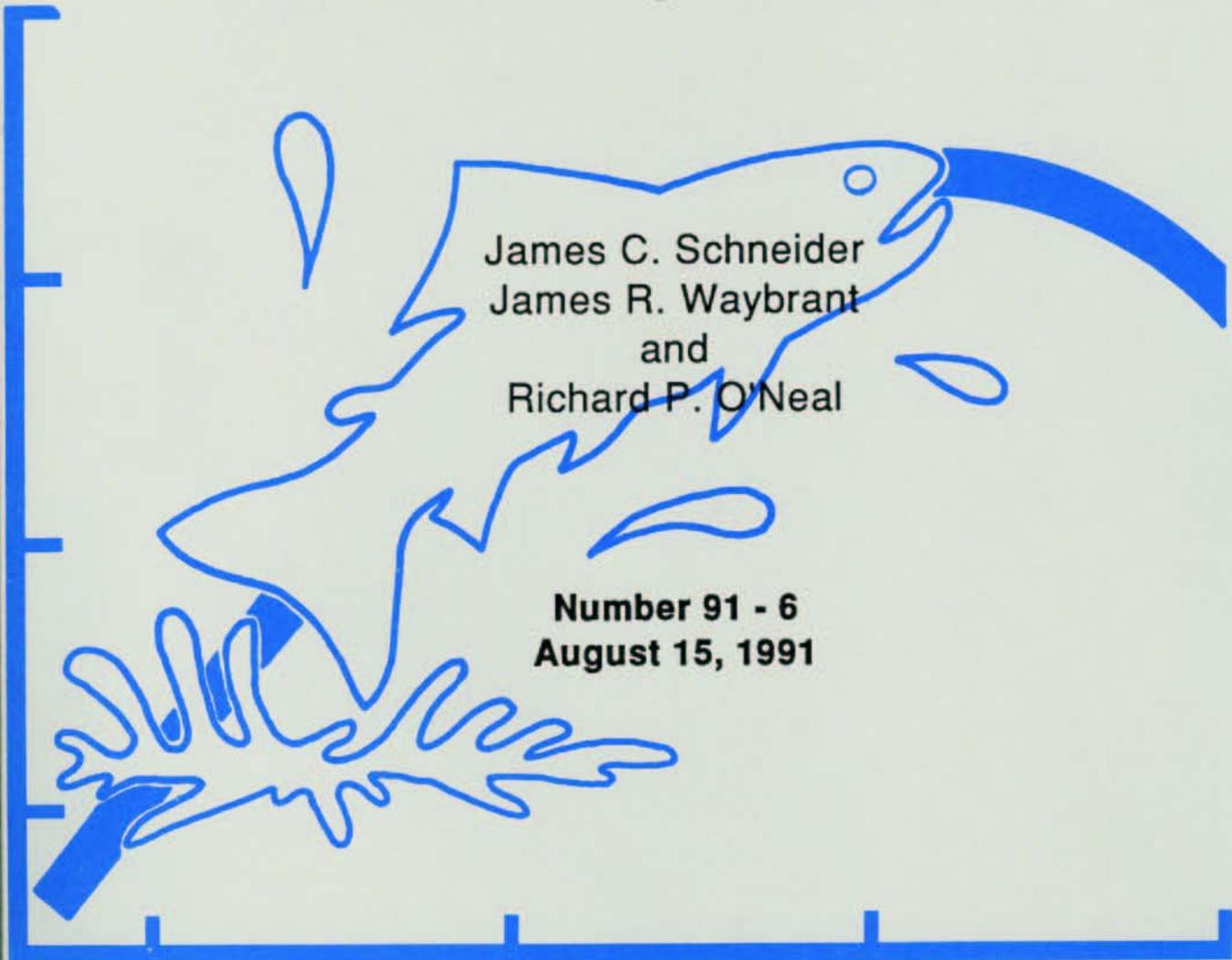


FISHERIES DIVISION

TECHNICAL REPORT

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Michigan Department of
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**MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FISHERIES DIVISION**

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Results of Early Season, Catch-and-Release Bass Fishing at Six Lakes

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Abstract.—A special regulation allowing anglers to catch-and-release largemouth bass (*Micropterus salmoides*) and smallmouth bass (*M. dolomieu*) from April 1 to the Memorial Day weekend, prior to the normal bass season, was tested on six lakes from 1988 to 1990. Effects on both fisheries and bass populations were evaluated at five lakes by means of opinion questionnaires, periodic catch surveys, and bass recruitment surveys. About 82% of the anglers approved of this test fishery and would approve of extending the concept of preseason catch-and-release fishing to some other lakes, 8% disapproved, and 10% had no opinion. Spring bass fishing effort increased approximately 40%, on average. Spring bass catch was modest. The quality of bass fishing, as measured by number of bass caught per hour, was no higher in the early season than during the normal season. Recruitment of small bass to these populations did not appear to be harmed by fishing during the spawning period. Changes in spring bass fishing effort and catch were smaller than expected, mainly because many anglers (about 44% of all anglers and 69% of the frequent bass anglers) were already in the habit of fishing for bass prior to the normal bass season. Thus, to a large extent, the special season simply made angler behavior legitimate. A large percentage (83) of all anglers said they usually release most of the legal-length bass they catch during the normal bass season. No unusual law enforcement or other problems were encountered. A wide-open policy on bass tournaments is not recommended because it could generate excessive fishing pressure on a few lakes. We recommend that the concept of preseason catch-and-release bass fishing be continued on these six lakes and extended to other southern Michigan lakes which have a history of good bass recruitment, ample adult bass populations, light to moderate fishing effort in summer, and no problems with excessive populations of slow-growing panfish. A revision of Fisheries Division policy will be necessary to implement this recommendation.

Over the last 30 years the popularity of fishing for largemouth bass (*Micropterus salmoides*) and smallmouth bass (*M. dolomieu*) has increased tremendously (Schneider and Lockwood 1979). This has caused additional stress on bass populations and created a demand for more bass fishing opportunities. Most bass anglers recognize that bass are in limited supply, and many voluntarily release their catch. In a 1980 survey at three Michigan lakes, 27% of the anglers said they usually release bass (Goudy 1981). That percentage has grown.

Some anglers now fish for bass prior to the statewide opening of bass season on the Saturday before Memorial Day even though it is illegal to "take or attempt to take" bass out of season. They question the need to protect bass populations from preseason catch-and-release fishing in every lake. Likewise, most fisheries managers believe that such fishing would not harm the resources or existing fisheries of many lakes and would generate many hours of additional recreational opportunity. Released bass are very likely to be caught again, probably an average of two times per year, and as many as 12 times per lifetime (Burkett et al. 1986; Weithman et al. 1980). However, they often become more wary (Schneider 1973; Westers 1963).

Therefore, it was proposed that the effects of preseason catch-and-release fishing for bass be tested at some Michigan lakes. This test was endorsed by the Bass Anglers Sportsmens Society, the Michigan United Conservation Club, and by the public at forums held at lakes being considered as test sites.

The two primary concepts in this proposal—receptivity of bass anglers to compulsory catch-and-release fishing and the effect of spring fishing on bass populations and catch—have been tested in Michigan before. Consequently, much background information is available.

Many northern Michigan lakes have been successfully managed under catch-and-release fishing for bass for up to 20 years. The most notable of these are 34 lakes in the Sylvania Recreation Area where all bass must be released, regardless of season. Lakes in

the Big Island Lake complex and in Craig Lake State Park have such a high minimum size limit on bass (18 inches) that they virtually have a catch-and-release fishery. In 1987, Wakeley Lake was restricted to catch-and-release fishing for bass and all other species and the open season was reduced to June 15-August 31. These special fisheries have been well received by anglers and serve to protect unique and vulnerable populations (Schneider and Juetten 1989; J. C. Schneider, unpublished data).

During the 1950s and early 1960s, year-round bass harvesting was tested for 8-10 years at three southern Michigan lakes (Schneider and Lockwood 1979). The normal bass season did not open until June 24 at that time, and anglers were allowed to harvest bass 10 inches and larger. Results indicated that fishing pressure from April 1 to June 24 increased by 67% or more, and 32-40% of the anglers fished for bass specifically. Up to 25% of the annual bass harvest was obtained in April and May.

