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Effects of Commercial Fish Removal on Sport Fish Populations in Two Arkansas Reservoirs

Tommie Crawford
Arkansas Game and Fish Commission

THE EFFECTS OF COMMERCIAL FISH REMOVAL, ON SPORT FISH POPULATIONS IN TWO ARKANSAS RESERVOIRS

TOMMIE CRAWFORD
Arkansas Game and Fish Commission
Little Rock, AR 72205

ABSTRACT

Commercial netting occurred October through April, 1971-1976 on Nimrod Lake and from October through April, 1973-1977 on Blue Mountain Lake in west central Arkansas. Using 7.6 cm or larger mesh gill and/or trammel nets, commercial fishermen harvested commercial fishes (buffalofishes [*Ictiobus* spp.]; common carp [*Cyprinus carpio*]; carpsuckers [*Carpiodes* spp.]; drum [*Aplodinotus grunniens*]; gars [*Lepisosteus* spp.]; suckers [*Catostomidae*]; and catfishes [*Ictalurus* spp. and *Pylodictis olivaris*]).

During the study period, cove rotenone samples were conducted on an annual basis. Fishes collected were placed into age classes and enumerated. Data were then grouped into general categories (black basses [*Micropterus* spp.], crappie [*Pomoxis* spp.], sunfishes [*Lepomis* spp.], clupeid fishes [*Dorosoma* spp], commercial fishes and catfishes) and analyzed.

Substantial reductions in standing crops of commercial fishes were noted in both reservoirs. However, in Blue Mountain Lake, reductions were temporary and commercial fish biomasses had begun to increase markedly by the end of the study period.

As catfishes were the species principally sought by commercial fishermen, it was somewhat surprising that total catfish biomasses increased in Blue Mountain Lake following the start of netting. For three of the four years prior to netting, catfish spawns were not recorded from Nimrod Lake. However, following the instigation of netting, spawns were recorded for the following four years.

Sport fish populations for the most part were unharmed by the commercial netting. In some instances, sport fish populations appeared to improve during the study period.

Visual analysis revealed that the increases in numerical standing crops of smaller sport fishes in Blue Mountain Lake appeared to correspond to decreases in commercial fish biomasses. Significant ($P \leq 0.05$) increases in sport fish young-of-the-year numbers were recorded for crappie in Blue Mountain Lake and sunfishes in Nimrod Lake and Blue Mountain Lake. Increases in numerical standing crops were also observed among intermediate black bass and crappie populations of both study lakes.

Adult black bass mean numerical standing crops were virtually unchanged in both study lakes. Adult crappie and sunfish population exhibited some variation in the study. A small increase in the adult crappie population was observed in Nimrod Lake, while a significant increase ($P \leq 0.05$) in the adult sunfish population was noted in Nimrod Lake.

In Blue Mountain Lake, an expansion of the forage base occurred which included an increase in the number of both adult and intermediate clupeid fishes present. Adult shad populations decreased in Nimrod Lake, while the numbers of young-of-the-year shad were lower in both study lakes.

It was felt that the netting program contributed significantly to the increases in sport fish populations in both lakes. However, other uncontrollable factors may have also influenced the sport fish populations in the two lakes (i.e. winter and spring water levels).

INTRODUCTION

Commercial fish removal programs have long been utilized as fisheries management tools (Moyle et al., 1950; Rose and Moen, 1952; Grice, 1958; Heard, 1959; Scidmore and Woods, 1961; Carroll et al., 1963; Starrett and Fritz, 1965; and Jester, 1972). The use of this type of management has resulted basically from four theories:

1. The removal of these fishes caused a biological void in the fishery into which forage species could expand, providing a larger forage base for game species (Simmons, 1981).
2. Since virtually all fishes go through various similar trophic levels in their development, detrimental competition between commercial (primarily rough species) fishes and sport fishes seemed plausible (Grinstead, 1975).
3. In stable bodies of water, the reproductive potential of commercial fishes was so great; through overcrowding and secretion of repressive reproductive substances; sport fish reproduction was greatly reduced (Swingle, 1956; Grinstead, 1975).
4. That commercial fishes represent an often underutilized resource which can be harvested without damaging sport fish populations (Arkansas Game and Fish Commission, 1976).

