SECTION G, CONSERVATION

Fish Samples and Year-class Strength (1965-1967) from Canton Reservoir, Oklahoma[1]

MICHAEL G. BROSS,

Oklahoma Fishery Research Laboratory, Norman

Management of a reservoir fishery can be aided by the ability to predict each year's addition to the population of each species. The enormous reproductive capacities of fishes are never realized, and factors which limit spawning and survival of fertilized eggs, of larvae, and of more advanced stages are known to restrict the actual increase in the adult population of a species to a small fraction of the theoretical potential (Gulland, 1965). These limitations do not operate uniformly from year to year and, therefore, factors affecting year-class strength are of great importance in determining the sizes of available fish stocks.

Environmental factors such as water quality (Buck, 1956), wind (Kramer and Smith, 1962), temperature (Gulland, 1965), and water level (Walburg and Nelson, 1966) have been cited as important in the establishment of year-classes of fish species. Evidence is presented here that temperature and water level conditions favored the establishment of strong year-classes of many species in Canton Reservoir in 1965 and 1967, but did not operate so favorably in 1966.

CANTON RESERVOIR

Canton Reservoir, impounded in 1948 by the U. S. Army Corps of Engineers, is a flood control impoundment on the North Canadian River in western Oklahoma. At normal water level it has an area of about 7500 surface acres, a mean depth of 13 ft, and a maximum depth of 39 ft. This alkaline (pH 8.4, methyl orange alkalinity 160 ppm), conductive (1200 micromhos at 25 C) reservoir is usually homothermic; chemical stratification has not been observed. Secchi disc measurements are usually close to 20 inches. The reservoir, shaped like a megaphone bent in the middle, has a shore development ratio of 3.6. Haag Cove is one of its few coves.

METHODS

Rotenone samples were taken in Haag Cove on five occasions: 7 September 1956, 6 August 1957, 31 August 1965, 30 August 1966, and 29 August 1967. Results of rotenone samples taken in 1956, 1957, and 1965 were presented in an earlier report (Bross, 1965). This paper deals with data from 1965, 1966, and 1967 concerning the numbers per acre of young-of-the-year fishes. Figures on the abundance of young fishes should be comparable for these years, as the samples were taken in the same manner. Almost all the cove was sampled each time; surface acres sampled were: 2.01 in 1965, 1.78 in 1966, and 2.85 in 1967.

Standard procedures of rotenone sampling and data taking were followed in 1965, 1966, and 1967: a block-off net closed the cove by 8:00 am, scuba divers checked the net, enough rotenone (in excess of 1 ppm 5% rotenone) to insure a complete kill was applied by pump, and vigorous efforts were made to recover all fishes in the sample area. Fishes were picked up during the day of poisoning and the following day in 1965 and

[1]Prepared under Dingell-Johnson Project F-16-R, contribution No. 169 of the Oklahoma Fishery Research Laboratory, a cooperative unit of the Oklahoma Department of Wildlife Conservation and the University of Oklahoma Biological Survey.

1966, and during an additional day in 1967. In 1965 and 1966 all fishes were individually counted and measured, but in 1967 numbers of some species were estimated by counting and weighing. Basic data tabulations followed the suggestions of Surber (1959). In addition, breakdowns into young-of-the-year and adult categories were made, and this paper presents only that portion of tabulated data concerned with numbers per acre of young-of-the-year fishes.

Reservoir water temperatures (Fig. 1) were taken with an electrical thermometer in 1965, and only intermittent readings were made in that year. Temperatures for 1966 and 1967 were taken with a recording thermometer; noon readings are plotted in Fig. 1. In 1967 there were brief periods with no record of water temperature.

Water level figures presented here (Fig. 2) were taken from tentative monthly reservoir regulation charts furnished by the U. S. Army Corps of Engineers, Tulsa District.

Results and Discussion

Young-of-the-year of several species were found in 1965 and 1967 but not in 1966 (Table I). For most species, whose young were found in all years, much greater numbers per acre were found in 1965 and 1967 than in 1966.

It could be argued that more young fishes were collected in 1965 and 1967 simply because the water level was higher on these sampling dates (1615.3 feet m.s.l. for both dates) than it was when the 1966 sample was taken (1610.0 feet m.s.l.). Inundated terrestrial plants were more abundant at the higher water level and more young fishes might have been collected in these years not because they were more abundant in the reservoir, but because they were associated with the shelter provided by these plants. Evidence against this interpretation is given by seining and trawling catch records, which suggest that many species did have larger populations of young in 1965 and 1967 than in 1966. Further evidence of valid year-class differences is given by internal consistencies in rotenone sample results. For many species the collection of large numbers of young in 1965 was followed by the collection of large numbers of yearling fish in 1966.

