GREAT LAKES HEALTH

Recruitment Failure of Yellow Perch in Lake Michigan: Evaluation of the Starvation and Predation Hypotheses

Final Report

Objectives
To determine what factors impact year class strength in yellow perch.

Summary of Progress
Our goals and objectives were to determine the timing and abundance of yellow perch larvae and determine the major sources of mortality during the larval to juvenile phase. The likely sources of mortality would be either starvation or predation, or some combination of the two factors.

Accomplishments
Our work on determining where young of the year yellow perch are during the period between hatching and becoming demersal (juvenile stage) is continuing as Sea Grant project (R/CF-02-99) "Influence of upwelling events on larval and juvenile yellow perch". Otoliths are being examined to determine age and thermal history of juvenile fish. So far our results indicate that juvenile yellow perch captured in Illinois probably originate elsewhere in Lake Michigan.

Narrative Report
Yellow perch in Lake Michigan have not had a strong year class since 1988. Because these fish are old and dying off, the catchable stock of yellow perch is extremely low and the population is at risk because of a low brood stock. Historical data suggest that yellow perch year class strength is determined during the larval stage. Changing conditions in Lake Michigan due to exotic species such as zebra mussels, alewife, and spiny water flea may be responsible for the decline in yellow perch. These species can alter the food supply for the yellow perch larvae, or, in the case of the alewife, generate excessive predation on the larvae. Our goal was to assess the impacts of starvation and predation on yellow perch larvae by tracking their "condition" (how well-fed they are) and the predation intensity. Our work has been in most direct collaboration with Dr. David Jude of the University of Michigan (southeastern Lake Michigan stations) but we have also coordinated with members of the Yellow Perch Task Group, which has members from all states that border Lake Michigan.

We have completed two years of samples for young-of-the-year yellow perch. Samples include neuston net tows, beach seines, cast netting, and trawling for young-of-the-year yellow perch, collections of zooplankton with plankton nets to assess food abundance for larval yellow perch, and collections of potential predators of larval yellow perch.

Our work has focused on the larval to juvenile stage because it appears that year class strength is determined during this early period. In both 1998 and 1999 we were mostly able to collect larval yellow perch in early June, while they still had yolk sacs. Yolk-sac larvae are not yet totally dependent on exogenous feeding. We did not collect young-of-the-year yellow perch again until late July/early August. Similar results were reported by Jude for his Michigan stations and members of the Yellow Perch Task Group at other stations. The coordinated work of our group and Jude's yielded evidence that the yellow perch larvae and other fish larvae were most abundant in areas of downwelling (generally downwind side of the lake) and least abundant where warm water was displaced offshore in an upwelling (generally upwind side). There was also some evidence that the juvenile yellow perch were first becoming demersal in association with a downwelling event. Our 1999 larval fish samples are consistent with the 1998 samples in that larval yellow perch were most abundant at downwellings and least abundant at upwellings. This led to the hypothesis that

larval yellow perch are quickly taken by wind-driven currents to areas probably far from where they were spawned and to possibly to considerable distances offshore. We have had some confirmation of this from a limited amount of offshore sampling in collaboration with Dr. John Dettmers of the Illinois Natural History Survey.

Thus far the Yellow Perch Task Group has not been able to adequately assess the effect of starvation or predation on larval yellow perch. This is because we have been unable to collect substantial numbers of post-yolk sac yellow perch larvae. Hence we have made it a major priority to determine where the larval yellow perch are during the more than month-long period in which we have been unable to collect them. For a new Sea Grant project (R/CF-02-99) samples of juveniles from 1998 and 1999 are being examined by means of stable isotope techniques to determine their feeding and temperature history. Stable isotope ratios of oxygen in the otoliths provide a record of the temperature history of the fish. If this history shows that the fish are in warm water with little temporal fluctuation it is evidence that the fish are staying with the epilimnetic water and water currents are probably determining what food supply they will encounter, what the predators and predation rate is likely to be, and where the juveniles will begin their demersal phase. If the otolith temperature history shows a considerable amount of temperature variation then it is more likely that the larval fish are remaining closer to where they were hatched. We think that our collections of some larvae offshore supports the hypothesis that the larvae are swept offshore by wind-generated events.

Once we have constrained the number of possible locations for the post-yolk sac larvae we will focus our sampling effort for these fish on the possible locations. This is part of the focus of a new Sea Grant project (R/CF-02-99). When we are successful in locating and collecting post-yolk sac yellow perch larvae we can begin to assess the relative importance and timing of starvation and predation. If the later larval and early juvenile stages are pelagic we may be able to recommend a sampling strategy for earlier year class strength estimation.

Brief Summary

Yellow perch in Lake Michigan and other large lakes typically have large fluctuations in year class strength. Lake Michigan yellow perch have not produced a good year class since 1988. As these fish age they become scarce and the population may not have an adequate brood stock. It appears that year class strength is determined during the about one month period after hatching. Unfortunately, no one in the four states surrounding Lake Michigan has been able to collect yellow perch during this period because we do not know where they are in the lake. Our study indicates that larval yellow perch are more abundant at downwelled versus upwelled sides of the lake. The concentration of larvae may be due to the combined effects of transport to nearshore areas and also the warm water and turbulence associated with downwelling may stimulate hatching. From daily growth rings in the otoliths of juvenile yellow perch is likely that the juvenile yellow perch caught in Illinois originated elsewhere. Larva peak abundance for Illinois has been early June, but the juveniles appear to have been born in lake June. These fish were probably transported from much farther north.

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Research Information

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