Effectiveness of a Catch-and-release Regulation for Largemouth Bass in a Florida Lake

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Abstract: The effectiveness of a catch-and-release regulation for largemouth bass (*Micropterus salmoides*) was assessed from 1982 to 1987 at Webb Lake, Florida. The objective was to prevent rapid overharvest of bass and maintain high angler success rates in this new 158-ha lake. Prior to opening the lake to public fishing, experimental angling for largemouth bass resulted in catch rates (C/E) averaging 3.3 fish/hour. During 30 months of public fishing, the average C/E dropped to 1.3 fish/hour. Decreases in largemouth bass biomass estimates, population density, and proportional stock density indicated that the largemouth bass population experienced high angling mortality during the first 6 months of public fishing. Few documented incidents of angler noncompliance were reported; however, it is possible that even low levels of illegal harvest, combined with hooking mortality, caused this decline. Public fishing pressure decreased after the first year, and the largemouth bass population recovered to levels documented prior to public fishing. The catch-and-release regulation was marginally effective since initial mortality was high and C/E decreased overall. The regulation provided the benefit of preventing rapid overharvest of bass that was likely to have occurred in the absence of harvest protection.

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Overharvest of largemouth bass is a common problem in lakes and reservoirs newly-open to public fishing. High initial mortality within the fishery often results in rapid declines in angling success, decreases in size of fish, and the subsequent overabundance of forage fishes. Several restrictive harvest regulations such as catch-and-release, slot limits, and higher minimum size limits have been used to prevent overharvest. These strategies are designed to reduce fishing mortality by recycling the catch, thereby maintaining desirable angler success and stocks of quality-size fish (Anderson and Nehring 1984, Eder 1984, Novinger 1984). Hooking mortality studies have shown largemouth bass to be quite tolerant to multiple

recapture (May 1972, Schramm et al. 1985), thus enhancing the application of catch-and-release strategies.

Webb Lake, an infertile system with a largemouth bass population highly vulnerable to angling, was open to public fishing with a catch-and-release regulation for largemouth bass. The primary objective of the regulation was to prevent rapid overharvest of largemouth bass and maintain a quality sportfishery. Protection of largemouth bass was expected to help prevent overpopulation of bluegill (*Lepomis macrochirus*) and redear sunfish (*Lepomis microlophus*). This study monitored the effects of public fishing on fish population size and structure. Our purpose was to determine the effectiveness of a catch-and-release regulation for maintaining high angler success rates.

Methods

Webb Lake is a 158-ha man-made lake located in Charlotte County, Florida. Completed in 1980, Webb Lake was created by the excavation of marl used for highway construction. The lake has an irregular, elongated shape with over 26 km of shoreline and numerous islands. The lake is shallow, averaging approximately 1.2 m in depth. Drainage basin soils are low in natural fertility and contribute a limited nutrient supply to the lake (Henderson 1984).

During the fall months from 1982 through 1986, fish productivity was estimated by treating 3 blocknet sample sites of 0.4 ha each with rotenone. Biomass estimates for largemouth bass, redear sunfish, and bluegill were obtained by computing mean weights from the 3 samples. Blocknets were placed in littoral areas having varying amounts of aquatic vegetation.

Numerical population estimates were completed for largemouth bass $\geq$26 cm in total length using the modified Schnabel method (Ricker 1975) during early spring from 1984 to 1987. This estimate yielded the number of largemouth bass vulnerable to angling. Preliminary sampling by hook-and-line indicated that bass $<$26 cm in length were significantly less vulnerable to capture. Largemouth bass were collected at night using an electrofishing boat equipped with a 220-volt direct current system. Fish were marked by fin clips. Confidence limits at the 95% level for each estimate were computed by treating recoveries as a Poisson variable (Ricker 1975).