If this year-class strength contrast is accepted as valid, attention can be focused on factors which might have affected spawning and survival. This shifts attention from the rotenone sampling time (late August) to spring and early summer.

Except for temperature and water level, measured physical and chemical conditions (dissolved oxygen, pH, alkalinity, conductivity, and turbidity) have been relatively stable in Canton Reservoir during the years 1965-1967.

It is likely that springtime water temperatures favored spawning and egg survival more in 1965 and 1967 than in 1966 (Fig. 1). Warming was abrupt in 1965; the water temperature was below 40 F on 26 March and was 60 F or above from 6 April on. In 1966 warming began earlier and proceeded haltingly; frequent cool periods kept the water slightly below 60 F for most of April, and readings remained only slightly above 60 F until the middle of May. In 1967 the temperature was well above 60 F for all of April. Watt (1956) pointed out that a variety of species have been found to establish strong year-classes in years of high water temperature during the normal spawning season. Kramer and Smith (1962) found largemouth bass egg survival to be directly related to water temperature during incubation. In April 1966, Canton Reservoir's water temperature rose above 60 F several times, but each time it fell back abruptly. Rising temperatures may have stimulated spawning, and falling temperatures directly after spawning may have caused heavy egg mortalities.

In addition to water temperature differences, water level differences during the months of spawning and early growing may have contributed to the year-class strength contrast between 1966 and the years of 1965 and 1967 (Fig. 2).

In the spring and early summer of 1965 the water level rose almost 15 ft after more than a year of relative stability at low levels. After this

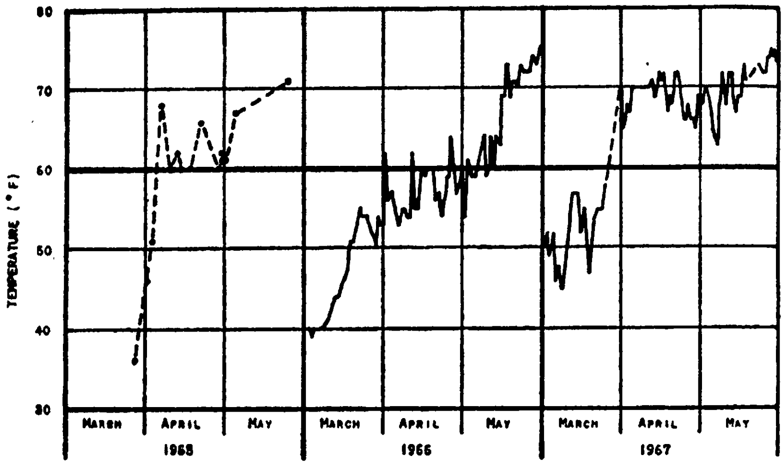

Figure 1. Canton Reservoir water temperatures. (Solid lines connect daily observations; broken lines connect intermittent observations.)

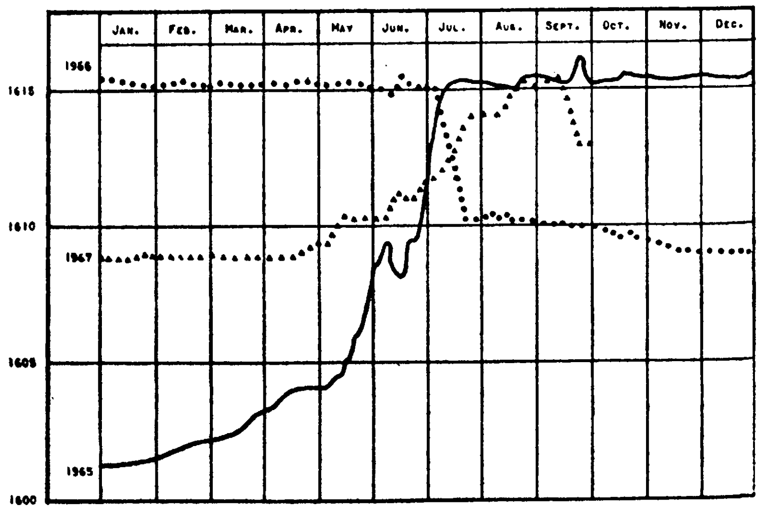

Figure 2. Canton Reservoir water levels, 1965-1967.

TABLE I. YOUNG-OF-THE-YEAR FISHES COLLECTED IN LATE AUGUST ROTENONE SAMPLES OF HAAG COVE, 1965, 1966, and 1967.

