The influence of vegetation on growth and survival of age-0 Largemouth Bass

Research Objectives

1. Quantify differential growth rates and diets for age-0 Largemouth Bass in habitats with and without vegetation during three successive periods throughout the summer using net-pen enclosures.
2. Quantify differential diets, densities, and stock-recruitment curves for age-0 Largemouth Bass in 20 Michigan lakes (Table 2) using electrofishing.

Introduction

Largemouth Bass *Micropterus salmoides* are an economically and ecologically important game fish distributed throughout the continental United States (Becker 1983). Largemouth Bass or Smallmouth Bass were targeted by 39% of freshwater anglers in 2011 (U.S. Department of the Interior et al. 2011). Ecologically, Largemouth Bass have been described as a keystone species due to their density-dependent foraging, which can influence the fish community in lakes (Schindler et al. 1997). However, the vegetated habitats that Largemouth Bass utilize in some north temperate lakes are changing as human development intensifies.

Lakeshore development modifies the vegetation that Largemouth Bass utilize throughout their life history (Olson et al. 2003, Becker et al. 1983). Age-0 Largemouth Bass are subject to greater predation in habitats without vegetation, because structural habitat provides small fishes with cover to hide in (Olson et al. 2003). Feeding efficiency and growth are expected to decline in very dense vegetation (Bettoli et al. 1992). Therefore, intermediate vegetation densities (10 – 25% coverage) may provide optimal habitat for age-0 Largemouth Bass (Miranda and Pugh 1997). Decreased emergent and floating vegetation abundances have been observed at developed sites in highly developed Wisconsin lakes (Jennings et al. 2003). While vegetation manipulations have been documented (Bettoli et al. 1993, Pothoven et al. 1999), these have typically occurred in situations where dense vegetation is suspected to limit growth. Therefore, a need exists for greater study of the relationship between vegetation and age-0 Largemouth Bass growth and survival in lakes with low to moderate vegetation densities. This information may be important for fisheries managers and the public as decisions impacting aquatic vegetation are made.

Objective 1: Quantify differential growth rates and diets for age-0 Largemouth Bass in habitats with and without vegetation during three successive periods throughout the summer using net-pen enclosures.

Preliminary results from research conducted at Blue Lake, MI indicate that Largemouth Bass growth rates were higher in vegetation. However, differential mortality and escapement may have occurred in each net pen. Age-0 Largemouth Bass in net pens with low final densities were generally larger. Potential hypotheses for this difference in size include differences in growth rates (density dependent growth), size-selective mortality, or size-selective escapement, which we plan to investigate during the coming field season.

We hypothesize that vegetation will provide benefits to growth through the provision of greater food resources. In order to quantify variable growth rates, age-0 Largemouth Bass will be placed in 10’ x 10’ net pen enclosures in Blue Lake, MI. These fish will be collected by backpack electrofishing and beach seining. Length and weight will be recorded for each fish before and after each experimental period. Net pens will be placed (with written landowner permission) over littoral habitats with vegetation coverage of 0%, 50%, and 100%. Net pens will be stocked with high or low densities of age-0 Largemouth Bass (Table 1) in order to experimentally control for potential effects of density on diet, growth, and survival. With two density treatment levels, three vegetation treatment levels, and two replicates per treatment, there will be a total of twelve net pens. Fish will be randomly assigned to each net pen to ensure similar initial size distributions. Differences in growth rates between net pens will be tested using a generalized linear mixed model for final size. Two ~30-d periods and one ~60 d period are proposed in order to assess differences in growth rates across early life history events (planktonic feeding, switch to piscivory, and fall lipid accumulation).
Our experimental design requires the use of age-0 Largemouth Bass during the first (180 fish), second (144), and third (144) experimental periods. In total, 468 age-0 fish will be placed in net pens for the growth study and ultimately euthanized for gut content analysis. This experimental design is sufficient to detect a difference in final length of 0.2 inches or greater assuming a standard deviation of 0.15 inches.

**Objective 2: Quantify differential diets, densities, and stock-recruitment curves for age-0 Largemouth Bass in 19 Michigan lakes using electrofishing.**

We hypothesize that vegetation plays an important role in the diet, growth, and survival of age-0 Largemouth Bass. Miranda and Pugh (1997) argue that moderate vegetation densities would provide optimal habitat for age-0 Largemouth Bass. We will test this hypothesis by surveying Largemouth Bass populations in 20 Michigan lakes with differing vegetation communities. Study lakes will have similar fish community composition and trophic status, representing replicates along a gradient of vegetation abundance. We hypothesize that per capita Largemouth Bass recruitment rates will increase when vegetation is more abundant.

We will use an electrofishing boat to survey adult Largemouth Bass during the summer and age-0 Largemouth Bass during the fall of 2014. Electrofishing transects will be stratified by vegetation coverage (present or absent). Catch efficiency will be calculated with a mark-recapture design using small dorsal fin clips. Catch efficiency will ultimately be used to calculate a weighted index of abundance for each lake. All fish will be released after marking and recovery except those age-0 Largemouth Bass used in the diet analysis described below. Abundance estimates will be used to identify the parameters of a stock-recruitment relationship for Largemouth Bass. Maps of late-season (August and September) vegetation on each lake will provide data on vegetation abundance and distribution, which will be compared with electrofishing data to test hypotheses on the relationship between vegetation abundance and recruitment.

To test the influence of vegetation on age-0 Largemouth Bass diets, we will analyze gut contents from age-0 Largemouth Bass captured in habitats with vegetation (10 per lake) and without vegetation (10 per lake)(Table 2). Diet studies must be lethal, because gastric lavage is not feasible in such small fishes. Each fish will be euthanized in ethanol or MS-222 in accordance with Institutional Animal Care and Use Committee (IACUC) regulations, frozen, and its gut contents will be identified (to the extent possible), enumerated, and weighed. Non-lethal gastric lavage will also be performed on adult Largemouth Bass in order to analyze gut contents by habitat type.
Table 2. Data Requirements for Objective 2.

<table>
<thead>
<tr>
<th>Lake</th>
<th>County</th>
<th># Age-0 LMB euthanized for gut content analysis</th>
<th># Age-0 LMB marked and released</th>
<th># Juvenile and adult LMB sampled and released</th>
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<tbody>
<tr>
<td>Harper Lake</td>
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<td>20</td>
<td>200</td>
<td>100</td>
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<td>Idlewild Lake</td>
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<tr>
<td>Meauwataka Lake</td>
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<td><strong>Total</strong></td>
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<td><strong>400</strong></td>
<td><strong>4,000</strong></td>
<td><strong>2,000</strong></td>
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</tbody>
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Communication Plan

After approval from the Michigan Department of Natural Resources (DNR) and before fieldwork begins, we will contact the Presidents of lake associations representing lakes in Table 2 to communicate our field plan, secure lake access on private lakes, and identify any potential concerns. Don Anderson, President of the Blue (Chancellor) Lake Property Owner’s Association has already been contacted for approval of this research. We will provide our sampling schedule to the Michigan DNR at least a week prior to any field collection.

Following sampling, we will provide a written summary of our results and raw data if desired to the regional fisheries biologist and to the Lansing office of the Michigan DNR. We will also provide digital maps of aquatic vegetation created during the research. We will communicate our results in a summarized form to lake association contacts gained throughout the field season, and will work with the Michigan Lakes and Streams Association to disseminate this information. Any reports resulting from the research will be provided to the Michigan DNR.
References