Population structures were evaluated by length-frequency distributions and the index of proportional stock density (PSD) described by Anderson (1980). PSD is the percentage of stock-size fish that have attained quality size. PSD for largemouth bass is defined as the percentage of fish $\geq$30 cm in a sample of fish $\geq$20 cm. PSD for bluegill and redear sunfish is the percentage of fish $\geq$15 cm in a sample of fish $\geq$8 cm. Annual PSD values were calculated by combining fall electrofishing samples with ensuing spring samples.

Controlled experimental angling was utilized to monitor catch per unit effort (C/E) for largemouth bass. Prior to public fishing, 7 angling trips were made for a

total effort of 390.3 man-hours. During the first 30 months of public fishing, 11 trips totaling 384.0 man-hours were completed. Sampling was conducted during various times of the year, with effort for each angling trip varying from 20 to 70 man-hours. Angling trips were completed by 2 to 6 project personnel (1 to 3 boats) using conventional bass fishing equipment. Sampling was conducted over a 2 to 3 day period for 8 to 12 daylight hours per day. Pressure was evenly distributed over the entire lake. The objective of our sampling regime was to reduce bias by maintaining consistency in personnel, effort, and fishing methods.

Public fishing commenced in July 1984, with a catch-and-release regulation imposed for largemouth bass. Fishing was limited to daylight hours, Thursday through Sunday. Qualitative estimates of public utilization were obtained by periodically taking random counts of fishing trips per day. Estimates were made by day-long monitoring and instantaneous counts.

Results

Total fish biomass estimates ranged from 13.0 to 39.0 kg/ha from 1982 through 1986 (Table 1). The biomass estimate for largemouth bass of 14.7 kg/ha in 1982 decreased by 36.7% to 9.3 kg/ha in 1983. Analysis of 95% confidence limits (Table 1) indicates that this decrease was not significant. After 3 months of public fishing, bass biomass was 3.8 kg/ha down 59.1% from the previous year. Estimates in 1985 and 1986 indicated that largemouth bass biomass increased from 1984 levels by 52.6% and 247.4%, respectively. By 1986, bass biomass had returned to levels observed prior to public fishing. Combined biomass estimates for redear sunfish and bluegill remained stable with only minor fluctuations (Table 1). Redear sunfish were most abundant, comprising 74.5% of the combined total.

The large decrease in largemouth bass biomass in 1984 followed by increases in 1985 and 1986 corresponds to numerical population estimates (Table 2). Before the lake was opened to the public, population density of largemouth bass $\geq$26 cm was 15.7/ha. Seven months after opening, the largemouth bass population declined by 52.5% to 7.5/ha. Density nearly doubled between 1985 and 1986, to 14.4/ha. The 1987 estimate was 15.0/ha, approximately equal to the 1986 estimate.

Table 1. Biomass estimates for total fish populations, largemouth bass, bluegill, and redear sunfish at Webb Lake, 1982–1986. Mean is the average of 3 block net samples.

		Year				
		1982	1983	1984	1985	1986
Largemouth bass	mean (kg/ha)	14.7	9.3	3.8	5.8	13.2
	CL[a]	7.7–21.7	6.4–12.2	2.6–5.0	2.2–9.4	9.0–17.4
Bluegill and	mean	9.7	13.6	9.2	15.2	13.8
Redear sunfish	CL	7.9–11.5	8.3–18.9	3.9–14.5	9.0–21.4	8.0–19.6
Total fish	mean	27.6	24.2	13.0	24.3	39.0
Population	CL	18.1–37.1	15.4–33.0	9.3–16.7	13.4–35.2	27.2–50.8

[a]95% confidence limits.

Table 2. Results from annual population estimates for largemouth bass (≥26 cm) at Webb Lake, 1984 to 1987.

	Year			
	1984	1985	1986	1987
Total number marked	779	356	921	1,044
Total population estimate	2,481	1,185	2,275	2,370
Population density (bass/ha)	15.7	7.5	14.4	15.0
Confidence limits ($P \leq 0.05$)	12.6–17.3	5.8–10.0	12.3–17.0	13.3–17.3

Table 3. Length-frequency distributions of largemouth bass (≥26 cm) for annual population estimates at Webb Lake, 1984 to 1987.

