AQUACULTURE

Influence of Upwelling Events on Larval and Juvenile Yellow Perch

Final Report

Yellow perch in Lake Michigan have experienced recruitment failure since 1988 and the strong 1995 year class is disappearing as the fish age, with detrimental effects on the important sport fishing industry. It appears that there is a critical period for survival during the larval stage. Two of the above projects address whether invasive species might play a role through competition for food or other interactions. This project by Dr. John Janssen (Loyola University Chicago) addresses two other hypotheses: that recruitment fails most years because of (1) predation or (2) starvation. The postulated mechanism is wind-driven water currents which may take larvae to regions with poor food, intensive concentrations of competitors for food, or intensive concentrations of predators which consume the perch. This project will also help find where the so-called "missing" phase of the life cycle goes: the post yolk-sac larvae and later stages. Currently it is difficult for managers to predict year class strength and recruitment to the fishery because the early life stages cannot be found. As a result, the strong year class of 1995 was not identified until three years had passed and the fish were large enough to show up in the catch. Managers need more rapid assessment of year class strength if measures such as supplemental stocking are to be cost-effective. This project is coordinated with the Lake Michigan Yellow Perch Task Force and with a project funded separately by the Great Lakes Fishery Trust. It will utilize physical data provided by NOAA-GLERL, Michigan State University Coastwatch, the National Weather Service, and various municipal and industrial water intakes (water temperature). Information and recommendations for effective early assessment of year class strength will be transferred to the U.S. Fish and Wildlife Service and the four state Departments of Natural Resources, through their representatives on the Yellow Perch Task Group and through the Great Lakes Fishery Commission. The Aquatic Resource Specialist will assist with this information transfer.

Major Goals and Objectives:

- Determine the factors that affect the survival of larval yellow perch in Lake Michigan
- To determine where young of the year yellow perch reside and are transported during the period between when the yolk is absorbed and when they are dispersed.
- Document, based on thermal history in the otoliths and stable isotopes in the muscle whether life histories of alewife or benthic fish are closer to yellow perch thermal life histories
- Determine the impact of wind-driven movements of water masses on young of the year yellow perch distribution

Summary of Progress

We have two major accomplishments regarding the goals and objectives. The first is in regard to movement of larval yellow perch with water masses. We have five seasons of data comparing nearshore versus offshore sampling for newly hatched larval yellow perch and the results show a statistically clear offshore movement with upwelling and nearshore movement with downwelling. in 2002 we also conducted offshore sampling and the results show that larval yellow perch can be transported in high numbers at least 10 miles offshore at about one week and over 20 miles offshore by 2 weeks. The fish remain pelagic for at least a month, during which time it is likely that perhaps large numbers are transport ed across Lake Michigan. The second major accomplishment is documentation of a preference by young of the year yellow perch for rocky habitat. Micromesh gill nets were set on rocky versus sandy substrate with five sets. The results show a statistically significant bias for rocky habitat with about 80% of the young of the year caught on rocky habitat. These fish are feeding on abundant prey associated with the rocks. Much of the Lake Michigan

assessment of young of the year yellow perch uses trawls on soft bottoms. This sampling is probably ineffective as it captures mainly young of the year yellow perch searching for the abundant food associated with the rocks. The Lake Michigan yellow perch population likely operates as a source-sink situation, with the rocky west side of the lake being the prime habitat, but the larval perch tend to drift toward the relatively poor, sandy habitats on the east side of the lake.

Stable Isotopes are currently being processed and not enough data are available yet for statistical analyses.

Accomplishments/Benefits

The major potential applications include the possibility of devising new methods for assessing year class strength, either by pelagic trawling for late pelagic phase yellow perch or micromesh gill netting of the young of the year yellow perch in rocky habitat.

A potentially important management issue relates to the developing source-sink hypothesis. If the abundance of yellow perch on the east side of the lake depends on spawning on the west side of the lake, then managing the yellow perch resource will require well-integrated multistate coordination and cooperation.

