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Food Habits of Larval Splittail

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Introduction

Splittail, *Pogonichthys macrolepidotus*, a cyprinid endemic to the Sacramento-San Joaquin Delta, is now listed as threatened by the US Fish and Wildlife Service. The listing process prompted several studies, which have improved our understanding of the relationship between spilttail life history and their environment (Meng and Moyle 1995; Sommer and others 1997; DWR 1998). However, many important aspects of splittail early life history remain unknown. This study was initiated to provide information on the food habits of larval splittail. The objectives were (1) to describe the diet composition; (2) to determine the relative importance of specific prey items; and (3) to identify ontogenetic diet shifts occurring through the larval and early juvenile life stages.

Methods

Larval splittail were collected by the California Department of Fish and Game (DFG) 20-mm Survey and North Bay Aqueduct Larval Survey from February to July 1998 (hereafter, 20-mm and NBA). For the NBA, a 10-minute stepped-oblique tow from bottom to top was made at each station with an egg and larval net (505 micron mesh) mounted on a sled. Sampling stations are located in Cache Slough and some of its tributaries. Samples from the 20-mm survey are collected throughout the Delta in a similar manner, however with a 1600 micron mesh net. More specific information concerning the sampling methods for the 20-mm and NBA surveys can be found online at http://www.delta.dfg.ca.gov/. DFG also collected splittail with light traps on the Sutter Bypass, a floodplain of the Sacramento River. DFG personnel preserved all samples in 10% formalin and performed the larval fish identification.

The standard lengths of 141 preserved larval splittail were measured to the nearest 0.1 mm. Gut content analysis on the larvae was performed by first removing the entire digestive tract. Then, the section from the esophageal sphincter to the first 180° bend was examined. If an intestinal bend had not developed, the entire gut was examined. Contents were identified to the lowest practical taxon. Average prey length was determined by measuring up to ten individuals of each prey type. Dry weight estimates for each taxon were calculated from prey lengths, using regression equations from Sommer and others (2001).

To examine ontogenic diet shifts, larvae were divided into three arbitrary size-classes (≤8.9, 9.0 to 14.9, and ≥15.0). Diet for each size class was analyzed as an index of relative importance (IRI). The index was calculated as follows: IRI = (percent numeric composition + percent weight composition) x percent frequency of occurrence. Mean prey biomass and the percentage of larvae with empty guts was also calculated.

Results

Gut content analysis revealed that larval splittail fed primarily on cladocerans, (56% of diet by dry weight), chironomid larvae (40%) and copepods (4%). Rotifers comprised less than 1% of the diet by weight. Other items

encountered infrequently included diatoms, detritus and terrestrial insects.

Cladocerans (mostly *Daphnia*) were important components of all larval splittail size classes from the Sacramento-San Joaquin Delta (Figure 1). Chironomid larvae became a more important food item as splittail grew, whereas copepods (mostly cyclopoid copepodids) began to disappear from the diet. As larval splittail grew, their guts contained more prey biomass (Figure 2).

Roughly 30% of the larvae examined had no food in their guts (Table 1). The percentage of larvae with empty guts appears to be size dependent, with half (58%) of the empty guts occurring in the smallest size class.

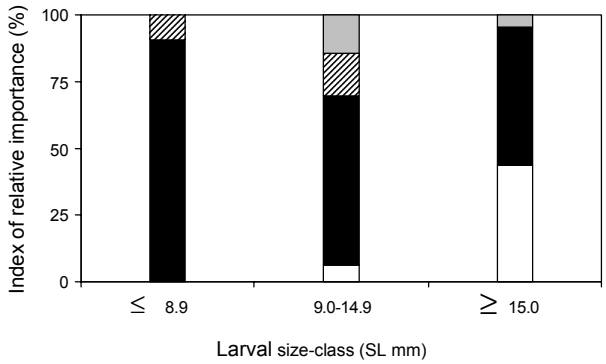

Figure 1 Larval splittail diet from March to July 1998 in Sacramento-San Joaquin Delta. Diet is reported as an index of relative importance (see text). Chironomidae larvae (open bars), Cladocera (solid bars), Copepoda (striped bars) and Rotifera (shaded bars) are displayed for each larval size-class. SL is standard length.

