catfish and expressed by pool and study years are shown in Table 3.

Table 2. Age distribution of channel catfish captured in baited hoop nets from Pools 9, 11, 16, and 18 of the Upper Mississippi River.

Area (year)	Fish in sample	Percent Occurrence in Age Class I	II	III	IV	V	VI	VII
Pool 9								
1984	541	39	54	7	<1			
1985	321	3	34	62	1			
1986	38	3	15	45	31	3	3	
1987	500	12	34	27	22	2	3	
1988	477	30	60	10	<1			
Pool 11								
1985	191	9	23	60	5	2	<1	
1986	145	1	7	30	41	7	13	1
1987	362	28	15	37	15	3	2	
1988	1,262	68	29	2	<1			
Pool 16								
1984	280	20	11	40	25	2	2	
1985	78	21	17	28	22	8	4	
1986	64	6	18	42	25	8	1	
1987	87	19	16	36	24	2	3	
1988	301	21	67	12				
Pool 18								
1984	279	15	54	28	2	<1		
1985	138	14	52	32	2			
1986	129	-	21	47	21	8	2	1
1987	792	4	34	52	8	1	<1	<1
1988	873	27	62	10	1	<1		

Slope (b) values for channel catfish from individual pools and study years were plotted to detect population changes. Confidence intervals (95%) around mean slope (b) values for channel catfish populations showed significant differences between pools and years. During 1986, slope values generally increased from north to south and the b value for catfish in Pool 18 was significantly higher than for fish in Pool 9 (Figure 1). Mean b values for 1987 catfish data showed the opposite trend, mean slope for Pool 18 channel catfish was significantly smaller than comparable values for catfish from Pools 9 and 11 (Figure 1). Mean slope information derived from channel catfish sampled in 1988 showed no significant difference between pools.

Mean relative weight (W_r) values for channel catfish from individual pools showed significant differences. Mean W_r values for catfish populations generally decreased from north to south in 1986 and increased from north to south in 1987 (Figure 2). No such trend was apparent in 1988 data.

Table 3. Regression coefficients of weight-length relationships and relative weights (W_r) for channel catfish sampled from Pools 9, 11, 16 and 18 of the Upper Mississippi River.

Pool (Year)	Number of Fish	Weight-length Regression	W_r
Pool 9			
1978[a]	68	$Log_{10} W = -5.8110 + 3.29 Log_{10} L$	-
1986	36	$Log_{10} W = -3.5357 + 3.01 Log_{10} L$	91.5
1987	93	$Log_{10} W = -4.0698 + 3.47 Log_{10} L$	85.4
1988	105	$Log_{10} W = -3.7540 + 3.24 Log_{10} L$	99.9
Pool 11			
1986	82	$Log_{10} W = -3.8443 + 3.29 Log_{10} L$	91.0
1987	99	$Log_{10} W = -3.5859 + 3.06 Log_{10} L$	96.6
1988	68	$Log_{10} W = -3.9215 + 3.37 Log_{10} L$	90.0
Pool 16			
1986	52	$Log_{10} W = -3.7957 + 3.23 Log_{10} L$	87.8
1987	75	$Log_{10} W = -3.3296 + 2.86 Log_{10} L$	107.5
1988	82	$Log_{10} W = -3.7583 + 3.24 Log_{10} L$	98.4
Pool 18			
1978[a]	84	$Log_{10} W = -4.6371 + 3.18 Log_{10} L$	-
1986	86	$Log_{10} W = -4.0455 + 3.45 Log_{10} L$	84.7
1987	180	$Log_{10} W = -3.2367 + 2.77 Log_{10} L$	109.9
1988	91	$Log_{10} W = -3.7502 + 3.19 Log_{10} L$	90.5

[a]from Pitlo, 1979.

The length frequency distributions of channel catfish captured by baited hoop nets for each pool and collection year are shown in Appendix Tables A and B.

DISCUSSION OF FINDINGS

The high CPUE of channel catfish in small mesh baited hoop nets was a result of the strong 1987 year class that was evident as 6-8 inch fish. This year class was represented in YOY trawl indices during 1987 and was nearly twice as abundant as previous year classes (Pitlo 1988). In addition, low river stages during the survey period resulted in ideal netting conditions and aided in catching large numbers of fish. Distribution of the 1987 year class (Table 2) by length-at-age proportions derived from 1979 aged samples showed these fish to be age II in Pools 9, 16 and 18. These fish were probably assigned to the wrong age group because growing conditions were excellent during 1987 and 1988 resulting in larger fish compared to previous years. Spines should be collected from fish in this length group and age verified.