There were some negative long-term trends in the southern Michigan experiment. Average catch-per-hour rates declined at all three lakes, probably because the available bass were split among more anglers. Total annual bass harvest increased and remained at a higher level at one lake, slightly declined at another lake, and briefly increased then slowly declined at the third lake. Smallmouth bass seemed to be more vulnerable to early spring fishing than largemouth bass. Causes for the declines could not be determined, but most likely they were due to increased total exploitation and possibly to fishing during bass spawning.

Given these negative outcomes, Michigan did not follow a nation-wide trend toward liberal bass fishing regulations. However, Michigan did gradually advance the opening day for bass fishing from the third week in June to the Memorial Day weekend.

Other northern states also retained relatively conservative bass seasons (and size limits). Pennsylvania and New York still protect spawning bass with closed seasons extending until mid- to late June. By contrast,

many southern states eliminated bass seasons and minimum size limits.

Based on previous Michigan studies, and other information, we anticipated that preseason catch-and-release bass fishing likely would have the following effects:

1. Spring fishing effort would increase by less than 67% and summer effort would stay about the same;
2. Summer bass catch rates and total annual bass harvest would decline slightly because, of the bass caught in the spring (about 25% of the yearly total), some would die from hooking mortality and some others would be more wary the rest of the year;
3. Hooking mortality of fish released immediately would be under 10% and be compensated for by reduced harvest in summer;
4. Temporary removal of some male bass from their redds would not significantly reduce bass recruitment for the population as a whole;
5. Bass population characteristics such as recruitment, growth, total mortality, and standing crop would not be altered significantly; and
6. Most bass anglers would find preseason catch-and-release fishing to be acceptable.

However, the effects of the current proposal were not fully predictable from previous results. Exploitation rates, angler attitudes, and angler behavior continually change. Therefore, this study was developed to evaluate primarily (1) angler acceptance and use of preseason catch-and-release bass fishing opportunities and (2) if recruitment and general abundance of bass populations were adversely affected over a 5-year period. The other effects were deemed to be either of lesser importance, or would require prohibitively long and costly study to obtain statistically valid results.

First-year results of this study were presented by Schneider et al. (1989). This report will summarize results through 1990 and include only new data and comparisons.

Methods

The Natural Resources Commission authorized a test of early season, catch-and-release bass fishing, from 1988 through 1992, at six lakes and reservoirs: Cass Lake, Pontiac Lake, Kent Lake, Muskegon Lake, Holloway Reservoir, and Hardy Pond. The designated special early season was from April 1 to the regular opening day (the Saturday before Memorial Day). These waters range from 585 to 4,150 acres in size, and are fairly representative of those in Michigan's Lower Peninsula. Some physical and biological characteristics of these waters are given in Table 1.

The evaluation plan included: (1) conducting an opinion survey to determine angler acceptance and usage at five lakes during spring and summer of 1988 and 1990; (2) conducting standard catch surveys during the open-water fishing period at two lakes in 1988 for comparison with prior data; and (3) monitoring trends in bass recruitment at all study lakes in 1988 and 1990. Originally, additional sampling was scheduled for 1992; however, the study was discontinued after 1990 because sufficient results had been obtained.

Opinion Survey

The opinion survey was designed to gather information about angler acceptance, likely change in fishing effort, types of anglers present, and bass fishing behavior. The survey was conducted in 1988, the first year of the test, and again in 1990, the third year of the test. Responses were similar, suggesting that the fishery had quickly moved to an equilibrium.

Two versions of a questionnaire were used in 1988 and a third version (Appendix 1) was used in 1990. Versions 1 and 2 were similar,

and versions 2 and 3 were identical except that version 3 was easier to enter on computer. All three versions gave similar results, so data were pooled.

The opinion survey was conducted during both the special early bass season and the normal bass season. These two periods are referred to as "early season" and "normal season" in this report. However, we found that the two groups of anglers gave similar responses. Interviews were obtained on weekdays and weekends, mostly at hours of peak fishing activity. Opinion surveys were conducted in 1988 at Pontiac Lake, Muskegon Lake, and Holloway Reservoir, and in 1990 at Pontiac, Cass, Muskegon, and Kent lakes. The opinion surveys were conducted along with the randomly scheduled catch surveys at Cass and Kent lakes in 1988. In total, 2,336 anglers were polled. Between 40 and 309 interviews were obtained for each strata (lake by year by season) except for the 1988 normal season at Holloway Reservoir (18). Anglers at Holloway Reservoir were not interviewed in 1990.

An angler was interviewed only once per year (Question 1), no matter how often that person frequented the lake. Only 5% of the contacts had been interviewed before. The interviewers were instructed to tell hesitant anglers that responses would be kept confidential and that no legal action would result if they admitted, in effect, to fishing for bass out of season (Question 6b). Few anglers balked at this question and we believe the great majority of answers were honest.

Catch Surveys

Catch surveys were conducted at Kent and Cass lakes from April 1 to August 28, 1988. The objective was to obtain estimates of total fishing effort, bass catch, and bass catch rate, and to compare them to predata collected in 1986 (Cass Lake) or 1987 (Kent Lake). Methods and results were previously reported by Schneider et al. (1989), so they will only be reviewed here.

General methods were as follows. Total fishing effort was estimated from periodic

counts of anglers. Hours fished, and numbers and types of fish harvested or released, were derived from angler interviews. Anglers were specifically asked how many legal-length bass (12.0 inches and larger) and sublegal-length bass (less than 12.0 inches) they caught. Each lake was sampled an average of 20 hours per week, during daylight hours, according to a stratified, random design. Strata were weekdays, weekends, shore anglers, and boat anglers. Little fishing occurred on Cass Lake during midsummer due to power boating, making it difficult to obtain enough fishing data for reliable estimates.

Some catch survey data were also collected at Muskegon Lake, Pontiac Lake, and Holloway Reservoir in conjunction with the opinion surveys. Interviewers made periodic counts of anglers on the lake, or of boat trailers in parking lots, to obtain an index of fishing effort. They also obtained small samples of the catch and of the catch rate.

Bass Recruitment Surveys

The relative abundance of small bass in all six test lakes was sampled with DC electrofishing gear in fall 1988 and fall 1990 to monitor reproductive success. If fishing for adult bass during the early season (when they were attempting to spawn) had a significant detrimental effect on bass reproductive success, then it should be reflected in weak or missing year classes beginning in 1988. Little background data on bass recruitment was available for the study lakes, but the typical pattern for other southern Michigan lakes is a modest amount of recruitment every year. If bass recruitment failed completely in the study lakes for 3 years, then even low sampling effort should detect it. This is the sampling approach we used, with 0.3 to 2.4 hours of electrofishing per sample. If bass recruitment were only slightly or sporadically effected, then a much more intensive, long-term study would be required.

For analysis, bass caught by electrofishing were divided into two size/age groups: 2.0-4.9 inches (young of the year), and 5.0-9.9 inches (mostly 1 and 2 year olds).

Results from Opinion Survey

Questionnaire results for 1990 are summarized in Table 2. In Table 3, 1990 results are compared to 1988 results for the four lakes which were sampled in both years. Basic data for each lake may be found in Appendices 2 and 3, and for 1988 data, in the corresponding sections of the first report (Schneider et al. 1989). Responses by all anglers will be discussed first, then responses of frequent bass anglers will be contrasted with those of anglers who do not fish for bass. Discussion will focus on typical responses, differences between early and normal seasons, differences among lakes, and changes since the 1988 survey.

All Anglers (Tables 2 and 3)

Question 2.—"Are you aware there is a special catch-release early bass season on this lake from April 1 to the Memorial Day weekend?" About 85% of the anglers were aware, a 15% gain over 1988.

Question 3.—"Do you approve, disapprove, have no opinion of this early season?" Overall, about 82% approved, 8% disapproved, and 10% had no opinion. For the four lakes sampled in both years, this was a 6% gain in approval rate over 1988. Few of the disapprovers felt very strongly, as reflected in extra comments (Question 9) or expectation to fish less (Question 5).

