

A MARK-RECAPTURE STUDY ON LARGEMOUTH BASS USED IN CONJUNCTION WITH A CREEL SURVEY

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ABSTRACT

A mark-recapture study used in conjunction with a roving creel survey utilizing non-uniform probability sampling was conducted in two 1,000 acre study areas on Lake Okeechobee. In one study area, 472 largemouth bass 216mm and greater total length were tagged and released prior to the creel survey. In the other study area, 201 largemouth bass 241mm and greater total length were tagged and released prior to the creel survey. Of 48 total recaptures from both years, only two fish had moved outside the creel survey area. Both surveys indicated under-utilization of bass less than 356mm total length, and over-exploitation of bass 356mm and greater.

INTRODUCTION

Previous studies conducted on Lake Okeechobee, a 467,000 acre lake, indicated that among the aquatic plant communities in the lake, density of harvestable size largemouth bass was greatest in the bulrush (*Scirpus*) community. Observation also indicated that most of the fishing effort for largemouth bass on the northeastern and northwestern shores as well as most other areas of the lake was exerted in the bulrush community.

The extensive dispersion of the bulrush community in the lake, the lake's large size, and limited personnel available, precluded a comprehensive creel survey of the entire lake. The creel surveys conducted in these studies were performed on isolated areas of the northeastern and northwestern shores believed typical of other sportfishing areas on the lake.

Information collected during these surveys provided estimates of fishing pressure, total harvest, success, and resident- non-resident fishermen ratio. Returns of tagged fish provided estimates of exploitation rate, population size, and movement of largemouth bass in the study areas.

MATERIALS AND METHODS

Area Designations

The two study areas, one on the northeastern shore and one on the northwestern shore were approximately 1,000 acres in size. Both areas were subdivided into ten designated units. Each of the ten units was subdivided into three portions providing a total of thirty sub-units for each study area. In each of the ten units there was an area of littoral zone, an area where limnetic and littoral zones met, and a limnetic zone. This designation of areas allowed for interpretation of movement of the tagged bass.

Tagging

Within a three week period prior to initiation of the creel surveys, largemouth bass were collected in each area by electro-fishing. Largemouth bass 216mm (8.5 inches) and greater total length were collected in the northeastern shore study area. Two types of tags were employed in this area. The Floy 68B Anchor Tag was inserted into the posterior base of the spiny dorsal fin. The Monel Strap Tag was clamped through the opercle of the bass. Approximately 60 percent of the bass tagged with Floy tags also had the first two dorsal spines clipped to check for tag loss. Bass collected from the northwestern shore study area were 241mm (9.5 inches) and greater total length. All bass from this area were tagged with the Floy 68B Anchor Tag. The inch group, area of release, and tag number were recorded for all bass tagged.

Creel Survey

A creel survey with non-uniform probability sampling was used to obtain data for computing estimates of fishing effort, harvest, and success according to species for each study area. The survey

¹ All estimates were made for the populations 216mm and greater on the northeastern shore and 241mm and greater on the northwestern shore.

covered a 15 week period from September through December. Each week was divided into three strata of equal fishing pressure probability. One two-hour period, selected at random based on the probability of fishing pressure, was sampled in each strata. An instantaneous count of fishermen was recorded at the mid-point of the two hour survey period. When possible, each fisherman was interviewed to determine fishing effort in hours, species sought, the number and species of fish taken, and the residency of the fisherman. Largemouth bass in the creel were examined for tags, clipped spines, and measured to inch group. Tag number and recovery location of marked bass were recorded.

RESULTS

Fish Movement

Northeastern Shore Study Area

Of 417 bass tagged in this area, 322 were tagged with the Floy Tag and 150 were tagged with the Monel Strap Tag. Of the 322 Floy tagged bass, 186 were fin clipped. A total of 11 recaptures were recorded in the creel survey of the northeastern shore area and 17 additional recaptures were reported. No significant movement of bass was indicated other than from one designated area to an adjacent area. All other reported recaptures were within the creel area. Of 28 total recaptures, 18 had been tagged with a Floy Tag and 10 had been tagged with a Monel Strap Tag. The two reported recaptures which had moved completely out of the creel area had been tagged with the Monel Strap Tag. No fin clipped fish without tags were detected in the creel survey and regeneration of the clipped spines was not noticeable on those recaptured. Of the 18 Floy tagged bass which were recaptured, 11 had been fin clipped. This was approximately the percentage which had been similarly marked.

Northwestern Shore Study Area

The Floy Anchor Tag was used exclusively on all 201 bass tagged in this area. Of six recaptures recorded in the creel survey of the northwestern shore area, one fish had moved approximately one-half mile from the area of release. No detectable movement of the other five fish had occurred. Of 14 reported recaptures, three fish had moved approximately one-half mile from the areas of their respective releases, and the remainder had either not moved or had only moved into an adjacent area.