Methods which have been used in past commercial fish removal programs have varied and have included the use of explosives (Copeland, 1958), extensive shoreline seining (Rose and Moen, 1952; Hoffarth and Conder, 1967), chemical toxicants (Pintler and Johnson, 1958; Becker, 1975; Filipek, 1981), and gill and/or other types of netting (Ricker and Gottschalk, 1940; Seidensticker, 1977). Netting programs have been conducted by both investigators (Ricker and Gottschalk, 1940) and by private commercial fisherman (Heard, 1959; Carroll et al., 1963; Parrack et al., 1968; and Seidensticker, 1977).

Recently, a controversy arose concerning the use of this type of management technique with the results of a 48 state survey being instrumental in the banning of commercial netting in one southern state (Earnest Simmons, Chief, personal communication, Fisheries Division, Texas Parks and Wildlife Department, Austin). According to the survey, most states responding had used some type of commercial fish removal program, but none knew of any documentation that sport fish populations did in fact benefit from the use of this type of management.

As a fisheries management tool and as a means to use underutilized fish species, special commercial netting seasons had been conducted on two Arkansas reservoirs. It was felt that data collected from these programs might give some insight into the above controversy. The objective of this study was to retrieve data collected from past special commercial netting seasons and analyze it is an attempt to determine the impact, if any, that commercial fish removal had upon standing crops of sport fishes.

METHODS AND MATERIALS

Special commercial netting seasons occurred on two U.S. Army Corps of Engineers reservoirs in west central Arkansas. Using 7.6 cm or larger mesh gill and/or trammel nets, commercial fishermen were allowed to harvest commercial fishes and catfishes. Fishing occurred from October through April, 1971-1976 on Nimrod Lake, an 1,437 ha flood control impoundment and from October through April, 1973-1977 on Blue Mountain Lake, an 1,178 ha flood control impoundment.

As an ongoing part of the fisheries management program of the Fisheries Division of the Arkansas Game and Fish Commission, annual cove rotenone sampling was conducted on both lakes by district fisheries biologists. Rotenone sampling methodology was according to Surber (1960). Fish collected were identified to species, grouped into age class (Table 1) and enumerated.

Table 1. Size groups (cm) of fishes comprising adult, intermediate and young of year age classes.

Species	Adult	Intermediate	Young-of-Year
Black Bass	>22.9	7.6-22.9	2.5-7.6
Crappie	>17.8	7.6-17.8	2.5-7.6
Sunfishes	>12.7	7.6-12-7	2.5-7.6
Catfishes	>30.5	10.2-30.5	5.0-10.2
Gar	>61.0	10.2-61.0	5.0-10.2
Paddlefish	>61.0	10.2-61.0	5.0-10.2
Drum	>25.4	10.2-25.4	5.0-10.2
Buffalofishes	>40.6	10.2-40.6	5.0-10.2
Common Carp	>35.6	10.2-35.6	5.0-10.2
Carpsuckers	>30.5	10.2-30.5	5.0-10.2
Suckers	>30.5	10.2-30.5	5.0-10.2
Gizzard Shad	>17.8	7.6-17.8	2.5-7.6
Threadfin Shad	> 7.0	2.5-7.6	2.5-7.6

For purposes of analysis, fishes were grouped into the following general categories: black bass (*Micropterus* spp.); crappie (*Pomoxis* spp.); sunfishes (*Lepomis* spp.); clupeid fishes (*Dorosoma* spp.); catfishes (*Ictalurus* spp. and *Pylodictis olivaris)* and commercial fishes (buffalofishes [*Ictiobus* spp.]; common carp [*Cyprinus carpio]; carpsuckers [Carpiodes* spp.]; drum [*Aplodinotus grunniens*]; gars [*Lepisosteus* spp.]; and suckers [*Catostomidae*]).