Question 4.—"Would you approve of early catch-release fishing at other lakes?" Responses were as strongly positive (80%), as in Question 3, indicating the concept could be extended to some other lakes.

Question 5a.—"Because of this early season, will you probably fish for bass here more, the same, or less than before?" Average responses were: 35% more, 55% same, 2% less, and 8% no opinion. Compared to 1988, this is a 9% gain in "more" responses. Early season fishermen responded "more" slightly more often than normal season fishermen.

Question 5b.—"How much more or less: 2x, 3x, other?" For anglers who responded "more" to Question 5a, the average was 2.2; for those who responded "less", the average was 1.3. However, these averages may not be precise because anglers may have interpreted the question differently; for example, as two additional fishing trips per season rather than twice as many trips per season (as intended). These statistics were the same in 1988.

Question 6a.—"Last year, did you fish this lake before Memorial weekend?" This question had special significance in 1988 because it referred to a year (1987) when spring bass fishing was illegal. "Yes" responses increased from 43% in 1988 to 68% in 1990 at the four lakes. Early season and normal season anglers responded similarly. The main purpose of Question 6a was to set up Question 6b.

Question 6b.—"If yes, what species did you fish for?" In the 1988 survey, a high percentage, 44, admitted to fishing for bass. Some may have been aware this was illegal, others not. The percentage was lowest (12) for Kent and Muskegon lakes, which have unusually attractive spring fisheries for other species. Kent Lake attracts a high proportion of panfish anglers because it offers much bank fishing opportunity. In the 1990 survey, 18% more anglers said they had fished for bass prior to Memorial Day in 1989 (legally, at the study lakes). Results of Questions 6a and 6b confirm those of Questions 5a and 5b, that anglers moderately increased their amount of spring bass fishing.

Question 7.—"Generally, during the summer months, do you usually keep the legal bass you catch or release them?" Responses averaged 17% keep and 83% release. The proportion of anglers releasing bass was 24% higher than in 1988. Thus, a high fraction of all anglers interviewed were practicing catch-release bass fishing most of the time. Anglers at Kent and Muskegon lakes were the anglers most likely to want to harvest bass.

Question 8.—"Are you affiliated with a fishing organization? If yes, which one?" A surprisingly high fraction, 21%, of all interviewees belonged to fishing clubs. A similar figure was obtained in 1988. A wide

variety of clubs was represented, not simply those concentrating on bass fishing. Thus, the special season did not attract large numbers of organized bass fishermen or bass tournaments.

Question 9.—"Do you want to make other comments?" About 20% of the anglers took the opportunity to express their opinions in 1988, but only 6% in 1990. Comments ranged from endorsements of the concept and/or study to concerns about poaching, extra stress on bass, and disturbance of nesting bass. An angler at Kent Lake stated he had seen at least 30 dead female bass last year, and attributed them to the early season. Unusual mortalities were not reported by anyone else.

Question 10.—"On average, how many times a year do you fish for bass?" About 9% (16% in 1988) said they do not fish for bass. A very high fraction, 56% overall, said they usually fish for bass more than 10 times a year. Thus, the majority of anglers were very interested in bass fishing. The responses of these two interest groups are contrasted in the next section.

Question 11.—"Did you fish for bass today?" Many (average 51%) early season anglers took advantage of the opportunity to fish for bass legally. As expected the percentage tended to be lower at Kent and Muskegon lakes because they have attractive spring fisheries for other species. For every lake except Pontiac, an even higher percentage of normal-season anglers were fishing for bass.

Frequent versus non-bass anglers (Table 4)

Responses to Questions 3-7 were next stratified into two groups based on the response to Question 10. Responses of anglers who usually fish for bass more than 10 times a year were placed in one group; responses from anglers who do not fish for bass comprised the second group. The attitudes of these two groups should represent the two extremes within the fishing public: anglers with a strong personal interest in bass versus anglers with little or no interest in bass.

In response to Questions 3 and 4, frequent bass anglers expressed a high degree of approval (94-97%, in 1990) of the early

bass season. Compared to the 1988 survey, about 10% of them had shifted from disapproval to approval. Non-bass anglers were about equally divided between those who approved (44%) and those with no opinion (50%).

In response to Question 5, in 1990 the majority of frequent bass anglers projected they would fish more (57%; 2.2 times more often) or the same amount (40%). This was a 24% gain in "more" as compared to 1988 results. As expected, most non-bass anglers responded "same" or "no opinion" since they were not strongly interested.

In response to Question 6, 49% of both types of anglers fished prior to the Memorial Day weekend in 1987. However, the species sought were markedly different; bass were admittedly sought by 69% of the frequent bass anglers as compared to 1% of the non-bass anglers. By 1989, there was about a 20% gain in each statistic by the frequent bass anglers.

In response to Question 7, the proportion of the frequent bass anglers who usually release bass during summer increased from 76% in 1988 to 94% in 1990. For the pooled data, all years, the proportion of anglers usually releasing bass was 84% for frequent bass anglers and 30% for non-bass anglers.

Results of Catch Survey

Cass and Kent Lakes

Monthly estimates of 1988 fishing effort and catch for Cass Lake and Kent Lake were presented in the prior report (Schneider et al. 1989). They were compared to similar data collected in previous years (1986 or 1987) to determine if there were changes in these fisheries caused by the early bass season.

The comparison indicated that the early bass season had little effect on the fisheries of these two lakes. Total fishing effort declined, but a higher percentage of anglers were targeting bass in both early and normal seasons. The partial catch survey on these lakes in 1990 provided additional information on those two important trends (Appendices 4-7).

First, total fishing effort continued to decline in 1990, rather than increase, as anticipated. At Cass Lake, the average weekend boat count during the period from April 1 to the Memorial Day weekend declined from 7.2 in 1986 to 5.4 in 1988, then to 2.6 in 1990. At Kent Lake, the comparable statistics were 14.2 in 1987, 15.1 in 1988, and 5.4 in 1990. This trend can be explained, in part, by unusually rainy weather on 18 consecutive weekends in the spring and summer of 1990.

Second, the proportion of spring anglers fishing for bass continued to increase. At Cass Lake, the percentage of anglers targeting bass (according to the catch survey version of the question) increased from 17% in 1986 to 40% in 1988, then to 52% in 1990. At Kent Lake, this statistic increased from 1% in 1987 to 13% in 1988, then to 24% in 1990. Not all of the increase should be attributed to the special regulation, though, because higher percentages also targeted for bass in the normal season. For Cass Lake, the comparable percentages were 52%, 58%, and 73%, respectively, and for Kent Lake, 16%, 42%, and 47%, respectively. At Cass Lake, a considerable proportion (17%) admitted to illegally fishing for bass prior to the Memorial weekend in 1986.

Other Lakes

Muskegon Lake.—Based on 1988 results, we concluded the special bass season had little effect on the fishery at Muskegon Lake. By 1990, however, the proportion of spring anglers targeting bass had increased from 27% to 39% (per the catch survey—Appendix 8) and bass fishing tournaments were being held. The proportion of anglers seeking bass in the summer remained about the same from 1988 to 1990 at 67%. However, total spring fishing effort was probably lower in 1990 due to cold and rainy weather. The average weekend boat count during the early season declined by two-thirds, from 31.8 in 1988 to 11.0 in 1990 (Appendix 9). Both species of bass were abundant, but smallmouth were caught more frequently than largemouth in the spring.

Holloway Reservoir.—This site was not sampled in 1990. Based on 1988 sampling (Schneider et al. 1989), we concluded that bass were not a major component of this fishery and that the early season had no important effect on effort or catch. About 31% of the anglers were targeting bass in the early season in 1988, and 41% admitted to fishing for bass illegally in 1987. Bass possession violations were observed in 1988, but probably were no more frequent than in previous years.

Pontiac Lake.—Fishing effort was light on this lake but a high percentage of anglers (71-75%) targeted bass (Appendices 10 and 11). Fisheries for other species were of minor importance because "stunted" bluegills dominated in this lake.

