AQUACULTURE

Determination of the Effects of Culture Temperature on Growth, Survival and Biochemical Composition of Largemouth Bass (*Micropterus salmoides*)

Final Report

Objectives
To evaluate the effect of culture temperature on growth, survival, and body composition of largemouth bass.

Summary of Progress
Completed.

Accomplishments
Study indicated that the optimal culture temperature for growth, survival and feed conversion in bass is approximately 26EC. At 20EC survival and feed conversion are good but growth rate is reduced. At 32EC growth, survival and feed conversion were all reduced.

Benefits
Temperature results establish optimal culture temperatures and growth implications. Temperature significantly effects growth and body composition of poikilothermic animals by controlling feed consumption, nutrient requirements, and food passage time. Diets fed to largemouth bass during different temperate seasons may need to be adjusted to better meet changing needs due to water temperature.

Narrative Report
The largemouth bass represents one of the most important freshwater fish in terms of sportfishing activities and expenditures. In recent years interest in largemouth of sizes larger than normally produced for sport fish stocking has increased. Asian consumers appear to desire live largemouth bass above all other freshwater fish and demand has been identified in excess of 700,000 pounds per year at over $4.00 per pound live weight. Demand for large largemouth bass has grown dramatically and far exceeds availability. This has resulted in increasing interest in them as an aquaculture species.

Temperature is the single-most pervasive environmental factor in poikilothermic animals (Stickney 1979). Temperature can affect fish growth directly by controlling feed consumption, nutrient requirements, and food passage time (Smith 1989). Culture temperature may also affect the amount of lipid deposited, as well as its fatty acid profile, due to the role of unsaturated fatty acids in maintaining bio-membrane fluidity (Sargeant et al. 1989). These changes could affect the nutrient demands of the fish, as well as their organoleptic attributes, when raised at different temperatures.

Previous work has demonstrated that largemouth bass have unusually high levels of the polyunsaturated fatty acid docosahexaenoic acid (DHA, 22:6 n-3). These levels are even higher than those found in cold-water fishes such as salmon. These high levels may make largemouth desirable as a human food item as this is a fatty acid identified as being advantageous for cardiovascular health in humans. However, as a fatty acid normally found in coldwater fishes, its apparent importance to largemouth, which has been considered a warmwater fish, appears contradictory and problematic. The biochemical analysis of largemouth reared at different temperatures, then compared to similar data on yellow perch (a coolwater fish) from a previous study, would be advantageous to a better understanding of the role of polyunsaturated fatty acids in largemouth bass nutrition.

It has been suggested that properties of fish tissue proteins are affected by the environmental temperature at which they are synthesized (Love 1980). If differences were of significant magnitude, nutritional requirements could potentially differ for fish cultured at different temperatures. Catfish diets for winter feeding normally contain less protein than those used at higher temperatures (Lovell 1989). It is essential to practical and profitable production that efficient and economical feeds be formulated which support rapid growth which may be different for different culture temperatures. It could be that adjustments in feed formulations for different culture temperatures may be justified for largemouth bass.

Progress

- On August 29, 2000, nine 3,610-*l* round polyethylene tanks were stocked with 650 feed trained juvenile largemouth bass (average weight, 9.1g; total length, 5cm). The tanks are housed within a greenhouse located at the Aquaculture Research Center, Kentucky State University, Frankfort, Kentucky, USA. The greenhouse is covered by shade cloth to reduce ambient light levels. Fish are being fed a commercial salmonid diet (40% crude protein, 8% crude lipid, Nelson and Sons, Murrary, Utah, USA) to apparent satiation twice daily.

Each tank receives a constant water flow of approximately 4-*l*/min. Dissolved oxygen levels are maintained by constant aeration. Water is recirculated through three heat pump units (AquaLogic, San Diego, California, USA) to maintain temperatures, with each heat pump supplying three replicate tanks. Each temperature treatment (three tanks) is constantly recirculated through its associated heat pump to maintain temperature, with approximately 25% of the total volume being replaced daily by a constant flow of approximately 1-*l*/min of new water from a storage reservoir. Temperatures in all tanks were maintained at 24°C for a 7-day conditioning period. After the conditioning period temperatures were gradually adjusted to achieve treatment temperatures of 20, 26, and 32°C, with three replicate tanks per temperature.

Baseline chemical analysis were taken from random samples of 5 fish per sample and 3 samples per tissue type for subsequent proximate analysis of whole body, white muscle, and livers; these samples were homogenized in a blender and are stored frozen until analysis. Separate samples were taken from random samples of 5 fish per sample and 3 samples per tissue type for subsequent fatty acid analysis of white muscle, white muscle phospholipids, and livers; these samples were immediately frozen in liquid nitrogen (-196°C) and stored (-40°C). Also, 3 vials were prepared each containing 3 livers preserved in 10% buffered formalin for histopathological examination.