Population sample data were arranged into two arbitrary groupings. To insure uniformity of the data, pre-netting data were selected to include the period four years immediately prior to the start of commercial netting. Post-netting data were selected to include a three year period following the start of netting. Data analysis in this study was by both visual analysis and by use of a students t-test for significant difference (Zar, 1974). In an attempt to determine any possible effects of outside factors on the study, historical stocking and reservoir water level data were retrieved and examined.

RESULTS

During the pre-netting period, commercial fishes comprised the bulk of the fish population of both study lakes. About 1½ years prior to the start of commercial netting, standing crops of commercial rough fishes had increased to 69.9 and 83.2 kgs/ha in Nimrod and Blue Mountain Lakes, respectively (Figure 1).

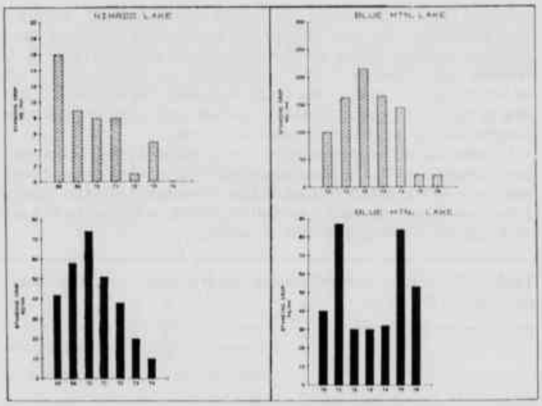

Figure 1. Commercial fish standing crops of Nimrod (1968-1974) and Blue Mountain (1970-1976) Lakes (▨ young-of-the-year fishes; ■ harvestable fishes).

Substantial reductions in adult commercial fish biomasses were observed once commercial netting began. Over a two year period, the commercial rough fish biomasses had decreased 53.8 kg/ha in Blue Mountain, while a 57.1 kg/ha decrease occurred in Nimrod Lake over a four year period. However, the reduction which occurred in Blue Mountain Lake was only temporary and by the end of the study period the commecial fish population had begun to increase markedly.

Although not as drastic, reductions in the number of young-of-the-year commercial fishes were also observed during the study (Fig. 1). Mean numerical standing crops decreased from about 144 to 53 fish/ha and from 9 to 3 fish/ha in Blue Mountain Lake and Nimrod Lake, respectively and although larger numers were present in Blue Mountain Lake, the percentage of the decrease was similar in both lakes.

Figure 2. Catfish standing crops of Nimrod (1968-1974) and Blue Mountain (1970-1976) Lakes (▨ young-of-the-year fishes; ■ harvestable fishes).

A gradual increase in the numbers of adult catfish (Fig. 2) was observed in Blue Mountain Lake, as the mean standing crop increased about 1 kg/ha (Table 2) in the post-netting period. A decrease of similar size was also noted in Nimrod Lake (Table 3).

Catfish spawns, as indicated by the number of young-of-the-year fish collected (Fig. 2), fluctuated widely both before and after netting in Blue Mountain Lake, with little change in the mean numerical standing crop observed during pre and post-netting periods (Table 2). In Nimrod Lake, however, catfish spawns were not documented in any of the pre-netting years of the study. Following the initiation of netting in late 1971, young-of-the-year catfish were taken in population samples during the next four consecutive years.

Commercial netting appeared to have a minimal effect upon black bass populations (Fig. 3). Mean numerical total standing crops of black bass were 49.1 and 46.8 fish/ha in Blue Mountain Lake and Nimrod Lake, respectively during the pre-netting period, compared to 38.6 and 48.8 fish/ha following the start of netting.

