Prey Selectivity of Juvenile Salmon on Neustonic Mesozooplankton in the Northern California Current

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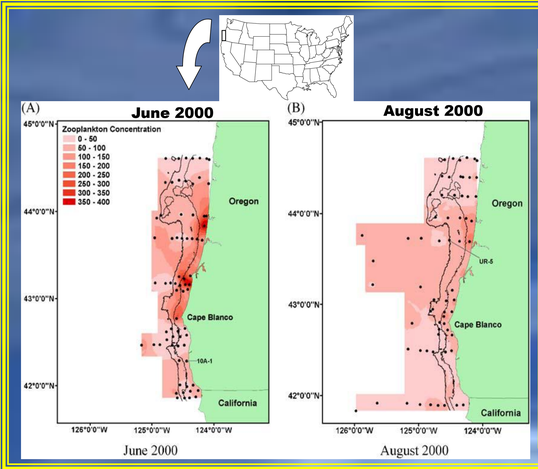
INTRODUCTION

Various factors could play a role in influencing early marine survival of juvenile salmon. One factor is availability of prey that salmon consume. Off the coast of Washington and Oregon, juvenile salmon tends to reside in the upper 20 m of the water column and feed primarily during daytime hours. Previous studies have indicated that juvenile coho salmon (*Oncorhynchus kisutch*) and Chinook salmon (*O. tshawytscha*) may be feeding in the neustonic layer (Brodeur 1989, Brodeur et al. 1987). In this study, we examined prey selectivity for four species of salmon (Chinook salmon (both subyearling and yearling), coho salmon, chum salmon (*Oncorhynchus keta*) and steelhead (*Oncorhynchus mykiss*)) by comparing stomach contents to concurrently sampled neustonic prey during four cruises off southern Oregon and northern California from cruises conducted in June and August of 2000 and 2002. We also compare size of prey consumed to those caught in the neuston sampler to examine the relative capture efficiency of the net to foraging juvenile salmon.



FIELD METHODS

Collections were made as part of GLOBEC salmon surveys during four cruises (June and August or 2000 and 2002) off Southern Oregon and Northern California (Pool and Brodeur 2006). To capture juvenile salmon, a Nordic 264 rope trawl was towed at the surface at 1.5 m/s for 30 min. Stomach contents were removed and then identified, measured, and enumerated to the lowest possible taxon. At stations where more than 30 individuals of a salmon species and age class were captured, at least 30 stomachs were processed. To collect potential prey of salmon, a neuston net was towed out of the ship's wake for 5 min. at approximately 1.0 m/s. The neuston net had a 1-m wide x 0.3-m high mouth and 333-µm mesh (Pool and Brodeur 2006, Reese et al. 2006).

DATA ANALYSIS

The Johnson's index (t_i) was chosen to examine prey selectivity of juvenile salmon (Johnson 1980). This index has the capability of using numeric proportion (%N), samples with zero counts, and exclusion of certain taxa such as digested fish tissue. The proportions were calculated from counts in stomach samples and concentrations in neuston samples. Next, prey in each stomach (i.e., usage) were ranked according to their %N (r_i). Ranks were also assigned to prey in each neuston sample (s_i; i.e., availability). The index is calculated as:

$$\bar{t}_i = \bar{r}_i - \bar{s}_i$$

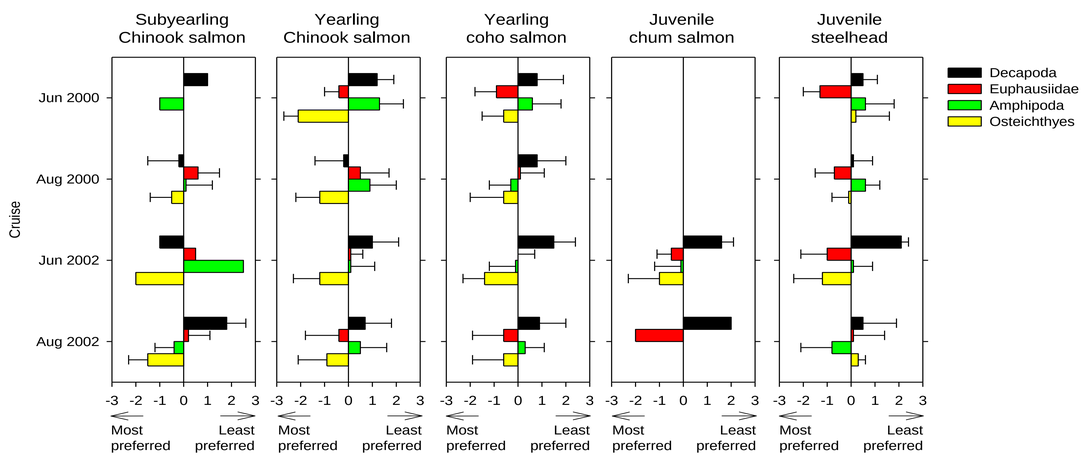
where the average t_i equals the difference between the average r_i and average s_i. The index number ranges from negative for the most preferred prey to positive for the least preferred prey. To examine feeding selectivity, twenty most dominant taxa by total %N were selected for each salmon species and age class. In the resulting lists of dominance, certain taxa were combined to enable comparison of prey in each sample type. In addition, taxa were removed if combining them into a higher taxonomic level would cause fine-scale loss in results at lower taxonomic levels.