Size ranges (cm)	Percent frequency of occurrence			
	1984	1985	1986	1987
26.0–27.9	40.2	38.7	52.0	45.0
28.0–30.4	24.4	21.6	27.4	27.4
30.5–33.0	15.3	14.9	10.0	12.8
33.1–35.5	7.1	5.8	3.0	6.8
35.6–38.0	3.2	2.5	1.3	3.2
38.1–40.6	1.4	2.2	0.5	1.3
40.7–43.1	1.2	2.0	0.8	0.2
43.2–45.7	2.0	1.4	0.2	0.9
45.8–48.2	1.4	3.4	0.2	0.3
48.3–50.7	1.0	2.2	0.9	0.4
50.8–53.3	1.0	2.0	1.3	0.3
53.4–55.8	1.0	1.4	0.3	0.3
55.9–58.4	0.6	1.1	1.5	0.5
58.5–60.9		0.6	0.3	0.3
61.0–63.4	0.2	0.2	0.2	0.3
63.5–66.0			0.1	
Total number	779	356	921	1,044

Length-frequency distributions (Table 3) of largemouth bass marked during population estimates from 1984 through 1987 showed that most fish were between 26 and 34 cm. During the 1985 population decline, structure remained unchanged from 1984, perhaps indicating that mortality rates were equivalent for all size groups. Higher bass density in 1986 was reflected by a higher percentage of 26- to 31-cm sized fish that recruited into the fishery. Length-frequency distributions for 1986 and 1987 indicated a shift toward sub-quality size, while larger fish decreased in abundance.

Largemouth bass PSD indices (Table 4) varied from 6.3 to 18.3, indicating a low abundance of quality-size fish. Prior to public fishing, largemouth bass PSDs were 18.1 and 15.0; however, after 20 months of public fishing, the PSD had

Table 4. Indices of proportional stock density for largemouth bass, redear sunfish and bluegill at Webb Lake, 1982 to 1986.

Date	Largemouth bass	Redear sunfish	Bluegill
Fall 1982	18.1	72.7	30.3
Spring 1983			
Fall 1983	15.0	87.1	41.9
Spring 1984			
Fall 1984	6.4	80.5	24.3
Spring 1985			
Fall 1985	6.3	64.7	23.9
Spring 1986			
Fall 1986	18.3	64.0	17.7

