**1Food and Growth of Young Yellow Perch near East Harbor, Ohio in Western Lake Erie and Food of Young Yellow Perch near Fairport, Ohio in Central Lake Erie ***



Michael T. Bur
U.S. Geological Survey
Biological Resources Division
Great Lakes Science Center
Lake Erie Biological Station
Sandusky, Ohio 44870

Charles P. Madenjian
U.S. Geological Survey
Biological Resources Division
Great Lakes Science Center
1451 Green Rd.
Ann Arbor, MI 48105

**Abstract**

The diet and growth of young-of-the-year yellow perch from western and central Lake Erie were examined to determine changes in the diet during their first year of growth and to document their diet and growth for modeling yellow perch recruitment. Crustacean zooplankton dominated the food ingested by young yellow perch in western Lake Erie during summer and fall of 1996. Calanoid copepodites, by weight, was the predominant diet component. The diet of YOY yellow perch shifted as a result of prey population shifts. As copepod numbers in stomachs decreased in July, *Daphnia retrocurva* and Bosminidae became increasingly more important in their diet. Young yellow perch became increasingly benthivorous from spring to fall, with the diet consisting of increasing proportions of amphipods, and *Hexagenia*. Young yellow perch selected zooplankton with a mean length which were generally greater than those available in the environment. Young yellow perch exhibited a preference for Calanoid copepods as well as Bosminidae, *Daphnia retrocurva*, and Sididae. The diet of central basin YOY yellow perch differed from that of western basin perch with benthic invertebrates composing a major proportion in August and September. Yellow perch were first collected in the larval stage when the mean total length were nearly 10 mm, and by the end of October they were 77 mm. Weekly growth increments were greatest in June and July when zooplankton was the primary food.

* Presented at: Great Lakes Fishery Commission
Lake Erie Committee Meeting
Ann Arbor, Michigan
March 24, 1997

**Provisional Data, not to be cited without permission**

The Lake Erie yellow perch (*Perca flavescens*) fishery is one of the most valuable freshwater fisheries in the world (Scott and Crossman 1973). From 1990 to 1995, yellow perch catch in Lake Erie steadily declined (1996 Yellow Perch Task Group Report). This decline in catch has prompted a preliminary examination by the Yellow Perch Task Group (YPTG) into factors that may be affecting yellow perch recruitment in Lake Erie. Potential factors have been identified but the relative importance of these factors has not been assessed. One way of identifying the most important determinants of recruitment to the Lake Erie yellow perch population is via some type of simulation modeling effort. In Oneida Lake, it has been shown that the diet of yellow perch during their first growing season affects the growth of these fish, and that YOY yellow perch growth is an important factor in determining recruitment (Mills & Forney 1981).

For management purposes, yellow perch populations in western Lake Erie and west-central Lake Erie are considered distinct stocks. Wu and Culver (1992) documented the summer diet and growth of YOY yellow perch in western Lake Erie during 1988 and 1989. These researchers showed that YOY perch switch from an almost exclusive zooplankton diet to a diet dominated by benthic invertebrates, and that this switch typically occurs in mid-July. Hayward and Margraf (1987) compared the growth and diet of age-1 and older perch from these two stocks during the 1970 to 1983 period. Information on the diet of central basin YOY yellow perch after the invasion of the zebra mussel (Dreissena polymorpha) apparently is lacking. Therefore, knowledge of YOY yellow perch diet and growth in Lake Erie would be useful information.

The objectives of this study were to: (1) document the diet changes in YOY yellow perch from summer to fall and assess the implications of diet on growth, and (2) compare the diet of YOY yellow perch between the western and central basins of lake Erie

The diet and growth of young-of-the-year yellow perch from western and central Lake Erie were examined to determine changes in the diet during their first year of growth and to document their diet and growth for future modeling of yellow perch recruitment. The study areas were near East Harbor, Ohio and near Fairport, Ohio; two depth strata were sampled at each location (6- & 9-m). Central Lake Erie sampling was conducted by Fariport Fish Research Station, Ohio Division of Wildlife. Sampling was biweekly from early May through late-October. Larval yellow perch were collected with a 1-m diameter (1 mm mesh) conical ichthyoplankton net from early May through late June at the surface and mid-depths. A bottom trawl was used to sample young yellow perch from late June through mid-October. Young yellow perch were measured to the nearest millimeter and weighed (g). Twenty stomachs were removed per sample-day from June 4 through October 22, 1996 (N=284). Stomachs from the western basin were preserved immediately after capture in 10% formalin. Young yellow perch stomachs from the central basin were frozen and returned to the lab to be fixed/preserved in 10% formalin. A supplemental sample of YOY yellow perch from trawl catches near East Harbor, Ohio were returned to the lab for length and weight measurements during each sampling period (N=2,232).