Bass Catch Rates

One concern at the beginning of the study was that bass might be very vulnerable to anglers during the early season, especially while nesting. Average catch-per-hour statistics for anglers who were specifically fishing for bass do not substantiate this concern (Table 5). For 12-inch and larger bass, both species combined, average catch rates were consistently higher after Memorial Day than during the early season. For bass of all sizes, catch rate was higher during the normal season than during the early season for three out of five comparisons. However, for smallmouth bass, which were more abundant at Muskegon Lake than any other study lake, catch rates were slightly higher during the early season; this suggests that they may be slightly more vulnerable than largemouth bass in the spring. Catch rates for all bass combined ranged from 0.33 to 0.82 per hour of bass fishing.

Results of Bass Recruitment Surveys

Fall electrofishing surveys in 1988 and 1990 found adequate numbers of small bass in one or both years (Table 6). This indicates that the early fishing season had not com-

pletely disrupted bass spawning success during the first 3 years of study. Samples were too small, too variable, and were taken over too few years to detect if only a slight reduction in recruitment was taking place.

Discussion

Eighty-two percent of the anglers using these lakes strongly approved of the special early bass season. And a large proportion (49%) said they had fished for bass on the day they were interviewed.

The special season generated a modest amount of extra fishing pressure in the first 3 years, less than anticipated. At Cass and Kent lakes, where we had prior catch survey data, total spring fishing pressure declined but spring bass fishing pressure increased slightly in 1988. Fishing pressure indices for these two lakes, and for Muskegon Lake, indicate pressure was even lower in spring 1990, probably due to unusually rainy weather.

Another way of estimating change in fishing pressure was to ask anglers if they expected to (or did) fish more or less because of the early season. In the first year, about 24% of the anglers said they would fish more (about 2.6 times), and based on those statistics we project that the amount of spring bass fishing pressure would increase about 38%. In the third year, about 35% said they would fish 2.2 times more, and the projected increase in spring bass fishing pressure was 42%. Thus our best estimate is about a 40% gain. The impression obtained from all six test lakes was that no obvious increase in bass fishing actually occurred. A change as small as 40% would be difficult to detect because of statistical variability in sampling and variations in fishing pressure caused by weather, employment rate, etc.

Relatively little increase occurred in spring fishing activity because, for the most part, the special regulation simply legitimized existing behavior. According to the opinion questionnaire, about 44% of all anglers (69% of the frequent bass anglers) who fished prior to Memorial weekend in 1987 fished for bass (illegally). Statistics derived from the catch

survey indicate a lower, but still appreciable, amount of bass fishing activity. Thus, in recent years, the closed season on bass has not been much of a deterrent to bass fishing; consequently, the special season did not stimulate much additional interest.

There was concern at the outset that the early bass season might attract large numbers of "professional" bass anglers and bass tournaments. Such was not the case in the first year, as just 19% of the early season anglers were members of fishing clubs of any type and no early season tournaments were held. Some local bass fishing clubs, sensitive to this concern, had agreed not to hold tournaments prior to Memorial weekend in 1988.

However, by 1990 there was mounting pressure to allow bass tournaments during the early season. Two tournaments which were officially sanctioned by the Fisheries Division were held at Cass and Pontiac lakes. Unapproved tournaments were held at Cass and Muskegon lakes, and possibly at other study lakes. Considering the large number of bass tournaments being held in Michigan during the normal season (about 300 per year), we believe some restraint is necessary to prevent a burst of spring fishing pressure on a few lakes.

Surprisingly, largemouth bass catch per hour was no better during the early season than during the first couple months of the normal season. This was unexpected because it is widely believed that (a) bass are vulnerable while guarding nests, (b) they concentrate in warm bays and feed ravenously, and (c) they are more naive after a winter's rest.

However, there was some evidence that smallmouth bass catch rates were slightly higher in spring than during the normal season. This tendency was noted for smallmouth bass in a previous study (Schneider and Lockwood 1979). Consequently, lakes containing marginal populations of smallmouth bass should be managed cautiously.

Limited statistics obtained from the two sanctioned bass tournaments at Pontiac and Cass lakes likewise indicate spring bass fishing

was unimpressive. Catch-per-hour rates were no better than the corresponding averages for the general public shown in Table 5. Tournament-caught bass ranged from 6.2 to 16.7 inches long (average, 11.8) at Pontiac Lake, and from 6 to 16 inches long (average 11.5) at Cass Lake. However, the above statistics do not rule out the possibility that spring fishing can be exceptionally good on certain days.

The catch-release aspect of the special season was readily accepted by anglers. Few (no more than normal) bass possession violations were reported by interviewers and Conservation officers, and from an enforcement perspective the test went smoothly. Questionnaire results indicate that even during the normal bass season a high proportion of anglers (83% of all interviewed anglers usually) release most of the legal bass they catch. Thus, the catch-release concept is already widely practiced on a voluntary basis.

Undoubtedly, the growing ethic of catch-release fishing has been of great benefit to bass stocks and fisheries throughout the State. It has helped offset the still-growing demand for bass fishing. In southern Michigan lakes, the demand for bass began to increase during the 1950s (Schneider and Lockwood 1979). By the end of the 1950s, 20 to 50% (depending on the lake) of the summer anglers targeted bass. In 1990, 42 to 74% targeted bass. At Pontiac Lake, which has been sampled frequently over the years, the proportion of summer anglers targeting bass was 7% in 1951, 32% in 1959, 39% in 1980, 67% in 1988, and 71% in 1990 (Goudy 1981; Schneider and Lockwood 1979).

So high a demand must be carefully regulated to prevent harm to bass populations and to maintain quality fisheries. The modest amount of spring fishing which has been occurring seems to be acceptable from a biological perspective. A large amount of spring fishing, albeit catch and release, could be risky. Even if not damaging to bass recruitment, it would cause some hooking mortality and provide more opportunity for poaching. Also, it is likely to increase competition among anglers and lower summer catch rates to the extent that the bass learn to

avoid recapture. However, these negatives seem relatively slight compared to the recreational opportunity spring catch-and-release fishing could provide.

The prior Michigan study supports a conservative view of spring bass fishing (Schneider and Lockwood 1979). The effects of spring harvest (not simply catch-and-release) were tested at three lakes—Bear (Manistee County, 1,744 acres), Pontiac (Oakland County, 585 acres), and Whitmore (Washtenaw and Livingston counties, 677 acres). Bass catches slowly declined at two lakes (Bear and Pontiac), and bass catch-per-hour rates declined at all three lakes. These changes were subtle, apparent only because many years of data were collected. Factors in addition to spring fishing could have been involved.

The most difficult effect of spring fishing to predict is its effect on bass recruitment. The problem consists of two parts: the effect of temporary removal of a guarding male bass on the survival of his young and, more importantly, the cumulative effect of each disturbance on total recruitment of fingerling bass to the population as a whole. The two are not always closely related because usually many more larval fish are produced than the environment can support and only a limited number of fingerling bass can survive.

It is clear that removal of protective males is likely to increase predation on his eggs and fry, although sometimes a successful hatch is brought off anyway (Kramer and Smith 1962; Mraz 1964). The risk is related to the length of time the male is gone and to the densities of predatory stunted panfish and yearling bass (Swingle and Smith 1950; Bennett 1972; Kramer and Smith 1962).

The more difficult question to answer is the probability of bass populations declining to a lower level of abundance, or even becoming extinct, because of spring catch-and-release fishing. Arguments suggesting a significant decline is unlikely include:

1. Other states (mostly to our south) have allowed year-round, almost unrestricted, bass harvest for many years, apparently

without ill effect (Latta 1974; Rideout and Oatis 1975).

2. Michigan has allowed some bass harvest during the spawning season for 30 years, apparently without obvious signs of detriment. Prior to 1962, spawning bass were almost completely protected by a closed season from January 1 to June 24. The opening day was advanced to June 1 in 1962, then to Memorial Day weekend (usually the fourth weekend in May) in 1973. Many bass populations, especially in northern Michigan, have not finished spawning by June 1.
3. Generally, there is no close relationship between the number of adult bass and the number of fingerling recruits they produce (Latta 1974, 1975). Only six adults per acre can produce excessive numbers of fingerlings (Schrouder et al. 1989; Mraz 1964). Environmental variation can cause wide fluctuation in survival of young.
4. Generally, anglers are unable to catch every bass, or even enough bass to harm recruitment (Bennett 1972).