Kind of fish	Number per acre collected in each sample		
	1965	1966	1967
Largemouth bass *(Micropterus salmoides)*	136.32	14.04	24.91
White bass *(Roccus chrysops)*	258.71	40.45	194.04
White crappie *(Pomoxis annularis)*	77.11	17.42	428.07
Black crappie *(Pomoxis nigromaculatus)*	45.77	9.55	15.79
Walleye *(Stizostedion vitreum vitreum)*	2.99	—	6.67
Channel catfish *(Ictalurus punctatus)*	179.10	3.37	31.93
Bluegill *(Lepomis macrochirus)*	412.44	161.24	1626.32
Longear sunfish *(Lepomis megalotis)*	94.53	7.30	382.11
Orangespotted sunfish *(Lepomis humilis)*	26.37	17.42	1097.89
Green sunfish *(Lepomis cyanellus)*	100.50	22.47	211.23
Green sunfish × orangespotted sunfish	0.50	—	—
Carp *(Cyprinus carpio)*	541.29	11.24	232.63
Drum *(Aplodinotus grunniens)*	470.65	39.89	474.74
Black buffalo *(Ictiobus niger)*	0.50	—	—
River carpsucker *(Carpiodes carpio)*	19.90	—	7.02
Black bullhead *(Ictalurus melas)*	101.99	—	7.37
Yellow bullhead *(Ictalurus natalis)*	—	—	0.70
Flathead catfish *(Pylodictis olivaris)*	19.40	—	15.79
Gizzard shad *(Dorosoma cepedianum)*	4804.98	144.38	3184.91

rise the level was maintained very near the normal mark until July 1966, when it was lowered about 5 ft. In April 1967, a gradual rise began which added about 6 ft to the water level by August. The samples of 1965 and 1967 (many young-of-the-year) were taken after spawning and early growing periods with rising water levels, while the 1966 sample (few young-of-the-year) was taken after a spawning and early growing period with a stable, high water level. Walburg and Nelson (1966) found evidence that strong year-classes of carp and suckers were dependent on rising water levels in Lewis and Clark Reservoir. Besides stimulating spawning and providing spawning sites for certain species, rising water levels can enhance the nutritive base for the survival of all species by inundating vegetated areas and increasing the standing crops of plankton and benthos.

If temperature and water level conditions in Canton Reservoir were less favorable for fish reproduction and survival in 1966 than in 1965, the plight of fishes which were spawned in 1966 was probably compounded by competition from the many yearlings of the 1965 year-class.

Some environmental features other than temperature and water level may have influenced year-class strength, but water-quality tests showed only slight yearly differences. Kramer and Smith (1962) found destruction of nests by wind to be the most important single factor in year-class formation of largemouth bass in Lake George, Minnesota. While wind may have destroyed nests in Canton Reservoir, we do not know the dates of nest building there. The fact that species which do not build nests also had strong year-classes in 1965 and 1967 and weak year-classes in 1966 suggests that factors other than wind or in addition to wind were involved in the contrast.

El-Zarka (1959), writing of the difficulties of doing conclusive research on factors affecting year-class strength, said: "Seemingly we must approach understanding through a process of slow accretion in which each new bit of evidence, though not conclusive in itself, must be welcomed." The evidence presented here concerning the influence of temperature and water level conditions on year-class strength is not conclusive. It is presented as one more bit of evidence that previously stated concepts may be valid.

LITERATURE CITED

Bross, Michael G. 1965. Rotenone samples of fish population in Haag Cove, 1956, 1957, and 1965. Okla. Fish. Res. Lab. Semi-Ann. Rep. July-Dec. 1965, Contrib. 162:20-27.

Buck, D. Homer. 1956. Effects of turbidity on fish and fishing. Okla. Fish. Res. Lab. Rep. 56:62.

Gulland, J. A. 1965. Survival of the youngest stages of fish, and its relation to year-class strength. Int. Comm. N. E. Atl. Fish., Spec. Publ. 6:363-372.

El-Zarka, Salah El-Din. 1959. Fluctuations in the population of yellow perch, *Perca flavescens* (Mitchill) in Saginaw Bay, Lake Huron. U. S. Fish Wildl. Serv., Fish. Bull. 151:365-415.

Kramer, Robert H., and Lloyd L. Smith, Jr. 1962. Formation of year classes in largemouth bass. Trans. Am. Fish. Soc. 91(1):29-41.

Surber, Eugene W. 1959. Suggested standard methods of reporting fish population data for reservoirs. Prepared for the Reservoir Committee, Southern Division of the American Fisheries Society. Proc. 13th Ann. Conf. S. E. Assoc. Game and Fish Comm., p. 313-325.

Walburg, Charles H., and William R. Nelson. 1966. Carp, river carpsucker, smallmouth buffalo, and bigmouth buffalo in Lewis and Clark Lake, Missouri River. U. S. Bur. Sport Fish. Wildl., Res. Rep. 69:30.

Watt, Kenneth E. F. 1956. The choice and solution of mathematical models for predicting and maximizing the yield of a fishery. J. Fish. Res. Bd. Canada 13(5):613-645.