Maturity And Fecundity Of The White Perch, *Morone americana,* In Western Lake Erie[1, 2]

MICHAEL T. BUR, Sandusky Biological Station, Great Lakes Fishery Laboratory, U.S. Fish and Wildlife Service, Sandusky, OH 44870

ABSTRACT. Among white perch (*Morone americana*) collected from bottom trawl catches in 1984 and commercial trap net catches in 1985, all males were mature at age 2, and all females by age 3. Fecundity estimates for 50 females collected in May, 1985 ranged from 64,480 to 388,736 eggs ($\bar{x} \pm SE = 174,945 \pm 10,198$).

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INTRODUCTION

The white perch, *Morone americana,* an anadromous estuarine species native to the northeast Atlantic coast of North America, has become established in Lake Erie (Scott and Crossman 1973). It apparently entered Lake Erie from the Hudson River through the Erie Barge Canal or from Lake Ontario through the Welland Canal. The first reported capture in Lake Erie was in Pennsylvania waters in 1953 (Larsen 1954). No other specimens were collected until 1973 when a five-year-old male was caught off Port Clinton, Ohio (Trautman 1981). The first evidence of successful natural reproduction in western Lake Erie was obtained in 1977 when the Ohio Department of Natural Resources captured several young-of-the-year white perch in trawls (Dave Davies, Ohio Department of Natural Resources, pers. comm.). Thereafter, the catch per unit of effort (number caught per hour of trawling) has increased steadily, from less than one in 1978 to more than 1,360 in 1985 (Sandusky Biological Station, Great Lakes Fishery Laboratory, Sandusky, Ohio, unpubl. data).

Schaeffer (1983), Schaeffer and Margraf (1986a), and Schaeffer and Margraf (1986b) studied seasonal distribution, population characteristics, and food habits of white perch in Sandusky Bay and the region near the Bass Islands, but little else is known of the species in Lake Erie. Although Busch et al. (1977) reported that the future role of white perch in Lake Erie was uncertain, they postulated that it would not become a dominant species because of the presence of large populations of such piscivores as walleye (*Stizostedion vitreum vitreum*) and white bass (*Morone chrysops*). This prediction may prove to be incorrect, however, if white perch abundance continues the rapid increase that was evident from 1983-1985.

The objective of this study was to obtain information on the reproductive potential of white perch from western Lake Erie that could be used to evaluate its potential for becoming the dominant species in Lake Erie as it had in Lake Ontario during the early 1970s (Christie 1974).

METHODS

Stage of maturity was determined for 210 age 1 to age 3 fish collected with a semi-balloon bottom trawl (7.9 m headrope) in April, June, and August-October, 1984, and 153 age 2 to age 4 fish collected with commercial trap nets in May, 1985. Estimates of fecundity were derived gravimetrically from ovaries removed from 50 fish collected from Lake Erie commercial trap nets near Cedar Point, Ohio on 9 May 1985.

The paired ovaries were removed from each fish in the field and preserved in 10% unbuffered formalin. In the laboratory, each pair of ovaries was weighed to the nearest 0.01 g after excess moisture had been removed by blotting with paper towels. Small cross-sectional samples (including the surrounding membrane) were removed from the anterior, middle, and posterior regions of the left ovary of each fish, and weighed to the nearest 0.01 g; the eggs in each of the three sections were then counted. The total number of eggs per fish was estimated by multiplying the mean number of eggs per gram of ovarian tissue (unweighted average of the number of eggs per gram in the anterior, middle, and posterior samples from the left ovary) by the total weight of the right and left ovaries. Eggs of two size groups which were found in the ovaries of each fish were included in the fecundity estimates.

RESULTS AND DISCUSSION

The total lengths (TL) of the smallest mature white perch collected in 1984 and 1985 were 123 and 150 mm, respectively. The difference between years probably reflects the ability of the trawl to catch smaller fish than the commercial trap net. Age at maturity of the 210 fish collected during April-October, 1984 showed no seasonal trend, so the samples were combined for presentation (Table 1). Some males and females reached maturity at age 1; all males age 2 and older and all females of age 3 were mature. All of the 153 white perch collected in 1985 were of ages 2, 3, or 4, and all were mature (Table 1). The apparent difference in age at maturity between 1984 and 1985 probably reflects the inability of the commercial trap nets to retain age 1 and age 2 fish smaller than 150 mm TL.

White perch mature at a younger age in Lake Erie than in other waters (Table 2). All age 2 white perch in Lake Erie collections made by the Ohio Division of Wildlife were mature (Davies et al. 1985). Age at first maturity of both sexes differs in other waters, however. In Chesapeake Bay, all males were mature by age 2 and all females

TABLE 1

Percentage of sexually mature white perch collected by trawling (1984) and commercial trap nets (1985) in western Lake Erie. Sample sizes are in parentheses.

Age (years)	1984 Males	1984 Females	1985 Males	1985 Females
1	93 (14)	67 (12)	—	—
2	100 (88)	95 (73)	100 (9)	100 (17)
3	100 (9)	100 (14)	100 (39)	100 (78)
4	—	—	100 (4)	100 (6)

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[2] Contribution 671, Great Lakes Fishery Laboratory, U.S. Fish and Wildlife Service, Ann Arbor, Michigan 48105.