Counter arguments, that there may be a real risk to some bass populations in Michigan from catch-and-release spring fishing, include:

1. Michigan bass populations are much smaller than southern bass populations, therefore there is a greater risk of unusual events causing insufficient spawners. In southern Michigan lakes, typical bass populations are about 10 pounds per acre and 10 adults per acre (Schneider 1971). Unproductive northern lakes may have only a few adults per acre (Wagner 1988). By contrast, typical ("balanced") midwestern ponds to our south contain 40+ pounds per acre and 20+ adults per acre (Reynolds and Babb 1978).
2. The climate in northern Michigan provides a variable environment for bass reproduction (edge of bass range), with a relatively high risk of reproductive failure.

To compensate, broodstocks and nesting success should be maintained at a relatively high level. For both largemouth and smallmouth bass, weather can have a large effect on reproductive success and cause weak year classes (Wagner 1988; Latta 1975).

3. Sometimes an alarmingly high fraction of a bass population is caught by anglers. Up to 55% of a bass population has been caught in 1 day (Redmond 1972). At Wakeley Lake, Crawford County, Michigan, where catch and release is in effect for all fish, the number of bass caught in 10 weeks exceeded the bass population by a factor of two (J. C. Schneider unpublished data). Most observers would agree that the potential for overexploitation has increased in recent years because of increased fishing for bass and improvements in gear and angling techniques.

We conclude that the greatest risk of reproductive harm is to bass populations which contain few adults (as in small or unproductive lakes), co-occur with excessive panfish populations (as in stunted bluegill lakes), are exploited more easily (as in heavily fished or unproductive lakes), or have variable recruitment (as in northern Michigan lakes). Smallmouth bass should be of greater concern than largemouth bass.

To summarize, results of the special early bass season were that anglers supported the regulation and fished about 40% more. No problems were created in terms of law enforcement or bass recruitment. However, given the high demand for bass fishing, and prior studies which suggest that sometimes spring bass fishing may be detrimental, a fairly conservative approach to the regulation of bass fishing is advised.

Recommendations

1. From a biological perspective, the special early bass season could be continued at the study lakes. However, their bass populations should be surveyed

periodically to confirm that recruitment is adequate.

2. Likewise, this concept could be extended to other selected southern Michigan lakes. Popular support is essential in the selection process. These lakes should be relatively large, have good populations of bass, have consistent recruitment of bass, and not have stunted panfish problems. Smallmouth bass, if present, should be of special concern.
3. Spring bass pressure should be maintained at a modest level. High pressure, as might be generated by unrestricted bass fishing tournaments, should not be promoted.
4. Fisheries Division policy on bass seasons should be reevaluated. Both biological and sociological factors should be considered.

Acknowledgments

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Table 1.—Characteristics of lakes designated for special early season bass fishing.

Lake, county, type	Area (acres)	Maximum depth (feet)	Produc- tivity	Bass abundance		Comments
				Largemouth	Smallmouth	
Cass Lake, Oakland, Natural	1,280	121	low	common	common	Clear, deep, diverse. Much recreational boating.
Hardy Pond, Newaygo, Impoundment	2,845	115	low	sparse	abundant	Perch and walleye abundant.
Holloway Reservoir Genessee, Impoundment	1,973	21	very high	sparse	sparse	Turbid. Crappie, walleye, gizzard shad abundant.
Kent Lake, Oakland, Impoundment + natural	1,000	38	high	abundant	common	Bluegill and crappie abundant. Walleye common. Much bank fishing.
Muskegon Lake, Muskegon, Natural	4,150	70	medium	abundant	abundant	Perch and walleye abundant. Also Lake Michigan migrants.
Pontiac Lake, Oakland, Impoundment + natural	585	34	medium- high	abundant	none	Very weedy. Stunted bluegill.

Table 2.—Summary of angler responses to the opinion questionnaire by lake and season, 1990. The Memorial weekend divides the early season from the normal season. The numbers are percentages except for Question 5b.

Question and answer	Lake and season								Simple average
	Cass		Kent		Muskegon		Pontiac		
	Early	Normal	Early	Normal	Early	Normal	Early	Normal	
2. Aware early season									
Yes	93	97	78	74	78	77	98	87	85
No	7	3	22	26	22	23	2	13	15
3. Approve									
Yes	88	94	62	67	87	87	93	80	82
No	1	4	15	19	13	7	2	4	8
No opinion	11	2	23	15	0	6	4	16	10
4. Approve other lakes									
Yes	88	89	65	61	81	87	89	77	80
No	1	9	21	24	13	7	7	7	11
No opinion	11	2	14	15	6	6	4	16	9
5a. Change fishing									
More	43	38	29	20	30	32	66	23	35
Same	46	59	41	70	66	67	25	64	55
Less	3	0	3	0	0	0	7	3	2
No opinion	8	3	27	10	4	1	2	11	8
b. Average multiple									
More	2.3	2.2	2.3	2.1	2.4	2.1	2.3	2.0	2.2
Less	2.0	—	2.0	2.0	—	—	2.0	2.0	1.3
6a. Fished pre-Memorial last year									
Yes	54	66	75	74	90	79	57	46	68
No	46	34	25	26	10	21	43	54	32
b. Species fished for									
Bass	64	80	29	41	46	56	83	67	58
Other	31	15	67	58	53	44	8	12	36
Any	5	5	4	1	1	0	8	21	6
7. Usually									
Keep bass	12	9	27	22	12	38	2	13	17
Release bass	88	91	73	78	88	62	98	87	83
Both	0	0	0	0	0	0	0	0	0
8. Club member									
Yes	12	25	7	4	40	25	30	21	21
No	88	75	93	96	60	75	70	79	80
9. Comments									
Yes	4	0	5	0	25	8	4	1	6
No	96	100	95	100	75	92	96	99	94
10. Average bass trips per year									
0	3	1	18	16	16	6	2	12	9
1-3	8	8	19	26	1	2	0	12	10
3-10	26	24	23	20	29	41	18	21	25
10+	64	67	40	39	54	51	80	55	56
11. Fished for bass today									
Yes	60	74	30	42	38	67	75	71	57
No	40	26	70	58	62	33	25	29	43

Table 3.—Differences between 1998 and 1990 in angler responses to the opinion questionnaire by lake and season. Also compared are the simple averages. Numbers are percentages except for Question 5b.

Question and answer	Lake and season								Simple average
	Cass		Kent		Muskegon		Pontiac		
	Early	Normal	Early	Normal	Early	Normal	Early	Normal	
2. Aware early season									
Yes	22	14	13	1	15	11	13	34	15
No	-22	-14	-13	-1	-15	-11	-13	-34	-15
3. Approve									
Yes	16	7	4	-4	8	0	1	15	6
No	-10	0	4	8	-1	-2	1	-1	-0
No opinion	-6	-7	-7	-3	-7	2	-2	-14	-6
4. Approve other lakes									
Yes	15	4	5	-14	6	3	-1	-10	1
No	-9	4	11	18	-6	-6	5	2	2
No opinion	-6	-8	-16	-4	0	3	-4	8	-3
5a. Change fishing									
More	16	19	5	-2	3	22	10	-2	9
Same	-9	-20	1	-3	-6	-22	-14	-3	-10
Less	0	0	0	-1	0	-1	6	3	1
No opinion	-7	1	-6	6	2	1	-2	3	-0
b. Average multiple									
More	-0.10	0	0	-0.10	-0.30	-1.30	-0.30	-1	-0
Less	-0.80	—	0	0	—	—	2	2	0
6a. Fished pre-Memorial last year									
Yes	6	35	10	24	33	39	30	24	25
No	-6	-35	-10	-24	-33	-39	-30	-24	-25
b. Species fished for									
Bass	39	6	17	-11	34	25	35	0	18
Other	-21	-4	6	12	-31	-23	-25	-21	-13
Any	-18	-1	-23	-1	-3	-2	-11	21	-5
7. Usually									
Keep bass	-16	-18	-10	-30	-25	10	-12	-35	-17
Release bass	17	22	11	34	44	8	13	42	24
Both	-1	-4	-1	-4	-19	-18	-1	-7	-7
8. Club member									
Yes	3	7	-1	0	17	-13	-10	-1	0
No	-3	-7	1	0	-17	13	10	1	-0
9. Comments									
Yes	-23	-15	-2	-6	-16	-43	-37	-14	-20
No	23	15	2	6	16	43	37	14	20
10. Average bass trips per year									
0	-15	-8	-30	-14	4	4	2	-9	-8
1-3	-3	-5	5	14	-4	-3	0	2	1
3-10	8	8	10	-8	10	25	18	3	9
10+	12	5	15	9	-10	-26	-20	5	-1
11. Fished for bass today									
Yes	3	-9	6	2	24	16	-12	29	7
No	-3	9	-6	-2	-24	-16	12	-29	-7

Table 4.—Responses of frequent bass anglers (“frequent”) compared to non-bass anglers (“non”) in 1988, 1990, and for pooled years. Answers to Question 10 were stratified according to anglers who said they average more than 10 bass fishing trips per year versus anglers who said they average no bass fishing trips per year. All lakes and seasons are included. Numbers are percentages except for Question 5b. Number of interviewed anglers in parentheses.