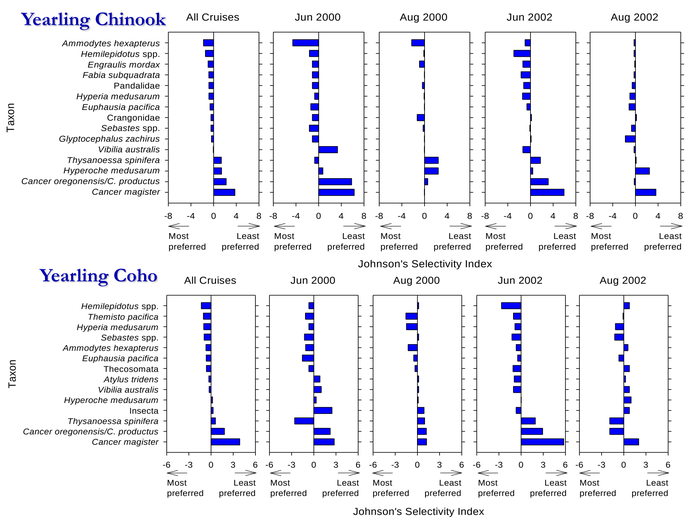
Data were input into a Resource Selection software (PREFER) version 5.1 to calculate the indices (Johnson 1980). The indices were examined with all cruises combined which was then compared with indices of each cruise for temporal trends.

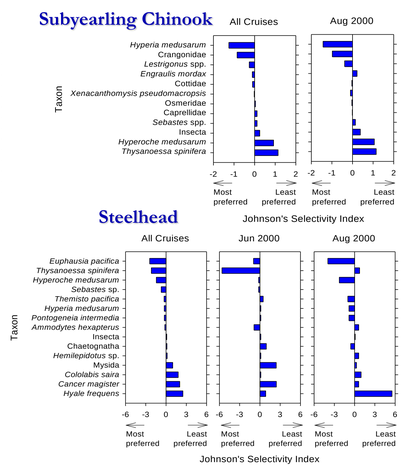
Length frequencies of prey in each sample type were analyzed to determine whether the neuston net captured the more frequently occurring sizes that juvenile salmon ingest.

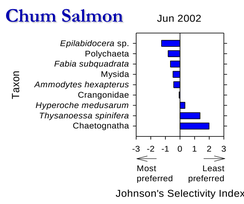
PREY SELECTIVITY

The surface trawling surveys collected samples from 366 stations, 127 of which captured juvenile salmon and had an accompanying neuston tow. Data from 717 stomachs of juvenile salmon were analyzed, and 695 of these stomachs contained prey. Juvenile salmon generally show a preference for fish and euphausiids over than decapods and amphipods although there was substantial variability by month and year .





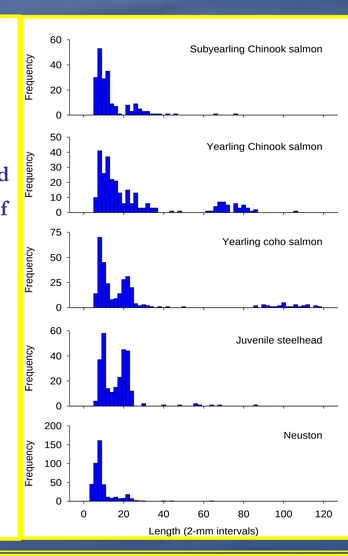




Analysis for individual prey or neuston taxa showed the same trends in selectivity with fish being most preferred for yearling Chinook, amphipods for subyearling Chinook, and both taxa for coho and steelhead along with euphausiids. Decapod larvae were negatively selected in most comparisons. Chum showed a preference for smaller prey such as copepods, polychaetes and small decapod larvae and a negative selection for euphausiids and chaetognaths.

PREY SIZE ANALYSIS

We also compared lengths of prey in stomachs with those in the neuston to determine whether prey size selection was occurring. Most salmon showed a similar bimodal distribution of prey lengths as found in the neuston sampler but yearling Chinook and coho salmon also consumed a larger mode of mostly fish prey that were not sampled by the neuston net, possibly due to their avoidance of the small mouth opening of the neuston net .



CONCLUSIONS

Although the neuston samples do not represent the full range of prey resources available to juvenile salmon as some prey are found only in subsurface layers, there has been a better correspondence between the neuston taxa and diets, especially for juvenile coho and Chinook salmon and steelhead, than with integrated bongo tows (Brodeur 1989, unpublished data). Based on the results of our analysis, prey are consumed in the following preference order: Osteichthyes>Euphausiidae>Amphipoda> Decapoda, for most species and life history types. Sand lance and sculpins appear to be particularly selected for and *Cancer* crab larvae selected against relative to their abundance in the neuston.

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