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Evaluation of plankton surface pushnets and oblique tows for comparing the catch of diadromous larval fish

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Abstract

A bow-mounted surface pushnet and an obliquely towed plankton net were compared to evaluate gear efficiency and effectiveness in collecting larval fishes under daytime and nighttime conditions. The diadromous species targeted were striped bass *Morone saxatilis*, white perch, *Morone americana*, and river herring *Alosa* sp. We sampled the lower Roanoke River, North Carolina, from March through June of 2002 and 2003. Striped bass, white perch and river herring represented over 90% of the larvae collected during the study period. Mean larval densities (number/100 m^3) were 63.4 for striped bass, 26.4 for river herring, and 17.7 for white perch. Striped bass larval densities were significantly higher in the surface pushnet for both years ($P \leq 0.05$). In 2002, white perch mean larval density was significantly higher at night in the surface pushnet samples, but in 2003 there were no differences between day and night samples. River herring mean densities were significantly higher in the surface pushnets for both years, but showed no clear patterns between day and night samples. Larger larvae were consistently collected in the surface pushnets for all species. Overall, the surface pushnet was easier to operate. The pushnet was mounted on the bow of a small jon boat and required less specialized gear and fewer personnel than oblique sampling. The method also allows for sampling in shallow water or vegetated habitats. Because larvae were significantly larger in the surface samples, using surface pushnets may not allow for detection of the smaller-sized larvae therefore underestimating the abundance of smaller fish. Depending on the question being asked, we recommend that sampling programs should use both gear types to reduce any gear biases.

Keywords: Ichthyoplankton; Striped bass; White perch; River herring

1. Introduction

Sampling planktonic larval fishes is a method used to develop an index of stock abundance and is often used as a management tool to estimate reproduction and year-class strength (Uphoff, 1989; Sammons and Bettoli, 1998). Investigating the early life histories and population dynamics of larval and juvenile fishes is important because year-class strength is established during these early stages (Cushing, 1990). A monitoring program for larval distribution, growth, timing and location of spawning, and mortality provides information on recruitment dynamics (Castro and Hernandez, 2002). Understanding the underlying principles that control recruitment and year-class strength are required for effective fisheries management at the species level.

Estimates of abundance and size distributions of larval fish are important in studying early life histories of fish. Traditionally, assessments are based on field collections using a variety of types, sizes, and configurations of plankton nets. Interpretation of abundance estimates may depend on the strengths and weaknesses of the collection gear. These may affect the diversity of the catch as well as the size distribution. Plankton nets can be deployed and towed either behind or beside a vessel, or mounted to a fixed platform to push the net through the water. The gear selected and the methods used are assumed to provide samples representative of the fish assemblage and the relative abundances of the constituents, but each gear type has strengths and weaknesses that affect the diversity of the catch as well as fish size distribution.

Understanding the strengths and weaknesses of the gear will govern the interpretation of abundance estimates. Larval fish patchiness, diel patterns, and vertical distribution patterns vary among species (Power, 1984; Hare and Govoni, 2005). The question of where and when to sample, and what type of gear to use, may depend on the species of interest. *A priori* knowledge of