Question and answer	Response by type of bass angler					
	1988		1990		Pooled	
	Non (236)	Frequent (458)	Non (72)	Frequent (372)	Non (308)	Frequent (830)
3. Approve						
Yes	48	84	31	97	44	89
No	2	12	18	2	6	8
No opinion	50	4	51	1	50	3
4. Approve other lakes						
Yes	46	85	35	94	43	89
No	2	12	21	5	6	9
No opinion	52	3	44	1	51	2
5a. Change fishing						
More	9	33	1	57	7	44
Same	47	65	44	40	46	54
Less	0	1	0	2	0	1
No opinion	44	1	55	1	47	1
b. Average multiple						
More	2.1	2.5	—	2.2	2.1	2.4
Less	—	2.0	—	2.0	—	2.0
6a. Fished pre-Memorial last year						
Yes	49	49	58	68	51	58
No	51	51	42	32	49	42
b. Species fished for						
Bass	1	69	0	90	1	78
Other	90	17	100	7	92	13
Any	9	14	0	3	7	9
7. Usually						
Keep bass	80	13	36	6	70	10
Release bass	19	76	64	94	30	84
Both	1	11	0	0	1	6

Table 5.—Average catch of bass per angler hour for anglers fishing for bass. Two length groups of bass were considered: greater than 12.0 inches and less than 12.0 inches.

Lake	Year	Season	Largemouth		Smallmouth		Total		All
			>12"	<12"	>12"	<12"	>12"	<12"	
Muskegon	1988	Early	0.12	0.05	0.20	0.23	0.32	0.28	0.60
		Normal	0.15	0.18	0.17	0.18	0.32	0.37	0.69
	1990	Early	0.02	0.01	0.31	0.48	0.33	0.49	0.82
		Normal	0.17	0.03	0.25	0.15	0.42	0.18	0.60
Pontiac	1990	Early	0.20	0.13	0.00	0.00	0.20	0.13	0.33
		Normal	0.32	0.22	0.00	0.00	0.32	0.22	0.54
Cass	1990	Early	0.16	0.18	0.06	0.02	0.22	0.20	0.41
		Normal	0.29	0.21	0.07	0.09	0.35	0.30	0.65
Kent	1990	Early	0.27	0.44	0.00	0.00	0.27	0.44	0.71
		Normal	0.32	0.20	0.00	0.00	0.32	0.20	0.52

Table 6.—Catch per hour of bass in electrofishing recruitment surveys, fall 1988 and 1990.¹

Species	Year	Length (inches)	Lake				
			Cass	Pontiac	Kent	Muskegon	Hardy
Largemouth bass	1988	2.0-4.9	2.7	10.7	12.7	2.0	1.3
		5.0-9.9	16.0	8.0	50.9	16.0	1.3
	1990	2.0-4.9	0.0	3.5	45.8	1.0	0.0
		5.0-9.9	40.4	14.0	6.2	2.0	0.0
Smallmouth bass	1988	2.0-4.9	0.7	—	5.4	0.0	0.9
		5.0-9.9	0.0	—	10.9	0.0	7.4
	1990	2.0-4.9	0.0	—	0.0	0.0	0.8
		5.0-9.9	2.1	—	12.5	2.0	5.5

¹ Only two small largemouth bass were collected from Holloway Reservoir, both in 1988.

References

- Bennett, G. W. 1972. Ecology and management of largemouth bass, *Micropterus salmoides* (Lac.). Pages 10-17 in J. L. Funk, editor. Symposium on overharvest and management of largemouth bass in small impoundments. American Fisheries Society, North Central Division, Special Publication 3, Bethesda, Maryland.
- Burkett, D. P., P. C. Mankin, and G. W. Lewis. 1986. Hook-and-line vulnerability and multiple recapture of largemouth bass under a minimum total-length limit of 457 mm. *North American Journal of Fisheries Management* 6:109-112.
- Goudy, G. W. 1981. The exploitation, harvest, and abundance of largemouth bass populations in three southeastern Michigan lakes. Michigan Department of Natural Resources, Fisheries Research Report 1896, Ann Arbor.
- Kramer, R. H., and L. L. Smith, Jr. 1962. Formation of year classes in largemouth bass. *Transactions of the American Fisheries Society* 91:29-41.
- Latta, W. C. 1974. Fishing regulations for largemouth bass in Michigan. Michigan Department of Natural Resources, Fisheries Research Report 1818. Ann Arbor.
- Latta, W. C. 1975. Fishing regulations for smallmouth bass in Michigan. Michigan Department of Natural Resources, Fisheries Research Report 1834, Ann Arbor.
- Mraz, D. 1964. Observations on large and smallmouth bass nesting and early life history. Wisconsin Department of Conservation Research Report 11, Madison.
- Redmond, L. C. 1972. Prevention of overharvest of largemouth bass in Missouri impoundments. Pages 54-58 in J. L. Funk, editor. Symposium on overharvest and management of largemouth bass in small impoundments. American Fisheries Society, North Central Division, Special Publication 3, Bethesda, Maryland.
- Rideout, S. G., and P. H. Oatis. 1975. Population dynamics of smallmouth and largemouth bass in Quabbin Reservoir. Pages 216-221 in H. Clepper, editor. *Black Bass Biology and Management*. Sport Fishing Institute, Washington, D.C.
- Reynolds, J. B., and L. R. Babb. 1978. Structure and dynamics of largemouth bass populations. Pages 50-61 in G. D. Novinger and J. G. Dillard, editors. *New approaches to the management of small impoundments*. American Fisheries Society, North Central Division, Special Publication 5, Bethesda, Maryland.
- Schneider, J. C. 1971. Characteristics of a population of warmwater fish in a southern Michigan lake 1964-1969. Michigan Department of Natural Resources, Fisheries Research Report 1777, Ann Arbor.
- Schneider, J. C. 1973. Angling on Mill Lake, Michigan, after a five-year closed season. *Michigan Academician* 5:349-355.
- Schneider, J. C., and R. N. Lockwood. 1979. Effects of regulations on the fisheries of Michigan lakes 1946-1965. Michigan Department of Natural Resources, Fisheries Research Report 1872. Ann Arbor.
- Schneider, J. C., and R. P. Juetten. 1989. An evaluation of special fishing regulations on Sylvania lakes. Michigan Department of Natural Resources, Fisheries Technical Report 89-9, Ann Arbor.
- Schneider, J. C., J. R. Waybrant, R. P. O'Neal, and R. L. Tillitt. 1989. First-year results of early-season catch-and-release bass fishing. Michigan Department of Natural Resources, Fisheries Technical Report 89-2, Ann Arbor.
- Schrouder, J. D., C. M. Smith, P. J. Rutz, R. J. White, and D. L. Garling. 1989. *Managing Michigan ponds for sport fishing*. Second edition, Michigan State University Cooperative Extension Service, Extension Bulletin E-1554. East Lansing.

