AVAILIBILITY, CONSUMPTION AND PREFERENCE OF PREY IN JUVENILE STRIPED BASS *(Morone saxatilis)* IN THE HUDSON RIVER

A Final Report of the Tibor T. Polgar Fellowship Program

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Howe, D. and F. Juanes. 2001. Availibility, consumption and preference of prey in juvenile striped bass (*Morone saxatilis*). Section VI:23 pp. *In* J.R. Waldman & W.C. Nieder (eds.), Final Reports of the Tibor T. Polgar Fellowship Program, 2000. Hudson River Foundation.

ABSTRACT

Striped bass (*Morone* saxatilis) is ecologically and socially an important fish in the Hudson River. Understanding factors related to the growth and survival of the juvenile life stage is important because these factors ultimately influence recruitment. Feeding behavior is one such factor. Past studies of diet composition of juvenile striped bass in the Hudson River have not explored prey availability. We investigated prey consumption of striped bass young-of-the-year and benthic macroinvertebrate abundances at three Hudson River locations on two dates. Dipteran larvae (family Chironomidae), decapod shrimp (*Crangon septemspinosa* and *Palaemonetes* spp.), amphipods (Oedicerotidae and Gammaridae), and polychaete worms (*Nephtys* spp. were found to be the most important diet components, whereas oligochaete and polychaete worms, dipteran larvae, and isopods (*Cyathura polita*) were found to be the most abundant macroinvertebrates. Values of the niche overlap index indicated that prey consumption differed spatially and temporally; and feeding largely occurred during day versus night. Macroinvertebrate abundances tended to differ more widely on a spatial rather than a temporal scale. Analysis showed decapod shrimp and dipteran larvae to rank among the highest in diet preference. When decapod shrimp were not available, preference rankings were shuffled and amphipods were most preferred. Abundance, size, color, and behavior are possible factors in juvenile striped bass diet preference.

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INTRODUCTION

Striped bass are important economically, recreationally, and ecologically in the Hudson River. Presently, adult populations are high and are likely substantially impacting ecological interactions within the river. Understanding the factors influencing adult population abundance is vital both for managing striped bass and for predicting the species' impact on other organisms.

Important to recruitment into the adult stock is juvenile survival. Juvenile survival depends upon foraging success, diet quality, and ultimately, condition and growth (Werner et al. 1984). Predation by larger fish can be a major source of juvenile mortality. By growing faster, juvenile fish can decrease the risk of predation (Juanes and Conover 1994; Buckel et al.1999). In addition, faster growing juveniles may be better able to survive over winter (Hurst and Conover 1998). Thus, variation in juvenile foraging efficiency may affect year-class strength (Stevens et al. 1985) and recruitment.

The Hudson River estuary is an excellent environment for investigating juvenile striped bass feeding habits. Juveniles are abundant and integral in the trophic interactions (Rathjen and Miller 1957; Gardinier and Hoff 1982; Pace et al. 1993; Dunning et al. 1997; Buckel et al. 1999). The lower portion of the river, in particular, has been cited as an important nursery area (Dey 1981; McKown and Young 1992; Dunning et al. 1997).

Recently, young-of-the-year (YOY) striped bass diets have been investigated within the Haverstraw Bay region of the river (Jordan and Juanes 1999; Howe and Juanes 2000). Schmidt (1993) investigated juvenile striped bass feeding in Manitou marsh and found different diet compositions than found in the Haverstraw Bay studies. The spatial extents of these recent studies were limited, however, and none examined prey availability. These studies did reveal, however, that habitat differences are important when considering juvenile feeding. In other systems, habitat differences have been shown to affect striped bass growth rates (Wainwright et al. 1996) and may explain higher abundances in certain areas (Boynton et al. 1981).

Prey availability likely is an important parameter driving differences in habitat quality. Assessment of available prey frequently accompanies studies of larval striped bass survival (Limburg et al. 1999; Robichaud-LeBlanc et al. 1997; Bennet et al. 1995), probably because plankton tows are relatively simple additions to the methodology. Despite their importance as a prey base for juvenile striped bass, sampling of benthic and epibenthic fauna of estuaries is often difficult and is therefore infrequent. One exception for the Hudson River is Haley (1999) who used trawls and benthic grabs to explore invertebrate prey available for sturgeon. No work, however, has been conducted on prey availability for Hudson River juvenile striped bass.