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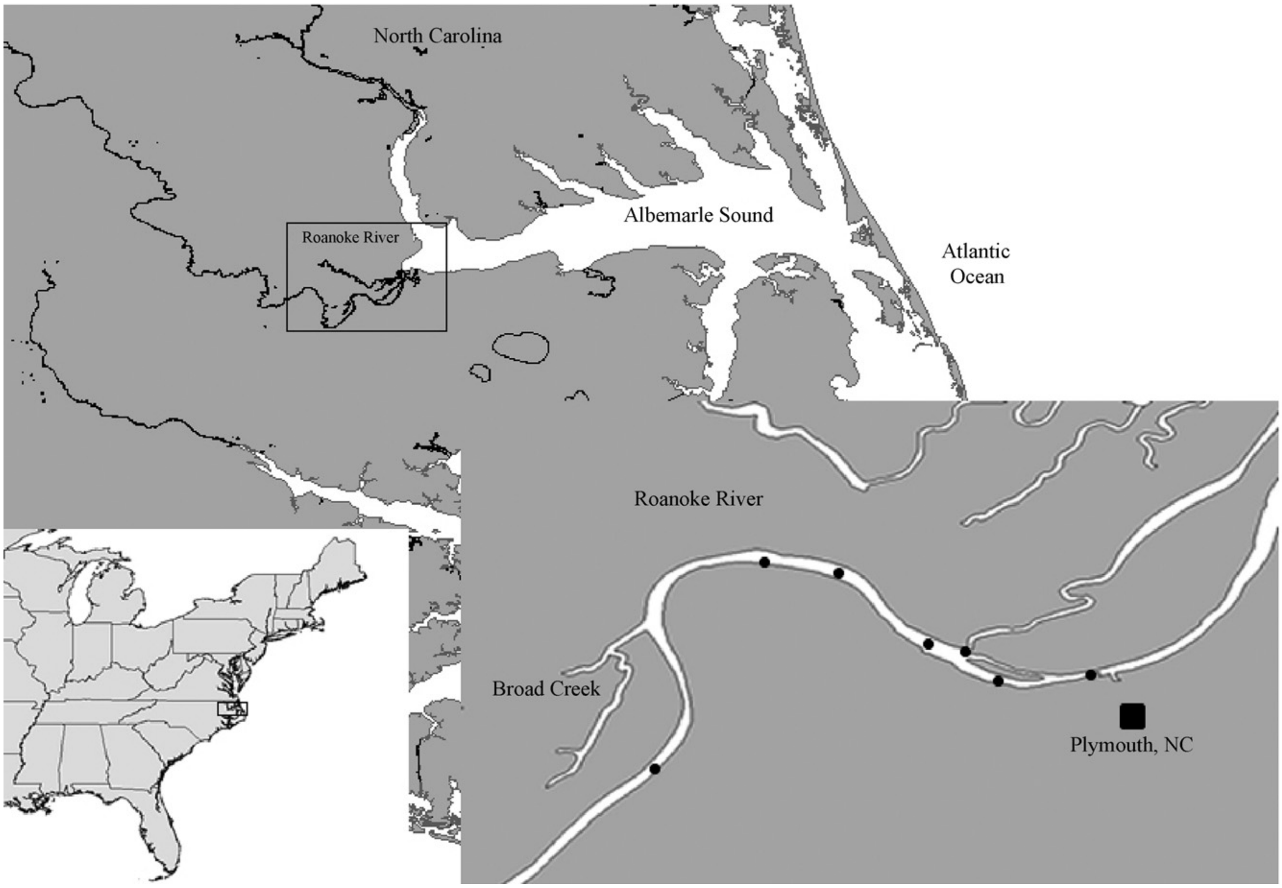

Fig. 1. Map of sampling stations (closed circles) in lower Roanoke River, North Carolina.

the vertical and diel distributions of larval fishes may be species specific; however, in most cases variation in the distribution and behavior of fish is often unknown by the scientist and is the subject of the research. Thus, if the sampling objective is to target a particular species of larvae, then a single sampling method may suffice. If the goal is to examine several larval species or a fish assemblage, then more than one sampling strategy may be required.

Bow mounted pushnets (Kriete and Loesch, 1980; Gallagher and Conner, 1983) and obliquely towed plankton nets (McGovern and Olney, 1996) are commonly used to sample ichthyoplankton. To determine whether larval catch differed between gear types we compared larval density estimates of three common diadromous fishes along the U.S. Atlantic coastline – river herring *Alosa* sp., white perch *Morone americana*, and striped bass *Morone saxatilis* – collected using a bow-mounted surface pushnet and obliquely towed plankton nets. We also compared the mean length of larval fishes between the two sampling gear types and between day and night (diel) samples. We hypothesized that the type of gear used would significantly affect larval abundance and length estimates.

2. Methods

Larval fish were collected approximately twice each week from March through June of 2002 and 2003 in the lower Roanoke River, North Carolina (Fig. 1: River kilometers 9.6–22.4). The fish community sampled was diverse with diadromous species including striped bass, white perch, American shad *Alosa sapidissima*, hickory shad *Alosa mediocris*, alewife *Alosa pseudoharengus*, blueback herring *Alosa aestivalis*, and American eel *Anguilla rostrata* dominating the springtime ichthyoplankton (Rulifson and Overton, 2005). Larvae of resident species from the Centrarchidae, Cyprinidae, and Ictaluridae were present but not targeted in this study.

Seven stations were sampled from pelagic areas in the river channel during the day and at night starting 45 min after sunset. Secchi visibility (cm) was measured at each station. Two types of plankton net configurations were used to collect larvae: (1) paired conical nets towed behind a 6.4-m boat equipped with an inboard engine and (2) paired push nets supported from a mount on the bow of a 4.8-m boat equipped with an outboard engine. The paired conical nets were 0.5 m in diameter constructed of 505-μm nitex mesh with a tail-to-mouth ratio of 5:1. These nets were towed against the current for 6 min in an oblique manner (i.e., raising the nets through the water column during the tow). The paired push nets were 0.5-m^2 and constructed of 505-μm nitex mesh with a tail to mouth ratio of 5:1. The nets were connected to an aluminum frame mounted on the bow of the boat and the nets could be lowered to sample 0.5-m below the surface. The surface nets were pushed for two minutes against the current to prevent the clogging of the nets with float-