Duplicate zooplankton samples were collected with a 30 L Schindler-Patalas plankton trap at the same times, locations, and depths as were yellow perch. To reduce the effects of patchiness, each sample jar contained three plankton trap grabs, each of which were taken at a separate location along the trawling plane. To identify, measure, and enumerate both the zooplankton and stomach contents, we used a stereoscopic microscope with a drawing tube and a digitizing tablet attached to a microcomputer.

Wet weights of prey items were calculated by applying known length-weight regression equations to length measurements. Food items consumed were presented as the weighted average of the wet weight percentage. The mean percentage wet weight was determined for each fish and all wet weights were then averaged for each sampling period.

A measure of feeding selectivity was calculated using Chesson's alpha which is an index of feeding electivity using proportions of zooplankton consumed and proportions of available zooplankton, where

$$\text{alpha} = \frac{r_i/p_i}{\Sigma\,(r_i/p_i)}$$

with $r_i$ = the proportion of prey item $i$ in the fish's diet; and $p_i$ = the proportion of prey item $i$ in the environment. Data from both the zooplankton and stomach samples were pooled by sample date, station, and time period for calculating alphas.

In Western Lake Erie, young yellow perch consumed mostly crustacean zooplankton, the exclusive food through early August in 1996 (Fig. 1).

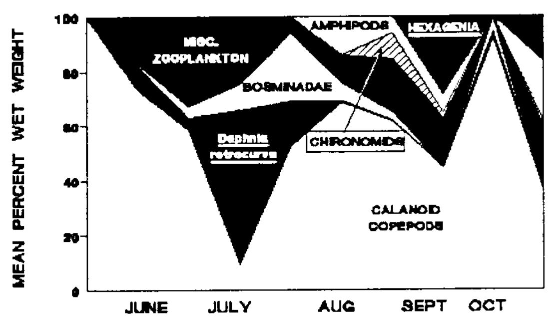


Figure 1. Diet composition of young-of-the-year yellow perch collected in western Lake Erie near East Harbor, Ohio in 1996.

Zoomacrobenthos did not become part of the diet until the middle of August and did not represent more than 40% (by weight) of the diet. During June and early July calanoid copepodites dominated the food ingested by weight. Larval yellow perch which were collected on June 4, fed exclusively on calanoid copepodites. During the middle of July, *Daphnia retrocurva* became an important food, comprising over 50% of the diet. The presence of *Daphnia retrocurva* followed periods in which they were abundant in the environment (Fig. 2). Calanoid copepodites, once again, dominated the food consumed from early August until late October when *Hexagenia*, amphipods and ostracods cumulatively comprised nearly 60% (by weight) of the food consumed.

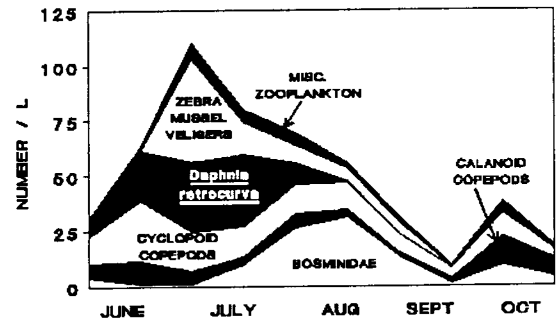


Figure 2. Crustacean zooplankton abundance and composition 1 m above the substrate in western Lake Erie near East Harbor, Ohio in 1996.

Although zebra mussel veligers were quite abundant in the zooplankton samples they comprised a very small portion of the food consumed. As zooplankton numbers dropped off in late September, YOY yellow perch increased their consumption of zoomacrobenthos, principally *Hexagenia*. Then as zooplankton numbers increased in early October, YOY yellow perch became increasingly zooplanktivorous, with the greatest proportion by number consisting of calanoid copepods. The diet shifts typically corresponded with zooplankton prey population shifts.

Calanoid copepodites were not only the most abundant zooplankton in the stomachs, but were also selected for most frequently by YOY yellow perch (Table 1). Calanoid copepodites were highly selected for from the first sampling date( June 4) to the last sampling date (October 22). Young yellow perch, to a much lesser extent, selected *Bosmina* spp., *Daphnia retrocurva*, and Sididae.