Table 2. Pre-netting and post-netting standing crops from Blue Mountain Lake (1970-1976).

Species	Age Class	Pre-netting Mean Standing Crop (No. Fish/Ha)	Post-Netting Mean Standing Crop (No. Fish/Ha)
Blue Mountain Lake			
Black Bass	Adult	4.1	6.0
	Intermediate	15.7	16.71
	Young-of-Year	29.3	16.0
Crappie	Adult	20.2	9.3
	Intermediate	12.4	31.0
	Young-of-Year	182.5	427.7
Sunfish	Adult	22.7	13.7
	Intermediate	91.3	32.5
	Young-of-Year	26.1	71.09
Catfish	Adult	1.4*	2.16*
	Intermediate	0.7*	0.5*
	Young-of-Year	8.84	12.2
Forage Fish	Adult	140.7	241.1
	Intermediate	13.5	203.8
	Young-of-Year	276.0	165.7
Commercial Fish	Adult & Intermediate	44.7*	56.2*
	Young-of-Year	144.1	53.0

*kg/ha

Adult black bass populations fluctuated similarly both before and after the initiation of commercial netting (Fig. 3). A slight increase in the mean numbers/ha was observed in both lakes (Table 2 and 3).

Visual analysis revealed that intermediate black bass populations increased in both lakes during the second half of the study (Fig. 3) and although not entirely conclusive, it appeared that the increases corresponded to decreases in the commercial fish biomass which occurred.

The greatest overall variation in the black bass populations examined occurred among young-of-the-year fishes in Blue Mountain Lake (Fig. 3). Fluctuations in the population were noted both before and after the onset of commercial netting, as the numerical standing crops during the latter half of the study were significantly lower ($P \leq 0.05$). However, black bass spawns in Nimrod Lake remained relatively unchanged during the entire study. The only exception was a brief increase of approximately twofold which occurred during 1973, late in the study.

The adult crappie population of Blue Mountain Lake continued to fluctuate throughout the study period (Fig. 4). Overall mean standing crops decreased from about 20 fish/ha to 9 fish/ha. However, Nimrod Lake adult crappie populations were characterized by low, stable pre-netting populations, followed by a rapid expansion during the post-netting period (Fig. 4).

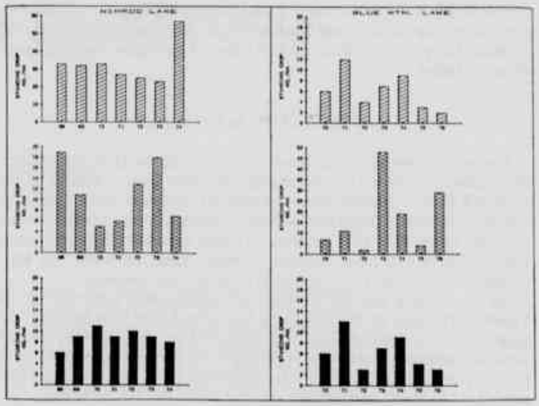

Figure 3. Black bass standing crops of Nimrod (1968-1974) and Blue Mountain (1970-1976) Lakes (▨ young-of-the-year fishes; ▩ intermediate fishes; ■ adult fishes).

Table 3. Pre-netting and post-netting standing crops from Nimrod Lake (1968-1974).

Species	Age Class	Pre-Netting Mean Standing Crop (No. Fish/Ha)	Post-Netting Mean Standing Crop (No. Fish/Ha)
Nimrod Lake			
Black Bass	Adult	7.8	8.3
	Intermediate	9.2	10.3
	Young-of-Year	29.8	30.2
Crappie	Adult	9.8	13.6
	Intermediate	16.3	28.4
	Young-of-Year	267.4	146.9
Sunfish	Adult	47.3	76.7
	Intermediate	187.9	159.8
	Young-of-Year	256.7	774.7
Catfish	Adult	1.77*	1.14*
	Intermediate	1.57*	0.3*
	Young-of-Year	0.8	0.1
Forage Fsih	Adult	598.5	236.5
	Intermediate	0.0	369.3
	Young-of-Year	453.7	184.3
Commercial Fish	Adult & Intermediate	52.5*	22.0*
	Young-of-Year	9.44	3.36

*kg/ha

Intermediate crappie populations (Fig. 4) from both lakes remained relatively low during the first half of the study period. However, during the post-netting period, significant increases ($P \leq 0.05$) occurred in both lakes.