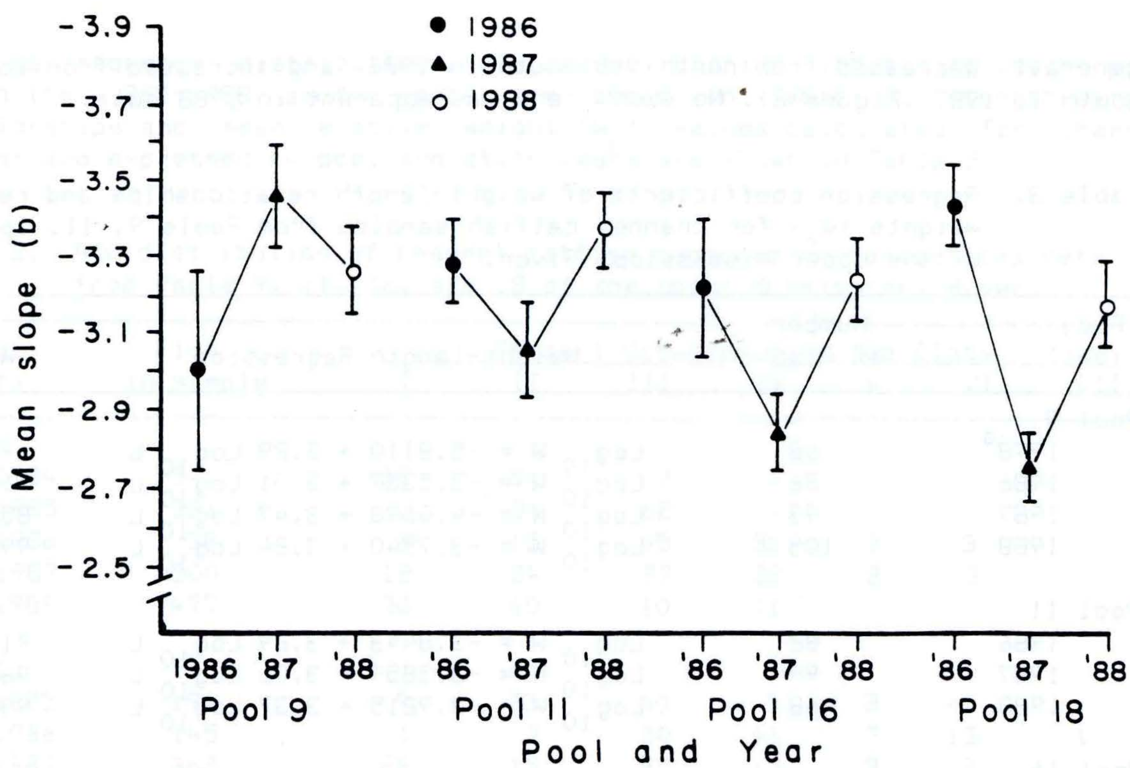

Figure 1. Mean slope (b) of channel catfish collected from the Upper Mississippi River.