Young yellow perch usually fed on zooplankton with a mean size greater than those which were available in the environment for consumption ($t$-test, $P < 0.05$) (Fig. 3). The four main zooplankton groups that were found to be consumed at larger sizes than were collected by the plankton trap were calanoid copepodites, cyclopoid copepodites, *Bosmina* spp., and *Daphnia retrocurva*. The exceptions were when calanoid copepodites were consumed at a size smaller than was available prey until

Table 1. Prey selection by young-of-the-year yellow perch described by Chesson's alpha for the four most abundant zooplankton taxa in diets from western Lake Erie near East Harbor, Ohio during 1996. The only values to appear in table are those ≥ 0.09 which indicate positive selection.

| Date | Calanoid copepods | *Bosmina spp.* | *Daphnia retrocurva* | Sididae |
|---|---|---|---|---|
| JUN 04 | 1.0 | | | |
| JUN 20 | 0.83 | | | |
| JUL 05 | 0.58 | 0.16 | | 0.12 |
| JUL 17 | 0.49 | 0.24 | 0.12 | 0.12 |
| AUG 01 | 0.65 | 0.17 | 0.15 | |
| AUG 21 | 0.88 | | | |
| AUG 29 | 0.93 | | | |
| SEP 20 | 0.96 | | | |
| OCT 02 | 0.80 | | | |
| OCT 22 | 0.97 | | | |

early August, and that during late June cyclopoid copepodites and *Daphnia retrocurva* were also consumed at smaller mean sizes than were available in the environment.

Differences existed between the food consumed by YOY yellow perch in the western and central basins of Lake Erie. Samples from four time periods were compared to determine similarities or differences. During the first time period (mid-July) calanoid copepodites dominated the diet from Fairport (central basin) whereas *Daphnia retrocurva* was the food that dominated near East Harbor (Fig. 4). In early August zooplankton comprised over 75% of the western basin diet, while chironomids dominated the food in the central basin. The diets were similar between basins in late August with calanoid copepods the main prey. The diets diverge in late September with chironomids the exclusive food in the central basin and a diverse mix of zooplankton and zoomacrobenthos in the western basin.

In the western basin, the initial mean total length was 10.6 mm (June 4) in 1996 and the final mean total length was 71.6 mm near the end of the growing season. The increase in mean total length from June through October was nearly linear (linear regression, $r^2=0.89$) (Fig. 5). The increase in mean total weight was also nearly linear (linear regression, $r^2=0.65$). The largest weekly length increment occurred between early August and mid-August (Fig. 6), whereas the largest weekly weight increment occurred between June 20 and July 17.

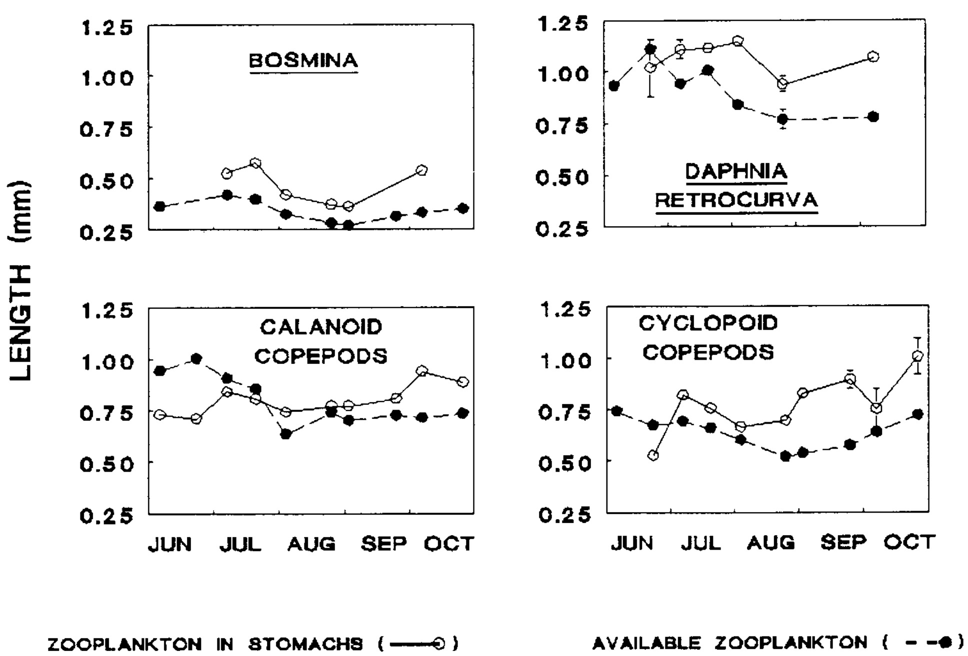


Figure 3. Size selectivity by young-of-the-year yellow perch on crustacean zooplankton in western Lake Erie near East Harbor, Ohio in 1996.