Table 1. Mark-recapture data for the northeastern and northwestern shore study areas.

NORTHEASTERN SHORE							
<i>Size Group (Inches)</i>	<i>Number Tagged</i>	<i>Percent</i>	<i>Number Creeled</i>	<i>Percent</i>	<i>Recaptures in Creel</i>	<i>Total Recaptures</i>	<i>Percent Recaptures of Size Group Tagged</i>
9	82	17.4	0	0		1	1.2
10	121	25.6	6	1.9		1	0.8
11	109	23.1	30	9.5	1	1	0.9
12	66	14.0	79	25.1	4	6	9.1
13	29	6.1	50	15.9	2	3	10.3
14	11	2.3	41	13.0	1	2	18.2
15	14	3.0	27	8.6	1	6	42.9
16	10	2.1	22	7.0	2	6	60.0
17	9	1.9	10	3.2			
18	5	1.1	6	1.9		1	20.0
19	2	0.4	11	3.5			
20	3	0.6	13	4.1			
21	4	0.8	11	3.5			
22	1	0.2	4	1.3			
23	3	0.6	3	1.0			
24	3	0.6	1	0.3			
25	—	—	1	0.3		1	(unknown length)
Total	472	99.8	315	100.1	11	28	

Table 1. Continued

NORTHWESTERN SHORE							
Size Group (Inches)	Number Tagged	Percent	Number Creeled	Percent	Recaptures in Creel	Total Recaptures	Percent Recaptures of Size Group Tagged
10	14	7.0	4	1.2			
11	13	6.5	11	3.2			
12	36	18.1	48	14.2	1	1	2.8
13	25	12.6	72	21.3	1	4	16.0
14	20	10.1	54	16.0	1	4	20.0
15	20	10.1	55	16.3	3	5	25.0
16	12	5.5	39	11.5		1	8.3
17	10	5.0	21	6.2		2	20.0
18	10	5.0	12	3.5		1	10.0
19	10	5.0	5	1.5		2	20.0
20	13	6.0	5	1.5			
21	6	3.0	9	2.7			
22	1	0.5	1	0.3			
23	5	2.5	1	0.3			
24	6	3.0	1	0.3			
25	—	—	—	—	—	—	—
Total	201	99.9	338	100.0	6	20	

Population Estimates¹ and Exploitation Rates

Tag returns (Table 1) provided a means to estimate populations and size and exploitation rate of largemouth bass in each study area. Population estimates were calculated using the following methods:

1. From the creel data, simple Peterson mark-recapture estimates were made for the entire populations treated as a whole.

The formula used was:

$$\hat{N} = \frac{m(C+1)}{R+1}$$

Where:

\hat{N} = population estimate

m = number marked

C = catch

R = number recaptured

The (+1) was added to catch and recaptures to avoid experimental bias. The estimates for the two 1,000 acre areas were 12,376 bass for the northeastern shore area, and 9,734 bass for the northwestern shore area.

2. Simple Peterson mark-recapture estimates (same formula as above) were made for three size groups of largemouth bass in both study areas. These estimates were:

Northeastern Shore		Northwestern Shore	
Size Range	Estimated Number	Size Range	Estimated Number
216-291mm	5,772	241-291mm	432
292-418mm	2,600	292-418mm	4,342
419mm	1,830	419mm	3,416
Totals:	10,202		8,190

3. Running Peterson (weekly) estimates were made for the entire population treated as a whole based on creel survey data (Table 2). The formula used,

$$\hat{N} = \frac{\sum m(C+1)}{\sum (R+1)}$$

should provide unbiased estimates of the populations if tag losses were low. The average of the weekly estimates for the northern shore study area was 10,191 bass and 6,146 for the northwestern shore.

4. Running Peterson (weekly) estimates were made for the entire largemouth bass population at both study areas based on creel survey estimates of total harvest and total tag returns (Table 3). The average of these weekly estimates for both study areas was considered unreasonably high due to the failure of fishermen to report all recaptures.

From Table 1, exploitation of largemouth bass populations in the 11 inch group and under was one percent or less for the 15 week period at both study areas. Bass in the 15 inch group and over were exploited at a rate of 24 percent and 12 percent of the populations at the northeastern and northwestern shores respectively during the 15 week period.

Table 2. Weekly largemouth bass population estimates \hat{N} based on creel survey data from the northeastern shore study area and the northwestern shore study area.