As indicated by the number of young-of-the-year fishes collected, crappie spawns did not appear to follow any particular trend during this study, as the population increased in one lake and decreased in the other (Fig. 4). Although the increase began just prior to the start of

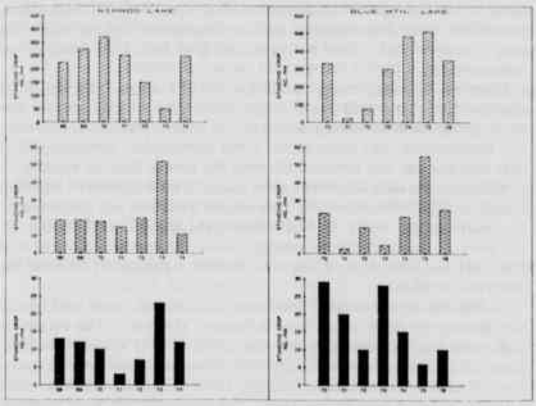

Figure 4. Crappie standing crops of Nimrod (1968-1974) and Blue Mountain (1970-1976) Lakes (▨ young-of-the-year fishes; ▩ intermediate fishes; ■ adult fishes).

netting, post-netting populations were significantly higher ($P \leq 0.05$) in Blue Mountain Lake. Crappie spawns recorded from Nimrod Lake recorded an overall decrease, until a substantial increase occurred late in the study period.

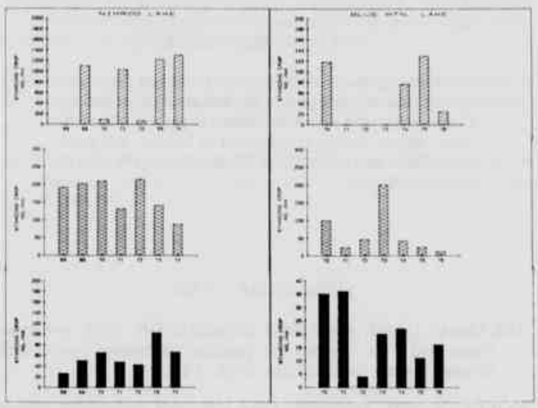

Figure 5. Sunfish standing crops of Nimrod (1968-1974) and Blue Mountain (1970-1976) Lakes (▨ young-of-the-year fishes; ▩ intermediate fishes; ■ adult fishes).

After the initiation of commercial netting, one lake exhibited a significant increase ($P \leq 0.05$), while the other exhibited a decrease in the number per hectare of adult sunfish (Fig. 5). The mean numerical standing crop increased about 30 fish/ha in Nimrod Lake, while decreasing about 9 fish/ha in Blue Mountain Lake.

Intermediate sunfish populations did not appear to follow any definite trend during the study period (Fig. 5). The Nimrod Lake population exhibited some fluctuation both before and after the onset of commercial netting, as the mean standing crop decreased about 30 fish/ha. Likewise, an even more substantial decrease occurred in Blue Mountain Lake (Table 2).

Significant increases ($P \leq 0.05$) in sunfish spawns were recorded from both lakes during the post-netting portion of the study (Fig. 5). Extreme annual fluctuations occurred early in the study in Nimrod Lake, however, during the last two years monitored, good spawns occurred for two consecutive years. Sunfish spawns were not documented for three of the four pre-netting years in Blue Mountain Lake, but young-of-year sunfishes were collected for the next three years following the beginning of commercial netting.