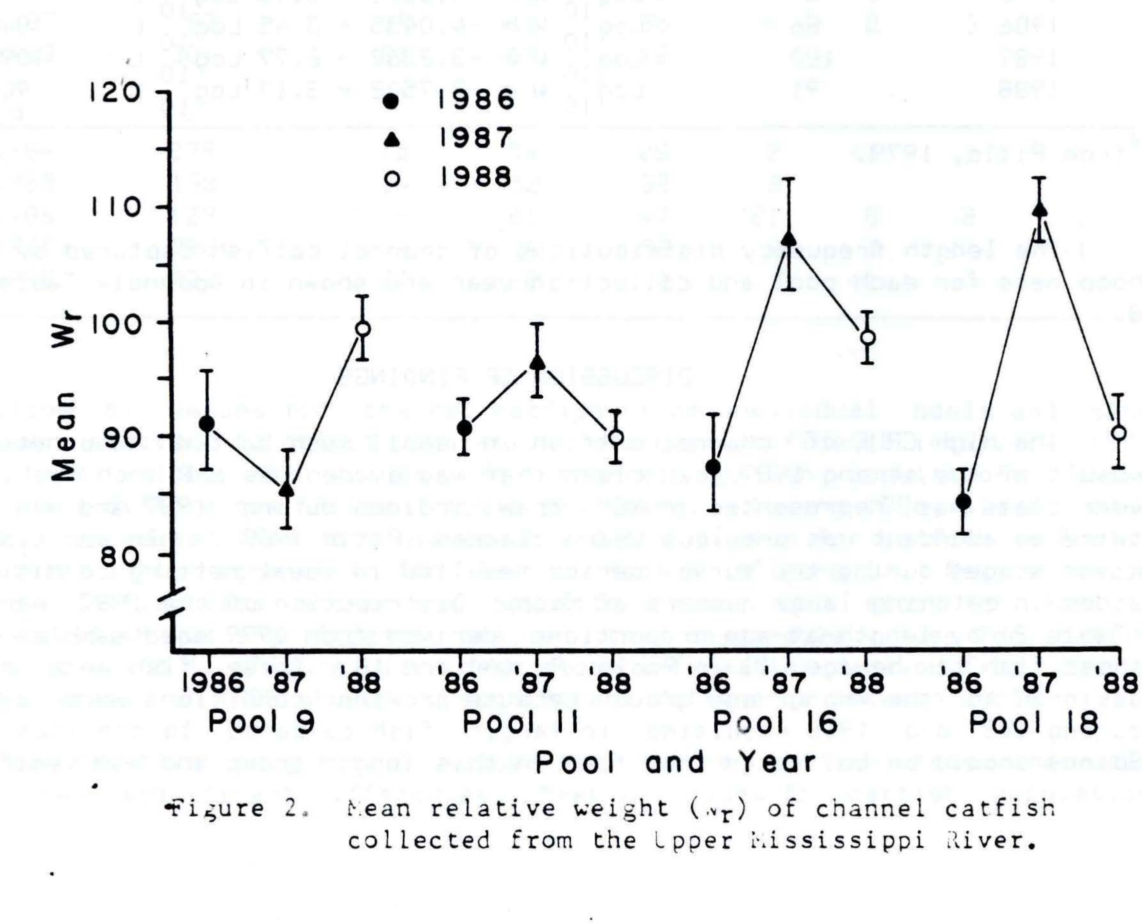

Figure 2. Mean relative weight (W_r) of channel catfish collected from the Upper Mississippi River.

The CPUE for large mesh hoop nets was expected to increase as a result of the 15 inch minimum length limit. Although the overall CPUE increased, individual pool values decreased in three of the four pools. This was probably due to the low numbers of 3 year old fish (1985 year class) which were not well represented in trawl samples (Pitlo 1988, Job 2).

The differences noted in slope and W_r values were probably due to changes in growing conditions between years. Water levels were high during 1986 and the spring period was later than normal. In contrast, 1987 and 1988 were characterized by early springs, no flooding and below normal water levels which resulted in a longer, warmer growing period. There is some evidence that pools act independently with respect to changes in W_r values. No significant differences in mean W_r has been noted in Pool 11 from 1986-1988, however, there are significant differences between years in other pools (Figure 2). The mechanisms contributing to these observed differences are unknown at present.

The commercial harvest of channel catfish reported by Iowa commercial fishermen in 1987 was 714,429 lbs (Figure 3). Channel catfish harvested from Pools 18 and 19 continue to contribute nearly 40% of all the fish marketed by Iowa commercial fishermen (Appendix Table C). Reported catch of channel catfish during 1987 by Wisconsin, Illinois and Iowa commercial fishermen from Pools 9-19 was 1,363,937 lbs, which was the fifth highest reported harvest in the last 33 years (Figure 4). This was an increase of nearly 500,000 lbs over the 1983-1986 period.

This project should be extended to determine if the improved commercial harvest remains near the 1987 level and to document the impact of the strong 1987 year class on the fishery.

RECOMMENDATIONS

1. Collect 6 spines from each .5 inch length group of fish in the 9-12 inch range in Pools 9, 11, 16 and 18 to determine the age of this length group of fish.

2. Continue the project as outlined by extending project for two years to document if the length limit objectives will be met.