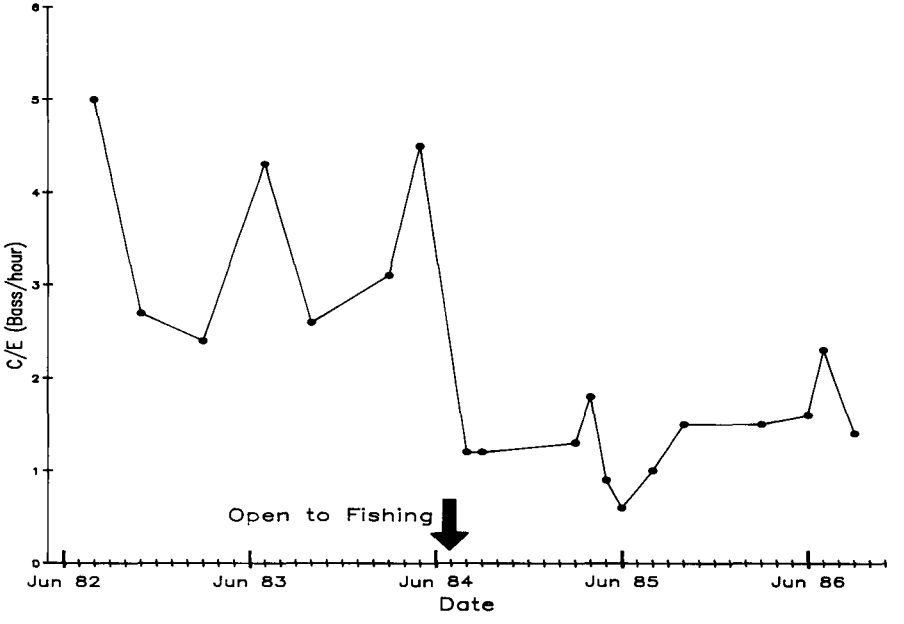

Figure 1. Catch rates (C/E) for largemouth bass during 18 experimental angling trips at Webb Lake from August 1982 through September 1986.

dropped to 6.3. The abundance of quality bass increased during 1986, and by the fall of that year, the PSD increased to 18.3.

Redear sunfish PSD indices of 64.0 to 87.1 indicate a fishery dominated by quality-size fish (Table 4). Redear sunfish PSD decreased by 20.0% during 1985 after 1 year of angler harvest. Bluegill PSDs were much lower than those of redear sunfish, ranging from 17.7 to 41.9. Highest bluegill PSDs were before public fishing and steadily decreased thereafter.

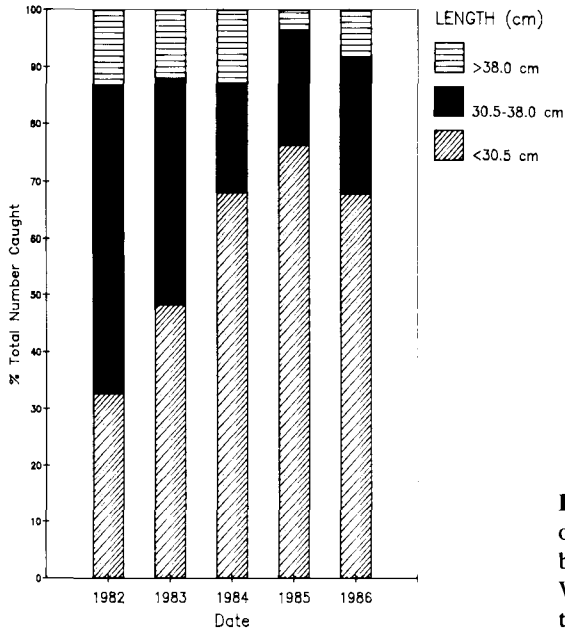

Figure 2. Size composition of the largemouth bass catch by experimental angling at Webb Lake from 1982 through 1986.

Before public fishing, experimental angling resulted in catch rates varying from 2.4 to 5.0 bass/hour (Fig. 1). Fluctuations in C/E corresponded to seasonal periods of high rainfall (June–September) when bass were most vulnerable. Overall C/E from August 1982 through May 1984 was 3.3 bass/hour. During the first 30 months of public fishing, C/E ranged from 0.6 to 2.3 bass/hour with an overall rate of 1.3 bass/hour. Size composition of largemouth bass caught during experimental angling (Fig. 2) indicated that quality-size fish ($\geq$30 cm) decreased in frequency. Prior to July 1984, quality-size bass accounted for 51.6% and 67.2% of the total catch. During the 30 months after public fishing began, quality-size bass decreased to 23.6% and 32.1%.

Public utilization estimates during the initial months of fishing varied from 10 to 20 fishing trips/day. Twenty months after opening, utilization decreased to 3 to 7 trips/day.

Discussion

Fish standing crop estimates indicated that Webb Lake is a system of low fertility. Lack of a strong forage base resulted in a largemouth bass population dominated by small fish. Population density estimates for largemouth bass in Webb Lake are low in comparison to Florida lakes of higher fertility (W. Coleman, pers. commun.). Due to the high flushing rate and extreme shallowness of the lake, artificial fertilization was not utilized. High hook-and-line vulnerability of this low-

density bass population indicated that without a harvest restriction, rapid overharvest of bass would have been imminent.