NORTHEASTERN SHORE							
Week	<i>m</i> No. Sub. to Recapture	<i>C</i> Catch	<i>m</i> ·(<i>C</i> +1)	Σ <i>m</i> ·(<i>C</i> +1)	<i>R</i> Number Recaptured	Σ <i>R</i> Recaptures	\hat{N}
1	470	18	8,930	8,930	0	0	8,930
2	468	15	7,488	16,418	1	1	8,209
3	467	43	20,548	36,966	4	5	6,161
4	461	21	10,142	47,108	1	6	6,730
5	455	14	6,825	53,933	0	6	7,705
6	454	36	16,798	70,731	1	7	8,841
7	453	13	6,342	77,073	0	7	9,634
8	453	26	12,231	89,304	0	7	11,163
9	453	25	11,778	101,082	1	8	11,231
10	452	23	10,848	111,930	1	9	11,193
11	450	26	12,150	124,080	0	9	12,408
12	450	44	20,700	144,780	1	10	13,162
13	447	9	4,470	149,250	1	11	12,437
14	446	0	446	149,696	0	11	12,475
15	446	2	1,338	151,034	0	11	12,586
Weekly Average							10,191

Table 2. Continued

NORTHWESTERN SHORE							
Week	<i>m</i> No. Sub. to Recapture	<i>C</i> Catch	<i>m</i> . (<i>C</i> +1)	Σ <i>m</i> . (<i>C</i> +1)	<i>R</i> Number Recaptured	Σ <i>R</i> Recaptures	\hat{N}
1	199	15	3,184	3,184	0	0	3,184
2	197	4	985	4,169	0	0	4,169
3	196	50	9,996	14,165	2	2	4,722
4	193	35	6,948	21,113	3	5	3,519
5	187	14	2,805	23,918	1	6	3,417
6	186	40	7,626	31,544	0	6	4,506
7	186	5	1,116	32,660	0	6	4,666
8	186	31	5,952	38,612	0	6	5,516
9	186	25	4,836	43,448	0	6	6,207
10	185	50	9,435	52,883	0	6	7,555
11	183	29	5,490	58,373	0	6	8,339
12	183	17	3,294	61,667	0	6	8,810
13	183	2	549	62,216	0	6	8,888
14	182	11	2,184	64,400	0	6	9,200
15	182	10	2,002	66,402	0	6	9,486
Weekly Average							6,146

Table 3. Weekly largemouth bass population estimates \hat{N} based on creel survey estimates of harvest and total tag returns from the northeastern shore study area and the northwestern shore study area.

NORTHEASTERN SHORE							
Week	<i>m</i> No. Sub. to Recapture	<i>C</i> Catch	<i>m</i> . (<i>C</i> +1)	Σ <i>m</i> . (<i>C</i> +1)	<i>R</i> Number Recaptured	Σ <i>R</i> Recaptures	\hat{N}
1	470	39.8	19,176	19,176	2	2	6,392
2	468	89.8	42,292	61,670	1	3	15,418
3	467	205.3	96,342	158,012	6	9	15,801
4	461	203.0	94,044	252,056	6	15	15,754
5	455	108.2	49,686	301,742	1	16	17,750
6	454	120.9	55,343	357,085	1	17	19,838
7	453	79.8	36,602	393,687	0	17	21,872
8	453	195.0	88,788	482,475	0	17	26,804
9	453	127.6	58,256	540,731	1	18	28,460
10	452	197.7	89,812	630,543	2	20	30,026
11	450	96.9	44,055	674,598	0	20	32,124
12	450	328.7	148,365	822,963	3	23	34,290
13	447	98.0	44,253	867,216	1	24	34,689
14	446	0	446	867,662	0	24	34,706
15	446	4.5	2,453	870,112	2	26	32,226
Weekly Average							24,410

Table 3. Continued

NORTHWESTERN SHORE							
Week	<i>m</i>	<i>C</i>			<i>R</i>	ΣR	\hat{N}
	No. Sub. to Recapture				Number Recaptured		
1	199	61.2	12,378	12,378	2	2	4,126
2	197	21.9	4,511	16,889	1	3	4,222
3	196	113.3	22,403	39,292	3	6	5,613
4	193	140.0	27,213	66,505	6	12	5,116
5	187	114.9	21,673	88,178	1	13	6,298
6	186	159.6	29,872	118,050	0	13	8,432
7	186	209.4	39,134	157,184	0	13	11,227
8	186	135.1	25,315	182,499	0	13	13,036
9	186	295.6	55,168	237,667	1	14	15,844
10	185	87.6	16,391	254,058	2	16	14,945
11	183	565.5	103,670	357,728	0	16	21,043
12	183	249.6	45,860	403,588	0	16	23,740
13	183	44.9	8,400	411,988	1	17	22,888
14	182	51.0	9,464	421,452	0	17	23,414
15	182	70.8	13,068	434,520	0	17	24,140
Weekly Average							13,606

Table 4. Weekly estimates of fishing effort and harvest as determined from creel survey data collected in 1973¹ and 1974² on Lake Okeechobee, Florida.