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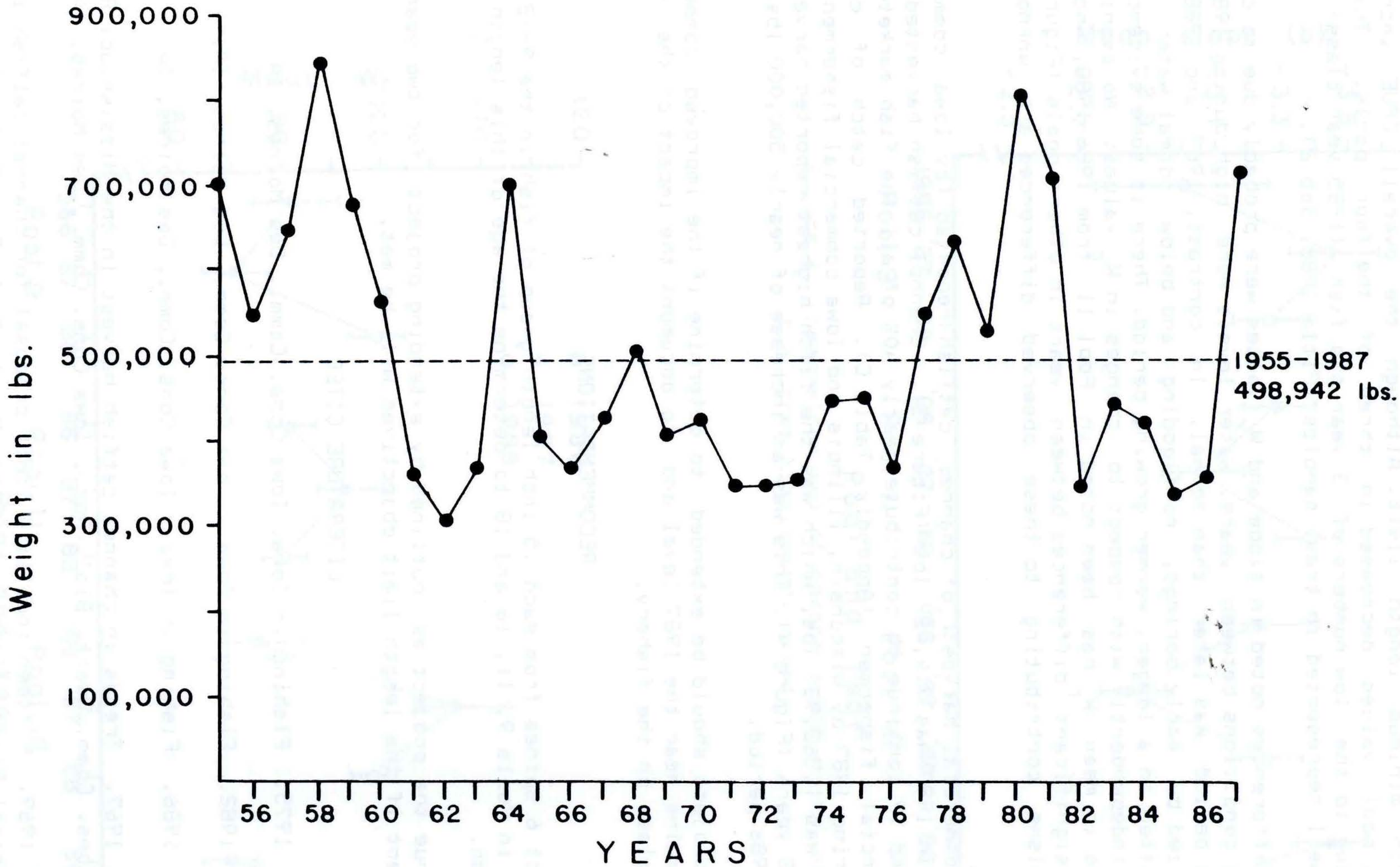

Figure 3. The channel catfish harvest as reported by Iowa commercial fishermen fishing Pools 9-19 of the Upper Mississippi River.