Preference is defined as active selection of particular prey (Juanes 1994). Work in some systems has demonstrated that adult striped bass may show preference for certain prey components (Matthews et al. 1988; Stevens 1969), in contrast to the common view that adults feed opportunistically (Boynton et al. 1981). These contrasting views may be explained by habitat differences: the former studies were conducted in fresh water and the latter in an estuary. It is unknown whether Hudson River juveniles feed randomly or with preference. Knowledge of feeding mode may explain differences in feeding such as the near lack of amphipods found in the diets of Manitou Marsh striped bass YOY by Schmidt (1993), in contrast to their historical predominance as a prey item elsewhere (Howe and Juanes 2000; Jordan and Juanes 1999).

OBJECTIVES

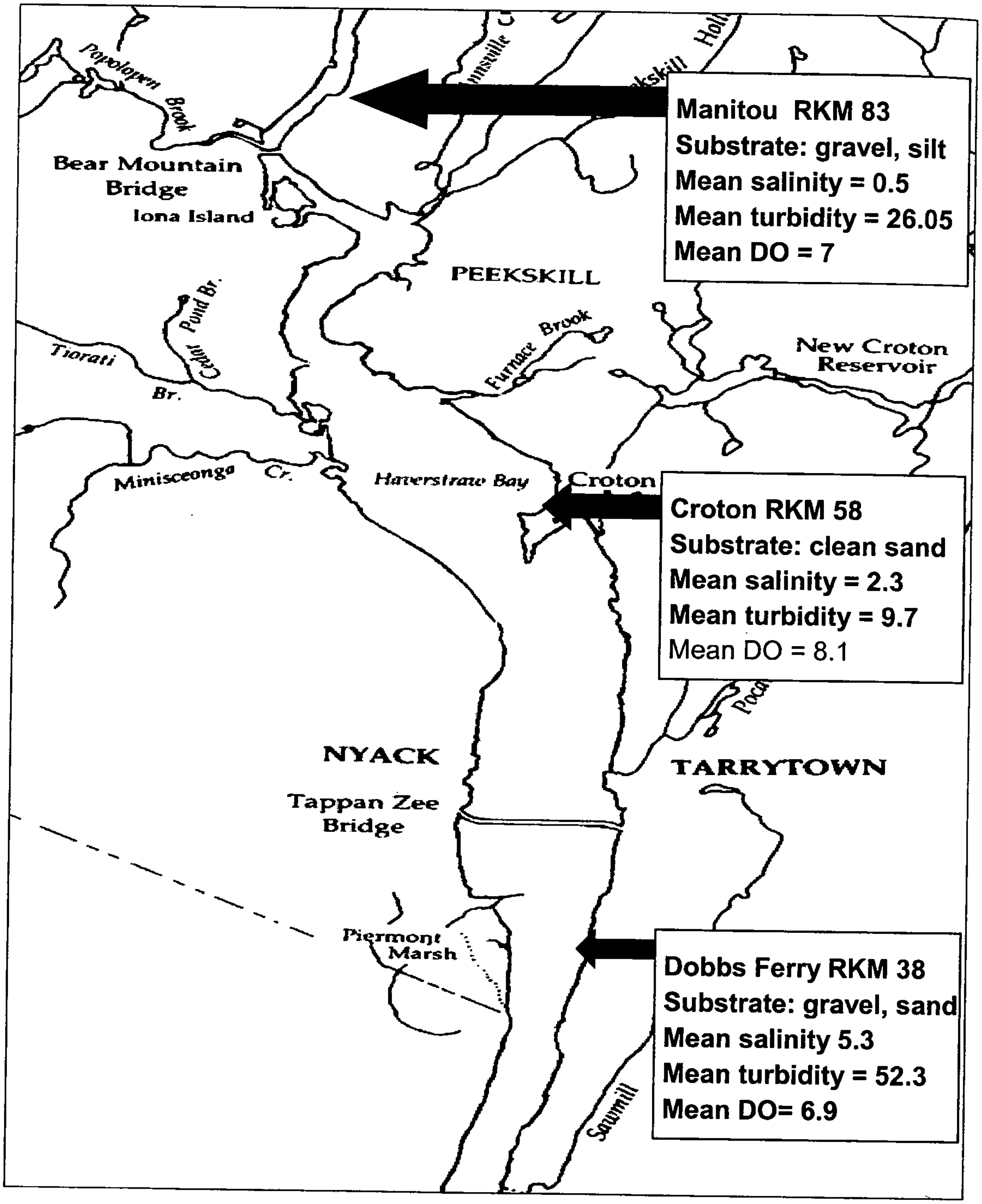
The objectives of this study were: (1) to compare feeding habits of YOY striped bass on diel and spatial scales; (2) to assess the invertebrate community available as prey; and (3) to investigate feeding preference with juvenile (young-of-the-year) striped bass in the Hudson River estuary.