Week	Total Effort		Total Harvest		Effort for Bass		Harvest for Bass		Success for Bass	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
1	148.0	57.1	45.7	61.2	134.3	57.1	39.8	61.2	.296	1.071
2	276.9	38.4	80.8	21.9	276.9	38.4	80.8	21.9	.292	.571
3	358.6	175.7	193.3	113.3	358.6	175.7	193.3	113.3	.539	.645
4	526.8	296.8	184.0	140.4	526.8	296.8	184.0	140.4	.349	.473
5	364.1	160.0	105.2	114.9	364.1	160.0	105.2	114.9	.289	.718
6	251.5	353.2	108.1	159.6	247.2	353.2	105.9	159.6	.428	.452
7	339.4	337.5	71.8	209.4	339.4	337.5	71.8	209.4	.212	.645
8	468.4	324.7	194.5	135.1	441.3	324.7	189.0	135.1	.428	.416
9	570.0	665.7	129.9	295.6	436.1	665.7	127.6	295.6	.293	.444
10	287.0	162.5	202.3	87.1	287.0	161.4	194.7	87.0	.678	.539
11	392.1	1,087.5	90.0	565.5	392.1	1,087.5	90.0	565.5	.232	.520
12	735.6	528.7	335.0	249.6	725.3	528.8	324.7	249.6	.448	.472
13	451.8	427.6	79.0	44.9	451.8	427.6	79.0	44.9	.175	.105
14	107.8	342.5	0	51.0	107.0	342.5	0	56.0	0	.149
15	44.7	247.6	4.5	70.8	44.7	247.6	4.5	70.8	.100	.286
Total	5,322.6	5,205.6	1,825.0	2,320.3	5,633.4	5,204.5	1,791.2	2,320.2	.349	.446
Weekly Average	354.9	347.0	121.7	154.7	342.0	347.0	119.4	154.7	.317	.500

Ratio of resident to non-resident 1973 — 27.3:1.0; 1974 — 7.7:1

Total Interviews — 1973 = 453, 1974 = 452

¹ 1973 data was collected on the northeastern shore of Lake Okeechobee between Henry Creek and J. & S. Lock.² 1974 data was collected on the northwestern shore of Lake Okeechobee between Pearch Canal and the end of Collier Ditch boat trail.

Fishing Effort and Harvest

Comparison summaries of weekly estimates of effort, harvest, and success are provided in Table 4 for the northeastern (1973) and northwestern (1974) shore studies. The average weekly fishing effort for largemouth bass was 342.0 hours on the northeastern shore with an average weekly harvest of 119.4 bass and 347.0 hours on the northwestern shore with an average weekly harvest of 154.7 bass. Success estimates were 0.349 and 0.446 for the northeastern and northwestern shores respectively.

The ratio of residents to non-residents on the more famous northwestern shore was 7.7:1.0 as compared the ratio of 27.3:1.0 determined for the northeastern shore.

Percent composition by size groups of the fish tagged (population cross-section of harvestable size bass) can be compared to the percent composition by size groups in the creel in Table 1. The 9, 10, and 11 inch bass comprised 66.1 percent of the population tagged on the northeastern shore but only 11.4 percent of the fish caught. The 10 and 11 inch bass comprised 13.5 percent of the population tagged on the northwestern shore but only 4.4 percent of the fish caught. Conversely, 12 through 16 inch bass comprised 27.5 and 56.4 percent respectively of the populations tagged on the northeastern and northwestern shores, but 69.6 and 79.3 percent respectively of the catches from the two areas. Larger fish (in the 17 inch group and greater) comprised 6.2 and 30.0 percent of the populations of the northeastern and northwestern shores but 19.1 and 16.3 percent respectively of the catches.

DISCUSSION

The creel survey areas were approximately 1,000 acres each. More than 95 percent of the sportfishing in each area occurred within 175 to 200 acres along the edge of the bulrush community. During the survey period on the northeastern shore, eight or nine bass per acre were harvested from 200 acres. Approximately 13 or 14 bass per acre were harvested from the 175 to 200 acres on the northwestern shore. This harvest represents 2 or 3 bass per acre harvested from each 1,000 acre area during the 15 week period.

Based on the rate of recaptures from the populations of bass in the 12 inch group and under in both areas, the fishing potential would be at least two to three times greater than that measured in this study.

Again, based on the rate of recaptures of the larger bass, there is evidence of exploitation by sportfishing which would exceed the estimated number of larger bass per acre. The explanation appears to be recruitment of larger fish to the area, presumably from the limnetic area.