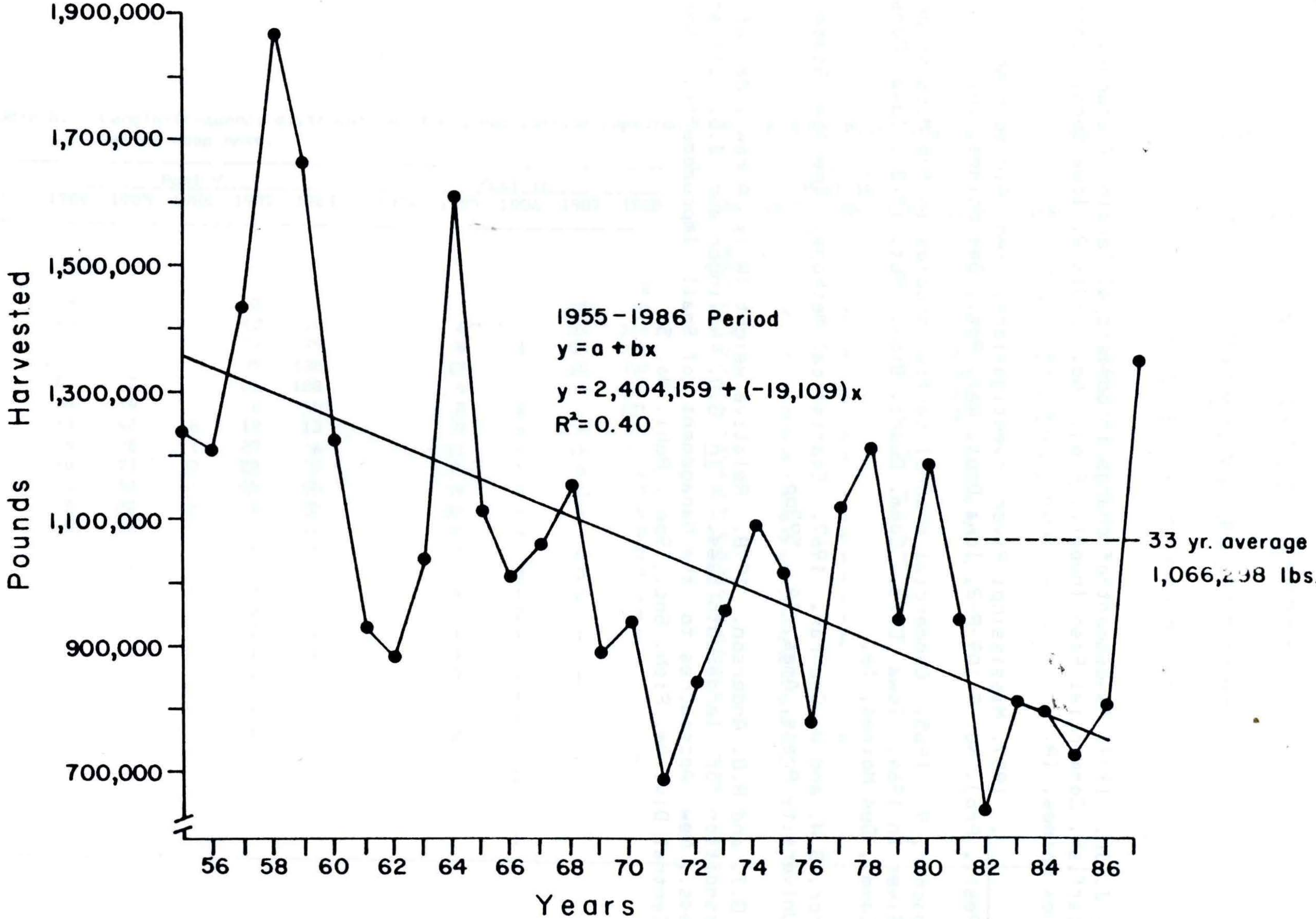

Figure 4. Linear regression of the total harvest of channel catfish reported by commercial fishermen operating in Pools 9-19 of the Upper Mississippi River, 1955-1987.

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Appendix Table A. Length-frequency distribution of channel catfish captured from the Upper Mississippi River in small mesh (3/4 inch bar) baited hoop nets.

Total	Pool 9					Pool 11					Pool 16					Pool 18				
Length (in)	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988
4.6- 5.0											1					1	1			
5.1- 5.5											2	1	1			3	5		3	
5.6- 6.0										2	7	3		1	1	18	10	1	7	4
6.1- 6.5	3	1	2	2	1				15	10	17	4	1	7	2	33	10		15	49
6.6- 7.0	20			13	22		6		31	112	17	7		11	24	48	10	1	22	177
7.1- 7.5	118	7		34	79		8	1	51	339	20	4	1	1	69	26	15		32	267
7.6- 8.0	221			39	132		17		18	338	7		2	5	90	21	8	10	61	175
8.1- 8.5	87	3		21	128		4		4	264	5	1	3	1	60	16	21	5	102	74
8.6- 9.0	34	14		2	48		2	2	7	121	6	3	7	2	27	29	9	10	72	34
9.1- 9.5	13	42	2	19	13		7	4	5	25	4	2	2	3	11	28	16	9	57	14
9.6-10.0	9	72	1	27	6		11	4	12	11	5	8	1	3	3	24	13	4	45	20
10.1-10.5	10	73	3	32	9		30	1	8	6	6				3	10	7	6	82	20
10.6-11.0	11	52	1	18	10		39	4	6	7	20	4	1	1	6	6	5	6	52	10
11.1-11.5	5	22	2	8	10		30	4	3	9	19	2	4	1	2	5	2	5	38	7
11.6-12.0	5	12	1	7	10		12	4	1	8	16	2	4	1	1	5	1	5	47	7
12.1-12.5		1		9	5		8		4	3	15	2	1	1	1	2		5	20	6
12.6-13.0		1		11			4	3	3	3	15	5	1	1	1	1	4	5	8	3
13.1-13.5			1	10	2		4	1	2	1	10	3	1	2			1	5	7	3
13.6-14.0				3				2		1	8	5	1			1		3	7	1
14.1-14.5				3	1		1	1	1	1	6	4	1	1				4	4	1
14.6-15.0		1		1	1		1				2	2						2	1	
15.1-15.5				1			3	1	1		2	1						2	2	
15.6-16.0								1			1	2						2	1	
16.1-16.5				1			2	1				1								
16.6-17.0				1			2					1	2							
17.1-17.5										1	1	1						1		
17.6-18.0								2			1									1
18.1-18.5																				
18.6-19.0																				
19.1-19.5								1					1							

Appendix Table B. Length-frequency distribution of channel catfish captured from the Upper Mississippi River in large mesh (1 1/4 inch bar) baited hoop nets.