- Swingle, H. S., and E. V. Smith. 1950. Factors affecting the reproduction of bluegill bream and largemouth black bass in ponds. Alabama Polytechnic Institute, Agricultural Experiment Station Circular 87.
- Wagner, W. C. 1988. Largemouth bass in Michigan's Upper Peninsula lakes. Michigan Department of Natural Resources, Fisheries Research Report 1945, Ann Arbor.
- Weithman, A., R. O. Anderson, and A. A. Ciuffa. 1980. Catch-and-release fishing for largemouth bass on Hunter's Lake – 1963 to 1977. Pages 109-118 in R. A. Barnhart and T. D. Roelofs, editors. Catch-and-release fishing as a management tool. Humboldt State University, Arcata, California.
- Westers, H. 1963. An evaluation of population estimate procedures in two ponds, containing only largemouth bass (*Micropterus salmoides*). M. S. Thesis, The University of Michigan, Ann Arbor.

Report approved by J. C. Schneider
Richard D. Clark, Jr., Editor
Alan D. Sutton, Graphics
Grace M. Zurek, Word Processor

Appendix 1.

Lake _____

Date _____

Special Questionnaire Version #3 (One per fisherman)

Hello, I'm taking a survey of fishermen opinions and would like to ask you some questions. Your answers will be kept confidential.

[code]

- ____ 1. Have we interviewed you earlier this year about your bass fishing attitudes?
[Yes=1, No=2] (If yes terminate)
- ____ 10. On average, how many times a year do you fish for bass?
[1 to 3=1, 3 to 10=2, 10 or more=3, None=4]
- ____ 2. Are you aware there is a special catch-release early bass season on this lake from
April 1 to the Memorial Day weekend? [Yes=1, No=2]
- ____ 11. Did you fish for bass today? (Don't ask if known) [Yes=1, No=2]
- ____ 3. Do you approve [1]...disapprove [2]...have no opinion [3]...of this early season?
- ____ 4. Would you approve of early catch-release bass fishing at other lakes?
[Yes=1, No=2, No opinion=3]
- ____ 5. Because of this early season, will you probably bass fish here more
[1]...the same [2]...or less [3]? [no opinion=4]
- ____ How much more or less?: 2x....3x....other....[2, 3, 4, etc]
- ____ 6. Last year, did you fish this lake before Memorial weekend?
[Yes=1, No=2]
- ____ If yes: What species did you fish for? (Check responses):
Bass____Panfish____Pike____Walleye____Salmonids____Anything____Other____
(Prompt about bass and assure no legal overtone)
- ____ 7. Generally, during the summer months, do you usually keep the legal bass you catch
[1]....or release them [2]?
- ____ 8. Do you belong to a fishing organization? [Yes=1, No=2]
If yes: Which one? _____
- ____ 9. Do you want to make other comments? [Yes=1, No=2]
-

THANK YOU!

Note: After the regular bass season opens, change Question 5 to:

- ____ 5. Because of this early season, did you bass fish here prior to the regular season more
[1]....the same [2]....or less [3]....than usual? [No opinion=4]
- ____ How much more or less?: 2x.... 3x....other....[2, 3, 4, etc]

Appendix 2.—Opinion Questionnaire (#3) results for Cass Lake and Kent Lake, 1990.

Question, answer, (code)	Cass Lake				Kent Lake			
	Early season		Normal season		Early season		Normal season	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1. Interviewed before								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	1	1.4	0	0.00	0	0.00	0	0.0
No (3)	73	98.6	91	100.0	119	100.0	102	100.0
2. Aware								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	69	93.2	88	96.7	93	78.2	75	73.5
No (2)	5	6.8	3	3.3	26	21.8	27	26.5
3. Approve								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	65	87.8	85	93.4	74	62.2	68	66.7
No (2)	1	1.4	4	4.4	18	15.1	19	18.6
No opinion (3)	8	10.8	2	2.2	27	22.7	15	14.7
4. Approve other lakes								
Blank (0)	0	—	0	—	0	—	1	—
Yes (1)	65	87.8	81	89.0	77	64.7	62	61.4
No (2)	1	1.4	8	8.8	25	21.0	24	23.8
No opinion (3)	8	10.8	2	2.2	17	14.3	15	14.9
5a. Fish more								
Blank (0)	0	—	0	—	1	—	0	—
More (1)	32	43.2	34	37.4	34	28.8	21	20.6
Same (2)	34	45.9	54	59.3	48	40.7	71	69.6
Less (3)	2	2.7	0	0.0	4	3.4	0	0.0
No opinion (4)	6	8.1	3	3.3	32	27.1	10	9.8
5b. How much								
More								
Blank (0)	1	—	0	—	3	—	0	—
2X (2)	22	71.0	26	76.5	21	67.7	19	90.5
3X (3)	8	25.8	8	23.5	10	32.3	2	9.5
4X (4)	1	3.2	0	0.0	0	0.0	0	0.0
Less								
Blank (0)	1	—	0	—	0	—	0	—
2X (2)	1	100.0	0	0.0	4	100.0	0	0.0
3X (3)	0	0.0	0	0.0	0	0.0	0	0.0
4X (4)	0	0.0	0	0.0	0	0.0	0	0.0

Appendix 2.—Continued:

Question, answer, (code)	Cass Lake				Kent Lake			
	Early season		Normal season		Early season		Normal season	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
6a. Pre-Memorial last year								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	40	54.1	60	65.9	89	74.8	76	74.5
No (2)	34	45.9	31	34.1	30	25.2	26	25.5
6b. Fished for								
Blank (0)	35	—	31	—	32	—	26	—
Bass (1)	25	64.1	48	80	25	28.7	31	40.8
No bass (2)	12	30.8	9	15	58	66.7	44	57.9
Anything	2	5.1	3	5	4	4.6	1	1.3
7. Usually								
Blank (0)	0	—	0	—	0	—	0	—
Keep bass (1)	9	12.2	8	8.8	32	26.9	23	22.5
Release (2)	65	87.8	83	91.2	87	73.1	79	77.5
Both (3)	0	0.0	0	0.0	0	0.0	0	0.0
8. Club member								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	9	12.2	23	25.3	8	6.7	4	3.9
No (2)	65	87.8	68	74.7	111	93.3	98	96.1
9. Comments								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	3	4.1	0	0.0	6	5.0	0	0.0
No (2)	71	95.9	91	100.0	113	95.5	102	100.0
10. Average trips/year								
Blank (0)	0	—	0	—	0	—	0	—
1-3 (1)	6	8.1	7	7.7	23	19.3	26	25.5
3-10 (2)	19	25.7	22	24.2	27	22.7	20	19.6
10+ (3)	47	63.5	61	67.0	47	39.5	40	39.2
None (4)	2	2.7	1	1.1	22	18.5	16	15.7
11. Fish bass today								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	44	59.5	67	73.6	36	30.3	43	42.2
No (2)	30	40.5	24	26.4	83	69.7	59	57.8

Appendix 3.—Questionnaire (#3) results for Muskegon Lake and Pontiac Lake, 1990.