METHODS

To accomplish these objectives, striped bass YOY and benthic macroinvertebrates were sampled in three locations within the Hudson River (Figure 1) estuary during two sampling events: July 31-August 1, and August 22-23. At each site, sampling occurred once during the day and once during the night.

Sites for this study were selected based on several criteria. First, we wanted to establish a somewhat greater spatial scale than used in previous studies (Howe and Juanes 1999). Second, despite this greater scale, the study needed to be confined to a region described as an important striped bass YOY nursery. Third, an attempt was made to maximize abiotic and biotic habitat differences. Fourth, approximately equal spacing between sites was deemed important. Finally, we needed shallow beaches with boat access and minimal obstructions for seining. The sites chosen include Dobbs Ferry in the south at approximately RKM 38, Croton Point at approximately RKM 58, and Manitou at approximately RKM 83 (Figure 1).

Figure 1: Map of the Hudson River indicating locations of the three sites used. Also indicated are physical conditions associated with the sites, including substrate composition, and salinity (ppt), turbidity (formazine turbidity units), and dissolved oxygen (DO, ppm) averaged over all visits.



Fish samples were taken at each site by a 50 m beach seine. An attempt was made to confine sampling to the lowest tide possible. The seine was either set by boat or by foot and was retrieved by hand. Seining continued until 5 hauls were completed or 30 juvenile striped bass were captured. All collected fish were identified to species and counted. Total length (TL), standard length (SL), and weight to 0.01 g were measured on location. Heads were removed and stored in ethanol to safely preserve otoliths for possible later analysis. The bodies of fish were placed in formalin to preserve stomach contents. In the laboratory, stomach contents were identified and an index of relative importance (IRI) was calculated (Hyslop 1980). This index is given by IRI = (%N + %WW) x %FO, where N= number of prey, WW= prey wet weight, and FO= prey frequency of occurrence. We also applied analysis of variance (ANOVA) to compare stomach fullness (the amount of prey divided by predator weight), SL among the sites and dates, and fish body condition. As a measure of condition we used Fulton's K, where $K = \text{weight}/(\text{length})^3$ (Busacker et al. 1990).

We computed diet overlaps between sites, dates, and diel phase using the simplified Morisita (Krebs 1989) index of niche overlap. This index compares a single pair of sites per calculation and is given by $M_{jk} = [2 \sum_{i-n} p_{ij}p_{ik}] / \sum_{i-n} p^2_{ij} + \sum_{i-n} p^2_{ik}$, where n = the total number of prey types used by striped bass at a given pair of sites; p_{ij}, p_{ik} = percent wet weight of prey type i for sites j and k, respectively. We deemed diet overlap "considerable" if the Morisita values exceeded 0.60 (Krebs 1989). The simplified Morisita index was also used to compare prey availability by site, date, and diel phase.

Prey availability data were collected concurrently with the fish sampling using a D-framed sampling net and a sand auger following the protocol designed by Hicks

(1999). Two methods were used to adequately capture the array of epibenthic and benthic fauna that is potential juvenile striped bass prey (Howe and Juanes 2000). Sampling locations were randomly assigned along transects (Figure 2). The D-net was swept along the surface of the substrate following three transects. The flow through the net was monitored to quantify surface area swept. Average substrate surface area sampled by three sweeps was 3.6 m^2.

The auger was twisted into the substrate to a maximum depth of 8 cm. Depth varied because of differences in substrate composition and compaction. Twelve auger cores were taken totaling 0.18 m^2 of substrate surface area sampled.

Figure 2: Fish and invertebrate sampling design. Auger core locations were randomly selected. Transects began at a randomly selected location and subsequent transects occurred in deeper water. Where space allowed, seining and invertebrate sampling areas were adjacent.