Total Length (in)	Pool 9					Pool 11					Pool 16					Pool 18				
	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988
4.6- 5.0												1								
5.1- 5.5																				
5.6- 6.0																				
6.1- 6.5																				
6.6- 7.0																				
7.1- 7.5																				
7.6- 8.0							1													
8.1- 8.5									1											
8.6- 9.0									4											
9.1- 9.5				1								1					1			1
9.6-10.0				4			1		1		1			1		1				
10.1-10.5			1	14				3	11							1			1	1
10.6-11.0		4	3	22	5		8	4	18	1	4	1	1	6		4	5	2	8	4
11.1-11.5	2	11	3	22	17		16	3	25	1	7		2	6		1	2	5	25	4
11.6-12.0		1	5	27	20		11	7	24	2	10	1	5	5		5	3	6	26	11
12.1-12.5	1	1	1	27	6		7	8	33	2	6	1	9	4		2	3	5	24	6
12.6-13.0			5	37	3		5	12	25	1	9		4	4		1	2	1	9	5
13.1-13.5		1	4	37	3		1	20	12	2	11		1	4				5	13	4
13.6-14.0		1	2	20			1	18	12	1	8		2	3		2	1	2	5	1
14.1-14.5	1	1	1	13			1	9	7		5	2	3	4		1	3		3	4
14.6-15.0				2				3	7	1	3		1	2		1		2	1	3
15.1-15.5				1	1		1	5	1	1						1		2	2	1
15.6-16.0			1	3				2	1											
16.1-16.5				3					2		1	1	2	1	1	1		1		
16.6-17.0				2			1	2	2		1	1		1		1		2		
17.1-17.5				3			2	2	2											
17.6-18.0							1	5	1	1	1							1	1	
18.1-18.5								1							1					
18.6-19.0													1							
19.1-19.5								1	1									1	1	
19.6-20.0								2										1		
20.1-20.5																			1	

Appendix Table C. Pounds of channel catfish harvested from the Upper Mississippi River as reported by Iowa commercial fishermen.

Year	Pool 18	Pool 19	Pools 9-19	% Contributed by Pools 18 and 19
1955	142,755	153,061	707,386	42
1956	137,324	125,777	547,212	48
1957	189,720	103,794	650,864	45
1958	193,823	240,843	846,144	51
1959	146,266	119,889	680,757	39
1960	103,338	54,462	566,011	28
1961	34,042	47,723	366,812	22
1962	42,892	72,449	310,816	37
1963	41,496	80,767	371,182	33
1964	143,148	94,159	701,175	34
1965	65,108	24,820	405,818	22
1966	41,401	89,563	373,699	35
1967	45,621	50,540	429,009	22
1968	55,008	51,127	505,234	21
1969	70,936	40,909	402,271	28
1970	74,420	27,421	424,103	24
1971	56,723	37,495	346,462	27
1972	57,758	46,202	346,472	30
1973	54,175	56,733	353,342	31
1974	64,859	56,222	448,802	27
1975	63,570	54,478	449,542	26
1976	64,647	49,501	366,812	31
1977	119,442	80,127	556,869	36
1978	124,687	154,308	639,660	44
1979	94,940	166,079	535,831	49
1980	196,260	289,670	803,056	61
1981	128,920	202,386	711,446	47
1982	57,101	85,953	343,253	42
1983	99,443	129,505	444,647	51
1984	55,428	162,985	421,763	52
1985	60,985	85,700	336,592	44
1986	89,247	57,898	357,629	41
1987	118,542	187,151	714,429	43
Average	91,940	99,370	498,942	38

ANNUAL PERFORMANCE REPORT
RESEARCH PROJECT SEGMENT

STATE: Iowa

PROJECT NO.: F-109-R

STUDY NO.: 2

JOB NO.: 2

NAME: An Evaluation of the Effect of a Change in Commercial Harvest Regulations on the Channel Catfish Populations Inhabiting the Upper Mississippi River

TITLE: Assessment of Young-of-the-Year Channel Catfish Abundance

Period Covered: 1 January, 1988 through 31 December, 1988

ABSTRACT: Over 335 channel catfish young-of-the-year and 8,376 other fish were captured in 180 trawl hauls. Catch of young catfish ranged from 15 in Pool 9 to 139 in Pool 18. There were two spawning periods as indicated by bi-modal length frequency distribution of young channel catfish. Freshwater drum, Cyprinid sp., sub-adult channel catfish, bluegill, and YOY channel catfish dominated trawl haul catches with 5,915, 1,039, 610, 373, and 339 fish, respectively.

JOB 2 OBJECTIVE

To determine the abundance of young of the year channel catfish.

METHODS AND PROCEDURES

Young of the year (YOY) channel catfish were collected from Pools 9, 11, 16 and 18 during 1984-1987 by trawling during August and September. Holland et. al. (1988) indicated trawling during these months might miss early hatched fish. For this reason, 12 trawl hauls was completed in each pool in July during the 1988 study segment. Trawl samples were completed with a 16 ft semi-balloon otter trawl containing an 1/8 inch cod liner. Trawl samples were approximately 1,200 ft in length, taken in a downstream direction and consisted of a minimum of 44 trawl hauls and a maximum of 74 trawl hauls per pool. Habitats sampled were main channel, main channel border and major side channels. Areas sampled were similar to those sampled by Helms (1967 and 1969) and Pitlo (1979). Young of the year channel catfish were measured for total length to the nearest 0.1 inch and all other species were recorded and enumerated.