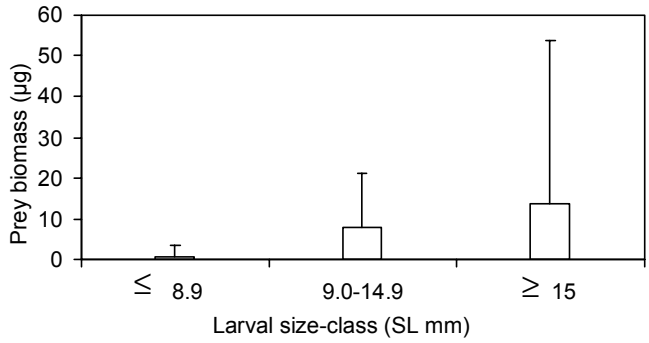

Figure 2 Feeding success of larval splittail from the Sacramento-San Joaquin Delta in 1998. Prey biomass is calculated from the estimated prey weight of gut contents. Mean and standard errors are shown.

Table 1 Percent of empty guts encountered per size-class of splittail larvae collected in the Sacramento–San Joaquin Delta between March and July 1998

Larval size class (SL, mm)	*Empty guts (%)*	*N*
≤ 8.9	50	38
9.0 to 14.9	22	23
≥ 15.0	16	50

Discussion

Diet Composition

Cladocerans and chironomid larvae were the dominant prey type of larval splittail, perhaps as a result of selective foraging or overall abundance. Without appropriate prey abundance data the distinction cannot be determined. Regardless of prey abundance, it appears larval splittail are precocial feeders able to consume a wide variety of prey types and sizes.

Diet Shifts with Larval Size

There was a size-related change in the diet of larval splittail. In general, as larvae increased in size, so did the size of their prey. This was likely a function of prey size and fish morphology, larger mouths enabling larvae to capture larger prey. Ontogenetic diet shifts have been reported for many other larval fish species (Goshorn and Epifanio 1991; Nobriga 1998). In larval cyprinids of the River Great Ouse, England, Garner (1996) found a similar shift from small prey (rotifers and diatoms) to larger cladocerans and chironomids.

There was a decrease in the number of empty guts with increasing size-class. The smallest larvae had higher proportions of small, rapidly digested prey, which may explain the higher frequency of guts without food (Sutela and Huusko 2000). Also small larvae have fewer prey to select from and are therefore more vulnerable to low prey abundances (Gadomski and Peterson 1988). Goshorn and Epifanio (1991) stated that due to possible factors such as inadequate food supply and relatively poorer foraging ability, it is likely younger weakfish larvae were less successful at obtaining food than older larvae.

Acknowledgements

This study would have not been completed if it were not for the valuable contributions of Ted Sommer, Randy Baxter and Zach Hymanson. Special thanks are also owed to the Department of Fish and Game, Central Valley Bay-Delta Branch. Funding was provided by the IEP.

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Fish Assemblage Structure and Associations with Environmental Variables in the Southern Sacramento-San Joaquin Delta

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Introduction

This article presents the preliminary results of a community analysis conducted on data collected as part of the South Delta Temporary Barriers Resident Fishes Monitoring Program. The monitoring program has been funded by DWR and implemented by DFG Bay-Delta since 1992 as part of the mitigation requirements for DWR's South Delta Temporary Barriers Program. This monitoring program was originally started to investigate the effects of the barriers on resident fishes but has developed into a useful tool for describing trends in fish communities of the south Delta. Mike Healey, formerly of DFG Bay-Delta, was instrumental in the collection of these data. I will be working with Mike to publish these results in a journal. My goals for this article are to (1) document faunal composition, including the status of native species, (2) determine the relative importance of environmental variables structuring fish assemblages, and (3) examine spatial and temporal (year-to-year) variation in fish assemblage structure within the south Delta.

Methods

Data Collection

Fishes were sampled in the south Delta over an eight-year period, 1992–1999. Initially, sampling was