After 97 days the average weight of bass in the 20°C treatment was significantly lower ($P < 0.05$) than fish in the 26 and 32°C treatments, which were not significantly different from each other ($P > 0.05$). Bass grown at 26 and 32°C had significantly higher ($P < 0.05$) SGR and production rates (kg/m3) than those in the 20°C treatment. Bass in the 26 °C treatment had significantly lower ($P < 0.05$) FCR than bass raised at 20 and 32 EC, which were not significantly different ($P>0.05$), indicating more efficient feed utilization at 26 EC. There was no significant difference ($P>0.05$) in survival among treatments which averaged 96.5%, overall. There was no significant difference ($P>0.05$) in the moisture, protein, lipid, whole body, or ash content of the liver. These data indicate that largemouth bass gain weight and convert feed most efficiently at 26 EC than at 20 or 32 EC. Proximate body compositions do not appear to be strongly impacted by these temperatures. Effects on liver composition and fatty acid profiles of different tissues are currently being analyzed.

Brief Summary

Temperature significantly effects growth and body composition of poikilothermic animals by controlling feed consumption, nutrient requirements, and food passage time. Diets fed to largemouth bass during different temperate seasons may need to be adjusted to better meet changing needs due to water temperature. Juvenile largemouth bass *Micropterus salmoides* were evaluated under controlled conditions in tanks for 12 weeks to determine the effect of temperature on growth rates, survival, and biochemical composition. Three treatment temperatures were evaluated (20, 26, and 32 EC). The water source was a reservoir pond and

temperatures were maintained by heat pumps. Juvenile largemouth bass weighing 9.1 g were stocked into the nine 3,610-L tanks at 140 fish/m3 (500 fish/tank). There were three replicates per treatment. Bass were fed to apparent satiation twice daily using a commercially available floating salmonid diet containing 42% crude protein.

After 97 days the average weight of bass in the 20 EC treatment was significantly lower ($P < 0.05$) than fish in the 26 and 32 EC treatments, which were not significantly different from each other ($P > 0.05$). Bass grown at 26 and 32 EC had significantly higher ($P < 0.05$) SGR and production rates (kg/m3) than those in the 20 EC treatment. Bass in the 26 EC treatment had significantly lower ($P < 0.05$) FCR than bass raised at 20 and 32 EC, which were not significantly different ($P>0.05$), indicating more efficient feed utilization at 26 EC. There was no significant difference ($P>0.05$) in survival among treatments which averaged 96.5%, overall. There was no significant difference ($P>0.05$) in the moisture, protein, lipid, whole body, or ash content of the liver. These data indicate that largemouth bass gain weight and convert feed most efficiently at 26 EC than at 20 or 32 EC. Proximate body compositions do not appear to be strongly impacted by these temperatures. Effects on liver composition and fatty acid profiles of different tissues are currently being analyzed.

Back to Research Project List (../../research_aquaculture.php)

Research Information

- **Principal Investigator**: James H. Tidwell
- **Initiation Date**: April 1, 2000
- **Completion Date**: October 31, 2001
- **Affiliation**: Kentucky State University

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)

Topics

- ☐ **AQUACULTURE (/topic_aquaculture.php)**
- ☐ **AQUATIC INVASIVE SPECIES (/topic_ais.php)**

- CLIMATE CHANGE (/topic_climate.php)
- COASTAL RESTORATION (/topic_coastal.php)
- GREAT LAKES ECOSYSTEMS (/topic_glecosystems.php)
- GREAT LAKES LITERACY (/education.php)
- MEDICINE DISPOSAL (http://web.extension.illinois.edu/unusedmeds/)
- NATURAL LAWN CARE (/l2l.php)
- NUTRIENTS (/topic_nutrients.php)
- RECREATION AND FISHERIES (/topic_recreation.php)
- RESILIENT COMMUNITIES (/topic_resilient.php)
- WATER RESOURCES (/topic_water.php)

Products

- AQUACULTURE (/products_aquaculture.php)
- AQUATIC INVASIVE SPECIES (/products_ais.php)
- CLIMATE CHANGE (/products_climate.php)
- COASTAL RESTORATION (/products_coastal.php)
- EDUCATION (/products_education.php)
- FISH CONSUMPTION (/products_fishcon.php)
- GREAT LAKES HEALTH (/products_glhealth.php)
- LAND USE PLANNING (/products_landuse.php)
- MEDICINE DISPOSAL (/products_gros.php)
- PROGRAM (/products_program.php)
- NATURAL LAWN CARE (/products_lawncare.php)
- WATER RESOURCES (/products_water.php)

Resources

- ABOUT US (/about.php)
- CHICAGO WATER WALK APP (http://www.chicagowaterwalk.org/)
- FUNDING (/funding.php)
- NEWSROOM (/newsroom)
- OTHER WEBSITES (/other_sites.php)
- PEOPLE (/staff.php)
- PHOTOS (http://iisg.photoshelter.com/)
- SOCIAL SCIENCE (/glssn.php)
- TEACHERS (/education.php)

Careers

- TEACHER TRAINING (/education.php)
- FELLOWSHIPS (/fellowships.php)
- INTERNSHIPS (/internship.php)
- SOCIAL SCIENCE (/glssn.php)

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)

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

Sea Grant **(http://www.seagrant.noaa.gov/)**

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

PURDUE UNIVERSITY **(http://www.purdue.edu/)**