FINDINGS

One hundred eighty trawl hauls captured 339 young of the year (YOY) channel catfish and 8,376 other fish during the 1988 sample period (Table 1). Catch of YOY channel catfish ranged from 15 in Pool 9 to 139 in Pool 18. The most abundant species captured in trawl samples were freshwater drum (5,915), Cyprinid sp. (1,039), sub-adult (5-10 inch) channel catfish (610), bluegill (373), and YOY channel catfish (339) (Table 2).

Table 1. A summary of young-of-the-year (YOY) channel catfish captured in trawl hauls taken from the Upper Mississippi River, 1988.

Pool	Number of Trawl Hauls	Number of YOY Channel Catfish	Number/ Haul	Other Fish
9	45	15	0.33	866
11	45	61	1.36	1,030
16	45	124	2.75	4,844
18	45	139	3.08	1,636
Totals	180	339	1.88	8,376

Table 2. Fish captured in trawl haul samples taken from the Upper Mississippi River.

	Pool																			
	9				11				16				18				Total			
Species	'85	'86	'87	'88	'85	'86	'87	'88	'85	'86	'87	'88	'85	'86	'87	'88	'85	'86	'87	'88
S. sturgeon	1	2	1	2	-	3	2	-	1	8	2	3	-	5	1	-	2	18	5	5
Ch. catfish																				
YOY	-	8	11	15	27	52	99	61	55	142	398	124	29	251	272	139	111	453	780	339
sub-adult	12	-	9	38	9	-	4	20	10	-	22	135	6	28	40	417	37	28	75	610
adult	3	2	3	-	-	-	2	-	7	3	5	1	11	2	4	2	21	7	14	3
F. W. drum	12	-	9	476	29	-	327	430	87	11	997	3992	111	33	357	1017	234	49	1753	5915
Wall./Saug.	3	3	8	23	3	3	4	13	2	1	1	9	1	-	3	13	9	7	16	58
F. catfish	1	-	3	2	1	1	2	-	2	2	4	3	2	1	3	3	6	4	12	8
Carp	-	-	2	13	-	-	-	29	-	1	2	25	2	2	3	21	2	3	7	88
S.M. buffalo	-	-	-	2	-	-	-	-	-	-	-	-	1	-	-	2	1	-	-	4
Bluegill	1	1	1	92	1	-	1	64	-	-	-	209	1	-	-	8	3	1	2	373
White bass	8	-	24	12	5	-	2	120	-	-	-	15	-	-	-	1	13	-	26	148
Redhorse sp.	3	3	21	37	1	2	14	2	-	-	1	-	3	-	5	-	7	5	41	39
Carpsucker sp.	-	-	2	11	2	-	5	2	1	-	2	17	2	1	6	5	5	1	15	35
Cyprinid sp.	22	3	13	144	66	2	43	331	86	24	68	429	9	12	35	135	183	41	159	1039
Blue sucker	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-
Mooneye	-	-	2	4	3	-	-	1	-	-	2	2	-	-	-	1	3	-	4	8
Rock bass	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-
Crappie sp.	-	-	-	4	-	-	5	15	-	-	-	-	-	-	15	-	-	-	20	19
Gizzard shad	-	-	-	6	-	-	-	3	-	-	-	4	-	-	2	10	-	-	2	23
Logperch	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1

DISCUSSION OF FINDINGS

The mean catch-per-unit-of-effort (CPUE) of YOY channel catfish for 1988 was the second lowest obtained during the 5 year study period (Table 3). Sampling conditions were excellent and similar to 1987 when high numbers of YOY were collected. It appears reproductive success was lower in 1988 despite an early spring, no floods, warmer water and stable river conditions.

Table 3. A summary of young-of-the-year (YOY) channel catfish taken in trawl haul samples from Pools 9, 11, 16 and 18 of the Upper Mississippi River.

Pool (Year)	Number of Trawl Hauls	Number of YOY	Number of YOY/Haul
Pool 9			
1984	72	30	0.42
1985	45	0	0
1986	45	8	0.18
1987	45	11	0.24
1988	45	15	0.33
Pool 11			
1984	75	142	1.89
1985	45	27	0.60
1986	45	52	1.16
1987	45	99	2.20
1988	45	61	1.36
Pool 16			
1984	75	234	3.12
1985	45	55	1.22
1986	45	142	3.16
1987	45	398	8.84
1988	45	124	2.75
Pool 18			
1984	59	236	4.00
1985	45	29	0.64
1986	45	251	5.58
1987	45	272	6.04
1988	45	139	3.08
Totals			
1984	281	642	2.28
1985	180	111	0.62
1986	180	453	2.52
1987	180	780	4.33
1988	180	339	1.88

Pool 9 continues to produce the lowest catch rate of YOY channel catfish and high catch rates of sub-adults and adults in baited hoop nets (Study 2, Job 1). Reasons for this discrepancy are speculative at present, however, interpool movement of fish is suspect. Experimental trawling in other habitats in Pool 9 failed to produce concentrations of YOY fish not observed in historic sites.