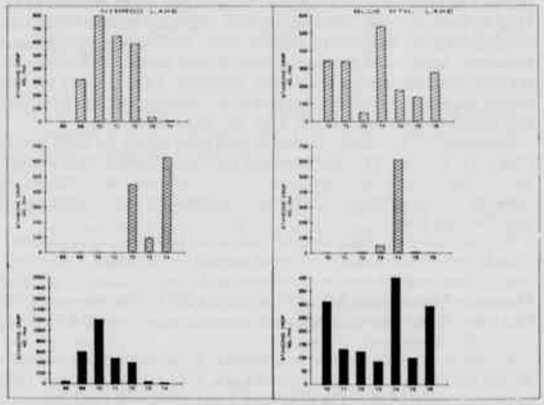

Figure 6. Clupeid standing crops of Nimrod (1968-1974) and Blue Mountain (1970-1976) Lakes (▨ young-of-the-year fishes; ▩ intermediate fishes; ■ adult fishes).

Table 4. Fish supplementally stocked into Blue Mountain Lake (1970-1976) and Nimrod Lake (1968-1974).

Lake and Date Stocked	Fish Stocked	Age Class	Total Number Stocked
Blue Mountain Lake			
January, 1971	Sunfish	Intermediate	60,000
March, 1971	Sunfish	Intermediate	111,000
May, 1971	Sunfish	Intermediate	7,200
	Catfish	Intermediate	900
August, 1971	Black Bass[1]	Young-of-Year	16,000
November, 1971	Black Bass[1]	Young-of-Year	15,000
Nimrod Lake			
August, 1972	Catfish	Intermediate	1,886
	Sunfish[2]	Intermediate	2,000
September, 1972	Catfish	Intermediate	800
October, 1972	Catfish	Intermediate	3,600

[1]Largemouth Bass

[2]Mixed Sunfish

Just prior to the start of netting, a decline in the adult clupeid population (Fig. 6) of Nimrod Lake was observed, which continued throughout the remainder of the study. The mean numerical standing crop decreased from 598.5 fish/ha to 236.5 fish/ha. The trend observed in Nimrod Lake did not repeat itself in Blue Mountain lake where an overall increase occurred in the study period (Fig. 6). Relatively stable, low pre-netting clupeid populations were followed by higher, somewhat fluctuating populations, as an increase in mean standing crop of about 100 fish/ha was observed.

In both study lakes, a significant increase ($P \leq 0.05$) in the nubmers of intermediate shad was noted during the post-netting period (Tables 2 and 3). In Nimrod Lake, there was no evidence of this size shad for the entire pre-netting period, however, a population expansion began during the first post-netting year (Fig. 6). Likewise, no shad of this size were collected three of the four years prior to netting in Blue Mountain lake. Like the situation in Nimrod Lake, an increase in the population occurred immediately following the start of netting (Fig. 6).

In both lakes, substantial decreases in mean standing crops of young-of-the-year clupeids were recorded (Tables 2 and 3). In Nimrod Lake, after an early increase in the population, a gradual decline began that continued for the duration of the study (Fig. 6). The decrease appeared somewhat accelerated during the post-netting period. The young-of-the-year shad population from Blue Mountain Lake (Fig. 6) did not exhibit the gradual decrease, but was more variable with some fluctuation observed both before and after the onset of netting.

Supplemental stockings occurred in both lakes during the study period (Table 4). During 1971, intermediate sunfishes, intermediate catfish, and young-of-the-year black bass were stocked into Blue Mountain Lake. In 1973, intermediate catfish and intermediate sunfish were placed into Nimrod Lake.

For the most part, water levels of both study lakes fluctuated seasonally and were within ranges considered normal for each lake. One exception was an extreme winter drawdown which was conducted on Blue Mountain Lake during late 1970 and early 1971. The volume of the lake was reduced from 30.8 million m^3 at conservation pool to 6.2 million m^3 for the drawdown.