Data collected during 1983 indicated that the largemouth bass population may have been declining prior to public fishing. Decreases in bass biomass, PSD and the percentage of quality-size bass caught during experimental angling may have resulted from increased mortality. High variability of these data precludes making firm conclusions; however, possible causes for increased mortality include stress due to experimental angling, illegal fishing while the lake was closed, or unknown environmental factors.

Commencement of public fishing led to a rapid decline of the largemouth bass fishery. Following opening of the lake in July 1984, largemouth bass biomass (October 1984) and population density estimates (February 1985) decreased from pre-opening estimates by 59.1% and 52.2%, respectively. Rapid declines in C/E from 4.5 bass/hour in May 1984 to 1.2 bass/hour in August indicate that the initial months of public fishing resulted in a significant decrease in fishing success. This decline could not be attributed to seasonal factors since during 1982 and 1983, C/E were highest during the summer when high water conditions resulted in increased vulnerability. Conditions during 1984 were favorable; however, C/E were lower than previously experienced. We concluded that either illegal harvest or high hooking mortality rapidly depleted largemouth bass stocks. Presence of law enforcement personnel was high following the opening, and it is believed that compliance with the catch-and-release regulation was high. It is likely that high vulnerability of the largemouth bass population resulted in a fishery so fragile that even a low rate of noncompliance had a significant impact.

Decreased public fishing pressure was noted within 6 months after the lake was opened. Lower mortality from less angling pressure resulted in largemouth bass population increases from 1985 through 1986. Increases in biomass and population density indicate that high recruitment occurred into the 25 to 28 cm size range. These sub-quality fish grew past 30 cm by fall 1986 and PSD values increased. Even though bass density returned to 1984 levels, the abundance of quality-size fish decreased, perhaps indicating higher rates of illegal harvest of larger fish.

Although decreases in angler success for largemouth bass resulted from public fishing, C/E remained high in comparison to the average catch rate of 0.25 bass/hour for most Florida lakes (W. Coleman, pers. commun.). While experimental C/E cannot be equally measured against the state average, we contend that fishing success at Webb Lake was higher than at many public fishing lakes in Florida. Anglers reported that fishing success at Webb Lake was excellent when compared to similar infertile borrow pits opened to the public. Number of fish caught is an important aspect as to how anglers rate fishing quality (Stroud 1977, Weithman and Anderson 1978). By maintaining high angler success rates, the catch-and-release regulation resulted in long-term quality fishing.

While standing stocks and population density of largemouth bass returned to levels observed before public angling, C/E did not attain previous levels. Continuous fishing pressure may have contributed to lower C/E by reducing vulnerability

of largemouth bass to angling. Mankin et al. (1984) correlated increasing angling pressure to decreasing catch rates under experimental conditions. Anderson and Heman (1969) stated that differential vulnerability may be due to learning and avoidance or to selection of a more vulnerable portion of a population which leaves fish which are more difficult to catch. The relative importance of the acquired and genetic components of reduced vulnerability has yet to be determined (Burkett et al. 1986).

Although initial mortality of largemouth bass was high, overharvest was prevented by the catch-and-release regulation. If this harvest restriction were not implemented, it is likely that the first weeks of public fishing would have resulted in a serious population collapse. Overpopulation and stunting of redear sunfish and bluegill did not occur as biomass and PSD estimates remained relatively stable. Redear sunfish sustained the highest harvest and although exploitation probably resulted in slight decreases in PSD, quality-size fish were still abundant after 30 months. Redear sunfish received the greatest pressure for all sportfish in Webb Lake and anglers reported good success.

The catch-and-release regulation was marginally effective in protecting the bass fishery. Following a population decline during the first year of public fishing, bass stocks were able to recover. Fishing success decreased; however, C/E were still indicative of quality fishing. The regulation will remain in effect indefinitely, since it has produced favorable results and public feedback has been positive. Implementation of restrictive harvest regulations must be accompanied with intensive educational efforts to generate maximum support of the angling public.

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