Lengths of YOY channel catfish varied by pool and collection year (Figure 1). There was evidence of disjunct spawning because of bi-modal length frequency distributions observed in Pool 11 and 18 in 1984; Pool 16 in 1985; all pools during 1987; and Pools 16 and 18 in 1988. Generally, YOY channel catfish were slightly longer in 1988 compared to the 1984-1986 period and similar in length to fish in the 1987 collections. These somewhat larger fish were probably due to an early spring and an earlier spawning season which resulted in a longer growing period during 1987 and 1988.

RECOMMENDATIONS

1. Collect trawl haul samples during July, August and September as suggested by Holland et. al. (1988) and compare to previous collections to note differences.

2. Continue experimental trawl hauls in other areas in Pool 9 to determine if YOY channel catfish are being sampled adequately.

ACKNOWLEDGMENTS

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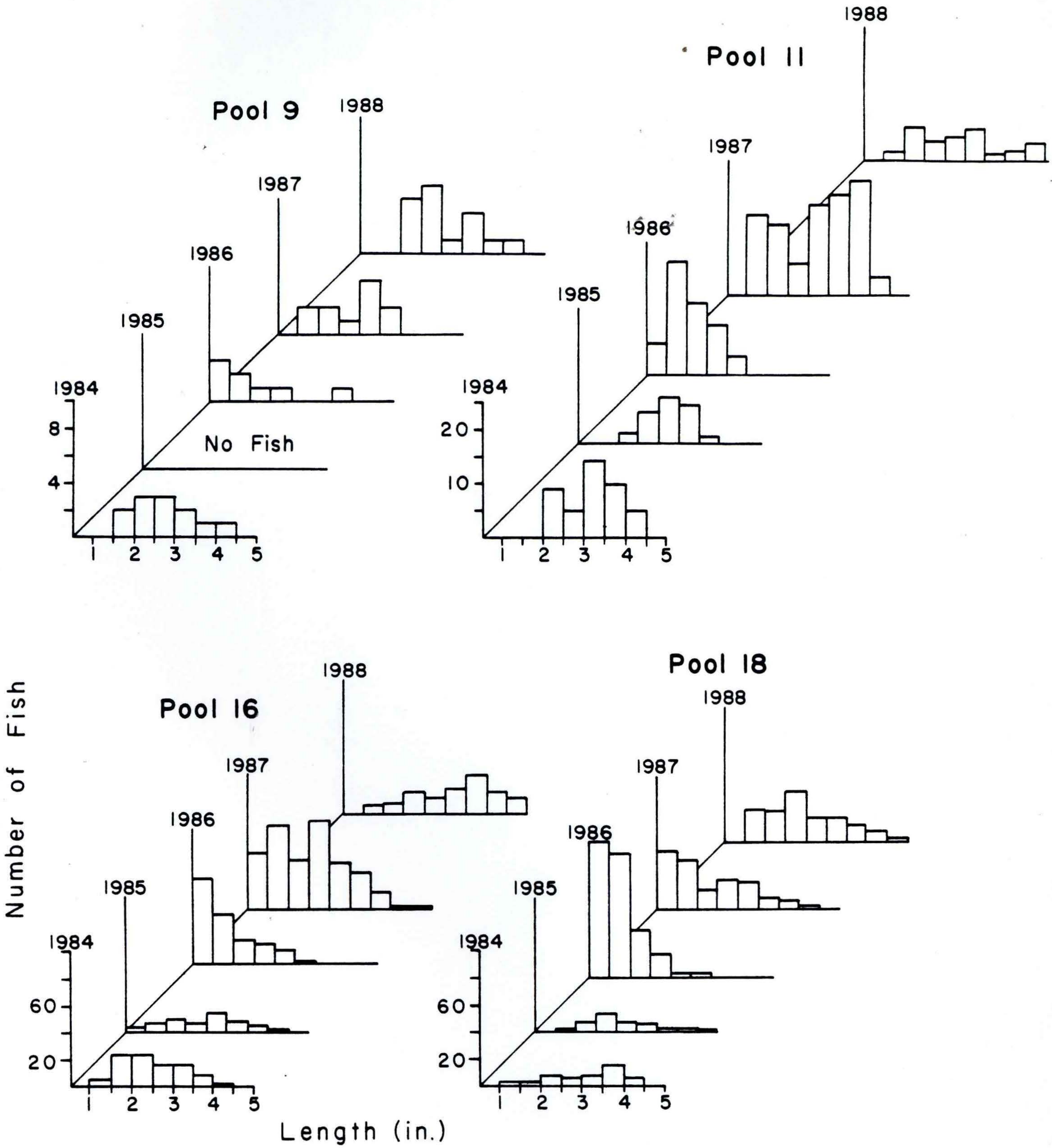

Figure 1. The length frequency distribution of YOY channel catfish collected in trawl haul samples taken from the Upper Mississippi River.

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