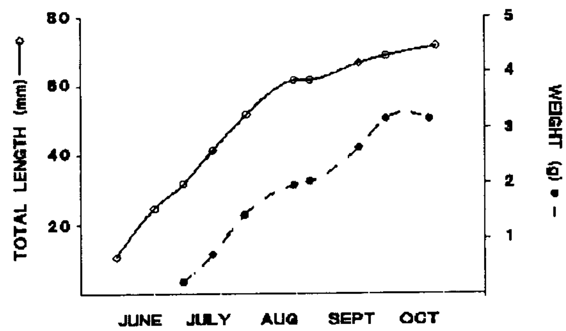


Figure 5. Growth of young-of-the-year yellow perch collected near East Harbor, Ohio in western Lake Erie during 1996.

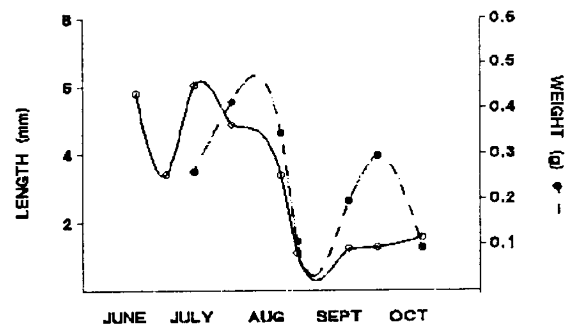


Figure 6. Mean weekly growth increments for young-of-the-year yellow perch collected near East Harbor, Ohio in western Lake Erie during 1996.

Figure 4. Comparison of food eaten by young-of-the-year yellow perch near Fairport, Ohio (central basin) and East Harbor, Ohio (western basin) in 1996.

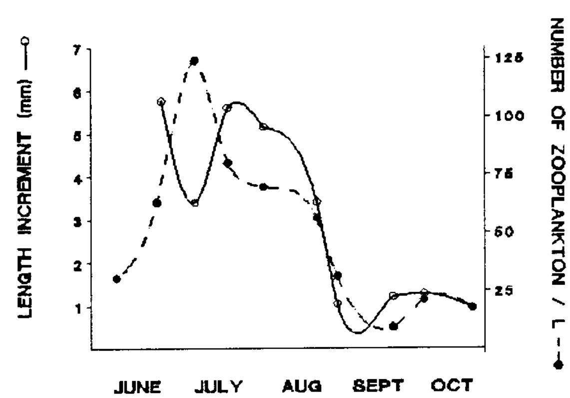


Figure 7. Mean weekly growth increments of young-of-the-year yellow perch and number of crustacean zooplankton/liter sampled in western Lake Erie near East Harbor, Ohio in 1996.

After the first peak of the weekly length increment occurred, a second smaller peak was evident between September 20 and October 2.

Growth (length) seemed to correspond with a couple of variables: number of zooplankton in the environment and percent of zooplankton in the diet. As an example, an increase in the weekly growth increment usually followed an increase in number of zooplankton in the environment (Fig. 7). The weekly length increment also appears to coincide with percent zooplankton in the diet (Fig. 8).

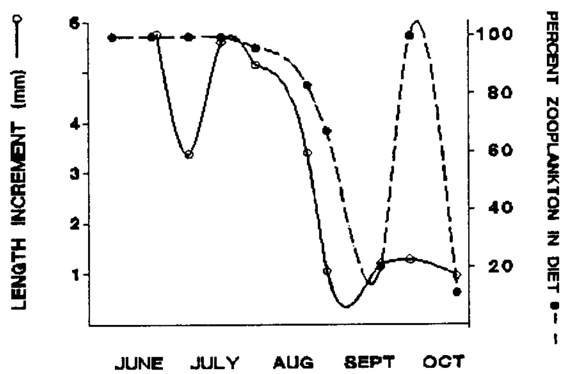


Figure 8. Mean weekly growth increments for young-of-the-year yellow perch and percent of crustacean zooplankton in the diet of young yellow perch in western Lake Erie near East Harbor, Ohio in 1996.