TABLE 2
Age at maturity of white perch in Lake Erie and other waters.

Location and source	First maturity		100% maturity	
	Male	Female	Male	Female
Lake Erie				
Present Study	1	1	2	3
Davies et al. (1985)	1	1	2	2
Schaeffer and Margraf (1986b)	—	—	2	3
Lake Ontario				
Busch and Heinrich (1982)	2	2	4	4
Sheri and Power (1968)	1	1	3	4
Hudson River				
Holsapple and Foster (1975)	2	3	3	4
Patuxent River*				
Mansueti (1961)	2	2	2	4

*Chesapeake Bay estuary

by age 4 (Mansueti 1961); in the Hudson River all males were mature at age 3 and all females at age 4 (Holsapple and Foster 1975). Busch and Heinrich (1982) reported that all males and females were mature by age 4 in Lake Ontario. Their findings were similar to those of Sheri and Power (1968) who reported that all males were mature by age 3 and all females by age 4 in the Bay of Quinte, Lake Ontario. The small discrepancy in the age of maturity of all males in Lake Ontario was probably a result of the difference in sampling periods. Sheri and Power (1968) made their collections during 1957-1966, when the white perch was first establishing itself in Lake Ontario, and when its abundance was increasing and its growth was rapid. Busch and Heinrich (1982) sampled the Lake Ontario population in 1972-1973, after overcrowding had reduced the growth rate and probably increased the age at which maturity was attained. Because the white perch is newly established in Lake Erie, its growth has been accelerated. This largely accounts for the earlier age at maturation which is also similar to that reported by Sheri and Power (1968) for Lake Ontario.

Examination of 50 gravid females revealed egg numbers ranging from 64,482 in an age 2 fish (176 mm TL) to 388,736 in an age 4 fish (244 mm TL); the mean fecundity was 174,945 (SE ± 10,198) (Table 3). Many (76%) of the fish were age 3, and only a few were ages 2 and 4. There were too few fish of ages other than age 3 to describe the relationship between fecundity and age with a linear regression equation. The relationship between fecundity (Y) and total length (X, mm) was described by the equation: $Y = -638981.7 + 4024.9\ X$ ($r = 0.87$, $P < 0.001$). This equation indicates that egg number increases with the length of the fish. Fecundity (Y) and weight (X, g) were also positively correlated ($r = 0.90$, $P < 0.001$); the relationship was described by the equation: $Y = -34877.1 + 1547.1\ X$.

Fecundity of white perch in Lake Erie was similar to the values reported by Zuerlein (1981) for age 2 fish ($\bar{x}$ = 167,462 eggs, N = 34) in Stagecoach Reservoir, Nebraska, and by Taub (1969) for age 3 to age 6 fish ($\bar{x}$ = 271,000 eggs, N = 53) in Quabin Reservoir, Massachusetts. Sheri and Power (1968) reported that the mean egg number of Lake Ontario white perch was 65,360 (N = 50); mean fecundity in the Hudson River was 50,678 (N = 65) (Bath and O'Conner 1982). Holsapple and Foster (1975) estimated that the mean number of eggs deposited by fish in the Hudson River ranged from 20,676 for age 3 fish to 135,289 for age 9 fish (Total N = 87).

The ovaries of white perch from Lake Erie contained eggs of two size groups, with mean diameters of 0.3 to 0.6 mm. Although there were two size groups of eggs, there appeared to be only one spawning in 1985. The length-frequency distribution for young-of-the-year fish taken from fall trawl collections indicated only one mode which is a strong indication of only one spawning. The other possibilities are that some mechanism, either predation or starvation, could have been responsible for the loss of the other mode, or that the fish that were spawned later grew faster, hence producing an overlap in the total length of the two groups by fall. There was no indication that the smaller size eggs are carried over to the next spawning year; therefore, eggs from both size groups were included in the estimates of fecundity. Sheri and Power (1968) found three egg sizes in Lake Ontario white perch, but included only the largest eggs in their counts. This could account for the difference in the fecundity estimates between Lake Ontario and the present study. Holsapple and Foster (1975) used a correction factor that was based on retention of eggs in ovaries after spawning to estimate fecundity in Hudson River white perch. It is clear that a standard method for estimating fecundity is needed if more reliable estimates are to be obtained.

TABLE 3
Mean estimated egg numbers for 50 white perch collected from western Lake Erie, 1985. Ranges are in parentheses.

Number of fish	Age (yrs)	Mean total length (mm)	Mean total weight (g)	Mean weight of ovaries (g)	Estimated mean total number of eggs per fish
9	2	183 (175-190)	87 (69-98)	6.85 (3.49-9.49)	95,055 (64,482-148,852)
38	3	205 (180-230)	142 (80-200)	18.36 (5.64-33.68)	186,253 (83,492-300,627)
3	4	224 (206-244)	200 (130-273)	31.86 (18.49-56.78)	274,389 (189,523-388,736)

In view of its demonstrated high fecundity, early age at maturity, and ability to adapt to new habitats (Bath and O'Conner 1982), white perch numbers in Lake Erie should continue to increase. This increase is of concern to state, federal, and provincial fishery resource agencies because of the potential impacts of the exotic white perch on other fish resources in Lake Erie. In the future, fishery management strategies for many species may have to consider the potential role of the white perch in the fish community. Additional research is needed to define this role.

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