Keywords

yellow perch, recruitment, Lake Michigan, upwelling

Narrative Report

In terms of field work we have made excellent progress. A chief complaint of the proposal reviews was that we did not have the ability to sample offshore to determine whether the young yellow perch were transported. We have taken advantage of opportunities to have access to suitable vessels and have been able to document the offshore transport we proposed. We also experienced difficulty obtaining demersal young of the year yellow perch for otolith analyses, but have solved that problem by switching to a new sampling gear, the micromesh gill nets. We now have an abundance of demersal young of the year yellow perch and have been able to share these with other groups. In addition, we are currently assembling a paper on habitat selection and diet of young of the year yellow perch. We will follow that with papers on (1) offshore transport of yellow perch, (2) diets of pelagic phase yellow perch, and (3) geographical variation in yellow perch "birthdays" in cooperation with other researchers. Our only slow point is the stable isotope analyses; these have been slowed because the person running the analyses moved his lab from Syracuse to Manitoba. AT this point we consider this minor because the stable isotope analyses were designed to find indirect evidence of transport of pelagic phase yellow perch and we have been able to generate substantial direct evidence.

Lay Summary

Yellow perch recruitment has been poor to fair in Lake Michigan since 1988. The best recent year classes are probably 1998 and possibly 1995; the 2002 year class appears to be relatively good, but not nearly a strong year class. A likely factor in poor recruitment are the effects of zebra mussels. These have affected food resources in two ways: (1) soft substrates have lost much of their invertebrate fauna that served as food for young of the year yellow perch and (2) rocky habitats have increased prey resources. Why yellow perch would be adversely affected on the west side of Lake Michigan is not obvious, because the prey is abundant. We have been working on the hypothesis that the young yellow perch are transported from the sites of egg deposition to other places in Lake Michigan, hence the young yellow perch that settle on the west side of Lake Michigan likely originate elsewhere in the lake. It has been shown in previous studies that adult yellow perch prefer rocky habitat and eggs are preferentially deposited there, Our work has shown that the young of the year also prefer rocky habitat and forage there. Our work has also shown that larval yellow perch are

rapidly dispersed by currents, up to 20 miles or more within two weeks of hatching. Hence is very likely that the rocky habitats on the west side of Lake Michigan produce most of the larval yellow perch, but these mostly settle to the bottom in poorer habitat where they have poor survival. To get a good year class for the west side of Lake Michigan may require unusual current patterns to return the young fish to the west side. Fish transported to the east side of the lake, with its poor habitats (made worse by zebra mussels), may have poor survival and be unable to find adequate habitat.

Partnerships
Illinois Natural History Survey (John Dettmers), University of Michigan (David Jude), North Carolina State University (Jim Rice), Wisconsin Department of Natural Resources.

Undergraduates/Graduates:

> Kirby Wolfe (Loyola U tech and graduate student
> Noah Kopp Summer undergraduate student
> Ian Thomas Summer undergraduate student

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Research Information

- **Principal Investigator**: John Janssen
- **Initiation Date**:March 1, 2000
- **Completion Date**:February 28, 2003
- **Affiliation**: WATER Institute, University of Wisconsin-Milwaukee

Contacts

Tomas Höök (../../staff/hook.html)

Associate Director of Research
765-496-6799
thook@purdue.edu (mailto:thook@purdue.edu)

Carolyn Foley (../../staff/foley.html)
Assistant Research Coordinator
765-494-3601
cfoley@purdue.edu (mailto:cfoley@purdue.edu)

Kwamena Quagrainie (../projects/staff/quagrainie.html)
Aquaculture Specialist
765-494-4200
kquagrai@purdue.edu (mailto:kquagrai@purdue.edu)

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Illinois-Indiana Sea Grant
Purdue University
195 Marsteller Street
West Lafayette, IN 47907-2033
765-496-6009
iisg@purdue.edu (mailto:iisg@purdue.edu?subject=IISG Inquiry)

(http://web.extension.uiuc.edu/state/)

(http://www.seagrant.noaa.gov/)

(http://www.noaa.gov/)

(http://www.purdue.edu/)