Excessive rainfalls resulted in abnormal water levels being recorded during the springs of 1970 in Nimrod Lake, 1973 in both lakes and 1975 in Blue Mountain Lake. The volume of water in Nimrod Lake increased from 35.8 million m^3 at conservation pool to 218.2 million m^3 during 1970. In 1973, volumes of 318.1 million m^3 and 456.4 million m^3 were recorded from Blue Mountain Lake and Nimrod Lake, respectively, while in 1975 the spring storage maximum recorded in Blue Mountain Lake was 147.9 million m^3.

DISCUSSION

For the most part, the special commercial netting seasons were successful in reducing harvestable commercial fish populations in both study lakes. The increase which occurred in Blue Mountain Lake, late in the study period, was attributed to lowered fishing pressure following the initial decline of higher valued commercial species such as the buffalofishes. Similar population increases resulting from lowered commercial fishing pressure were also reported by Jester (1972).

Catfish populations were affected little during the study period and since catfish usually are the species most actively sought by commercial fishermen, it was somewhat surprising that a greater impact was not observed. Another indication that catfish populations were not adversely affected were the unchanged spawns recorded from Blue Mountain Lake and the marked increase in numbers of young-of-the-year catfish collected from Nimrod Lake following the instigation of commercial netting.

It has been shown that "cropping" or partial harvest increases biomasses of catfish in the pond environment (Snow, 1976). Although entirely speculation, it might be that cropping has some application in the reservoir environment and could merit future investigation.

In determining the possible effects of commercial fish removal on the standing crops of sport fishes in the two study lakes, it was felt that any effects on fish available to the sportfishermen would be of foremost importance. Generally, this would represent adult fishes, but under the classification system used (Table 1) also encompassed some intermediate fishes.

Of the twelve harvestable sport fish populations in the study (including both adult and intermediate fishes), increases were observed in eight of the populations. With the exception of crappie and sunfish populations of Blue Mountain Lake, all adult populations expanded during the post-netting period. This might be an indication that gill and/or trammel netting with 7.6 cm or larger mesh nets does not harvest large numbers of catchable sport fishes. Similar opinions have been expressed by Heard (1959), Bailey (1971) and Seidensticker (1977).

As both increases and decreases occurred, no definite trend could be established concerning possible effects of the commercial fish removal upon sport fish spawning activities. The increased numbers of intermediate sport fishes present during the post-netting period would tend to suggest that at least in this study higher larval fish survival and subsequently, a higher recruitment potential existed.

Likewise, although mean standing crops of young-of-the-year shad decreased, higher numbers of intermediate shad suggest greater survival during the post-netting period of this study. The increase of adult and intermediate shad might reflect views expressed by Simmons (1981) that commercial fish removal allowed the forage base to expand.

Although periodic stockings were made in both bodies of water, it would be highly doubtful that they would have had any influence on the results of this study. In Blue Mountain Lake, all stockings occurred prior to the initiation of netting, while the numbers stocked into Nimrod Lake were deemed too small to have significantly affected the observed results.

As both lakes are primarily flood control structures, water level regulation during the study could have influenced the study. The extremely high water levels observed during the spring of 1973 would have inundated large areas of normally dry shoreline and would have caused a "new reservoir" environment (Keith, 1974). This undoubtedly was a primary factor in the increased sport fish spawns which were recorded during 1973.

For the most part, the sport fish population observed in this study did not appear to be harmed by commercial netting. Also, since some populations did expand during the post-netting period, the distinct possibility exists that the commercial fish removal by netting was beneficial. However, since many uncontrollable factors exist in the reservoir environment (i.e., water level regulation, fishing pressure, etc.), it would be impossible to emphatically state that the observed results of this study were directly the result of the commercial fish removal.

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