Question, answer, (code)	Muskegon Lake				Pontiac Lake			
	Early season		Normal season		Early season		Normal season	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
1. Interviewed before								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	12	11.1	5	4.9	0	0.0	0	0.0
No (3)	96	88.9	97	95.1	44	100.0	75	100.0
2. Aware								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	75	78.1	75	77.3	43	97.7	65	86.7
No (2)	21	21.9	22	22.7	1	2.3	10	13.3
3. Approve								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	79	86.8	84	86.6	41	93.2	60	80
No (2)	12	13.2	7	7.2	1	2.3	3	4
No opinion (3)	0	0	6	6.2	2	4.5	12	16
4. Approve other lakes								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	78	81.3	84	86.6	39	88.6	58	77.3
No (2)	12	12.5	7	7.2	3	6.8	5	6.7
No opinion (3)	6	6.3	6	6.2	2	4.5	12	16
5a. Fish more								
Blank (0)	1	—	0	—	0	—	0	—
More (1)	28	29.5	31	32.0	29	65.9	17	22.7
Same (2)	63	66.3	65	67.0	11	25.0	48	64.0
Less (3)	0	0.0	0	0.0	3	6.8	2	2.7
No opinion (4)	4	4.2	1	1.0	1	2.3	8	10.7
b. How much								
More								
Blank (0)	6	—	2	—	0	—	0	—
2X (2)	14	63.6	25	86.2	19	65.5	17	100.0
3X (3)	8	36.4	4	13.8	9	31.0	0	0.0
4X+ (4)	0	0.0	0	0.0	1	3.4	0	0.0
Less								
Blank (0)	0	—	0	—	0	—	1	—
2X (2)	0	—	0	—	3	100.0	1	100.0
3X (3)	0	—	0	—	0	0.0	0	0.0
4X+ (4)	0	—	0	—	0	0.0	0	0.0
6a. Pre-Memorial last year								
Blank (0)	0	—	0	—	0	—	4	—
Yes (1)	86	89.6	77	79.4	25	56.8	33	46.5
No (2)	10	10.4	20	20.6	19	43.2	38	53.5
b. Fished for								
Blank (0)	9	—	20	—	20	—	42	—
Bass (1)	40	46.0	43	55.8	20	83.3	22	66.7
No bass (2)	46	52.9	34	44.2	2	8.3	4	12.1
Anything (3)	1	1.1	0	0.0	2	8.3	7	21.2

Appendix 3.—Continued:

Question, answer, (code)	Muskegon Lake				Pontiac Lake			
	Early season		Normal season		Early season		Normal season	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
7. Usually								
Blank (0)	0	—	0	—	0	—	0	—
Keep bass (1)	12	12.5	37	38.1	1	2.3	10	13.3
Release (2)	84	87.5	60	61.9	43	97.7	65	86.7
Both (3)	0	0.0	0	0.0	0	0.0	0	0.0
8. Club member								
Blank (0)	1	—	0	—	0	—	0	—
Yes (1)	38	40.0	24	24.7	13	29.5	16	21.3
No (2)	57	60.0	73	75.3	31	70.5	59	78.7
9. Comments								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	24	25.0	8	8.2	2	4.5	1	1.3
No (2)	72	75.0	89	91.8	42	95.5	74	98.7
10. Average trips/year								
Blank (0)	0	—	0	—	0	—	0	—
1-3 (1)	1	1.0	2	2.1	0	0	9	12.0
3-10 (2)	28	29.2	40	41.2	8	18.2	16	21.3
10+ (3)	52	54.2	49	50.5	35	79.5	41	54.7
None (4)	15	15.6	6	6.2	1	2.3	9	12.0
11. Fish bass today								
Blank (0)	0	—	0	—	0	—	0	—
Yes (1)	37	38.5	65	67.0	33	75.0	53	70.7
No (2)	59	61.5	32	33.0	11	25.0	22	29.3

Appendix 4.—Average counts of fishing boats and shore anglers at Cass Lake, April 2-August 2, 1990.¹

Strata	Period			July ²
	April	May 1-25	May 26-June 30	
Weekday				
Boat	0.80	1.20	1.50	1.42
Shore	0.13	1.20	0.31	0.26
Weekend and holiday				
Boat	3.89	1.75	3.06	1.67
Shore	0.12	1.75	0.75	0.25

¹There were an unusual number of rainy weekends during this period which reduced fishing effort.

²July average includes data through August 2.

Appendix 5.—Tabulation of angler interview forms for Cass Lake catch survey, spring-summer, 1990. Early catch-release bass season was April 1-May 25.

Statistic	Period		
	April 1-30	May 1-25	May 26-August 1
Number of interviews	5	26	45
Angler hours	50	209	344
Target species			
Bass	4	12	33
Panfish	1	7	4
Trout	—	—	1
Walleye	—	1	3
Anything	—	6	4
Blank	—	—	—
Number caught			
Largemouth bass			
Kept	—	—	5
>12" released	11	17	76
<12" released	13	19	53
Smallmouth bass			
Kept	—	—	2
>12" released	—	6	20
<12" released	—	5	26
Bluegill	—	47	
Pumpkinseed	—	2	
Walleye	—	—	15

Appendix 6.—Average counts of fishing boats and shore anglers at Kent Lake, April 2-July 14, 1990.¹

Strata	Period			
	April	May 1-25	May 26-June 30	July
Weekday				
Boat	2.20	2.67	1.11	1.37
Shore	9.07	2.91	3.72	0.62
Weekend and holiday				
Boat	6.83	2.50	4.21	1.00
Shore	12.67	5.17	7.00	1.50

¹There were an unusual number of rainy weekends during this period which reduced fishing effort.

Appendix 7.—Tabulation of angler interview forms for Kent Lake catch survey, spring-summer 1990. Early catch-release bass season was April 1-May 25.

Statistic	Period		
	April 1-30	May 1-25	May 26-July 13
Number of interviews	38	24	44
Angler hours	164	188	300
Target species			
Bass	6	8	21
Pike & bass	—	1	—
Walleye	—	—	3
Perch	—	—	—
Panfish	25	10	12
Salmonid spp.	—	—	—
Anything	7	3	7
Blank	—	2	1
Number caught			
Largemouth bass			
Kept	—	—	7
>12" released	10	22	50
<12" released	14	33	29
Walleye	—	3	6
Pike	—	3	—
Bluegill	326	141	87
Black crappie	45	13	—
Rock bass	—	3	—
Pumpkinseed	—	1	—
Green sunfish	—	—	1
Bullhead	—	2	—
Carp	—	2	—

Appendix 8.—Tabulation of angler interview forms for Muskegon Lake catch survey, spring 1990. Early catch-release bass season was April 1-May 25.

Statistic	Period		
	April 1-30	May 1-25	May 26-July 1
Number of interviews	70	28	98
Angler hours	581	183	759
Target species			
Bass	21	17	65
Pike	—	2	—
Walleye	—	—	3
Perch	48	2	8
Panfish	—	3	8
Salmonid spp.	—	—	3
Anything	1	4	11
Number caught			
Largemouth bass			
Kept	—	—	20
>12" released	1	5	49
<12" released	5	—	16
Smallmouth bass	— ¹	—	—
Kept	—	—	15
>12" released	39	25	119
<12" released	59	30	71
Walleye	—	—	7
Pike	—	—	11
Yellow perch	3,336	72	366
Bluegill	1	66	315
Black crappie	—	2	—
Rock bass	—	—	3
Pumpkinseed	—	8	79
Channel catfish	—	—	2
Bowfin	—	1	3
Gizzard shad	—	—	1
Carp	—	—	2
Chinook salmon	—	—	2

¹An additional 23 smallmouth bass of unspecified size were caught and, presumably, released.

Appendix 9.—Average counts of fishing boats at Muskegon Lake, April 7-June 30, 1990.¹

Strata	Period		
	April 1-30	May 1-25	May 26-June 30
Weekday Boat	—	7 ²	13.1
Weekend and holiday Boat	10.2	13.5 ³	25.0

¹There were an unusual number of rainy weekends during this period which reduced fishing.

²Based on only one count.

³Based on only two counts.

Appendix 10.—Average counts of fishing boats and shore anglers at Pontiac Lake, April 2-August 2, 1990.¹

Strata	Period			
	April	May 1-25	May 26-June 30	July 1-August 2
Weekday Boat	0.54	1.21	1.00	1.17
Shore	0.00	0.14	0.22	0.28
Weekend and holiday Boat	1.92	1.33	2.56	0.33
Shore	0.17	0.17	2.11	0.08

¹There were an unusual number of rainy weekends during this period which reduced fishing effort.

Appendix 11.—Tabulation of angler interview forms for Pontiac Lake catch survey, spring-summer 1990. Early catch-release bass season was April 1-May 25.

Statistic	Period		
	April 1-30	May 1-25	May 26-August 2
Number of interviews	7	14	31
Angler hours	60	121	242
Target species			
Bass	6	11	21
Panfish	1	1	1
Anything	—	2	8
Blank	—	—	1
Number caught			
Largemouth bass			
Kept	—	—	5
>12" released	13	18	69
<12" released	10	9	48
Pike	—	1	2
Bluegill	22	18	—
Black crappie	—	1	—
Pumpkinseed	—	3	—
Bullhead	—	—	3