The Seasonal and Spatial Variability of Flatfish Feeding Habits on the Northeast US Continental Shelf: Preliminary Insights from Cooperative Research

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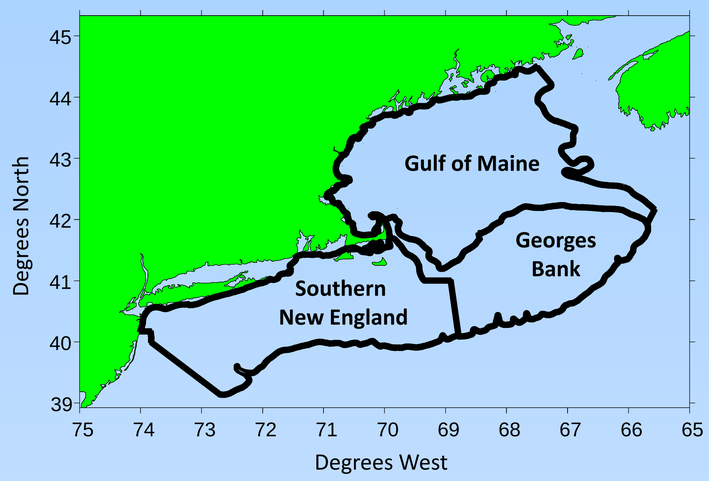
INTRODUCTION

The trophic ecology of flatfishes in the northwest Atlantic has been well documented for broad-sampling scales (e.g. by decades and geographic regions; see Link et al. 2002; Smith and Link 2010). However, few studies have examined the variability of flatfish feeding habits over bimonthly and geographic scales with the added benefit of processing samples exclusively in the laboratory.

The objectives of this study were to quantify the temporal and spatial differences in flatfish feeding habits for three species: summer flounder (*Paralichthys dentatus*), yellowtail flounder (*Limanda ferruginea*), and winter flounder (*Pseudopleuronectes americanus*) of the northeast US continental shelf.

The bulk of this work was made possible with the cooperation of the commercial fishing industry. Fishers supplying individual fish samples were participants in the NEFSC Cooperative Research Study Fleet Program and NEFSC Industry Cooperative Sweep Comparison Study.

Sampling Regions



METHODS

Data Collection

The field sampling for this study occurred between December 2009 and October 2010 in cooperation with the commercial fishing industry and the Massachusetts Division of Marine Fisheries. In each case, flatfish were obtained using bottom trawl gear and placed on ice for laboratory processing. The geographic regions sampled included the Gulf of Maine, Georges Bank, and Southern New England (figure left).

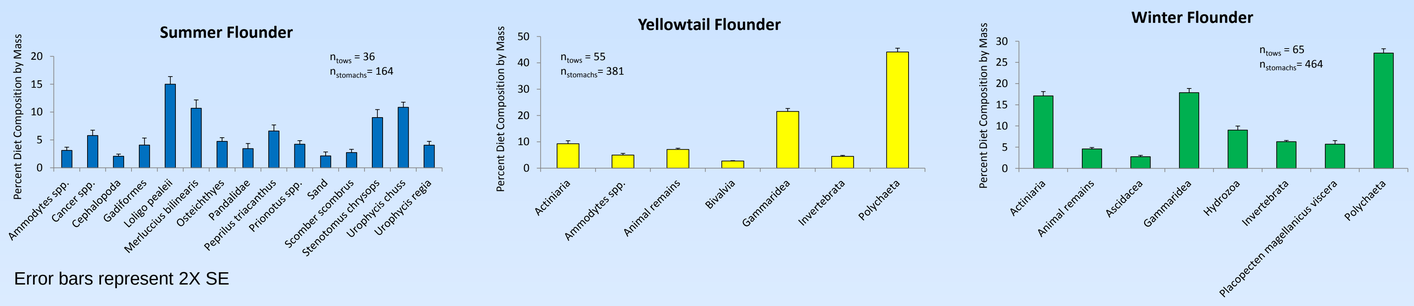
In the laboratory, individual fish lengths, weights (±0.1g), age structures, sex, various reproductive measures including maturity stage, GSI, and HSI, and bioelectrical impedance data were collected. A subset of individuals were sampled for food habits data. Stomach contents were identified to the lowest taxonomic level feasible and weighed (wet; ±0.001g).

Data Analysis

Diet Composition: A cluster sampling estimator for the contributions of each prey type was expressed as percent diet by weight across all factors (Bogstad et al. 1995; Latour et al. 2007).

Total Stomach Contents and Prey Variability: Total stomach content index (stomach weight standardized by predator weight). Mean total amounts per tow compared with one-way ANOVA (*F*: 9,999 permutations; geographic region and 2-month block [e.g. MAYJUN = May-June] as fixed effects). Variation in mean prey proportions per tow assessed with Principal Coordinate Analysis (PCO) in relation to geographic region and 2-month block factors. Tows with < 3 fish and cells containing < 2 tows were removed prior to analysis.

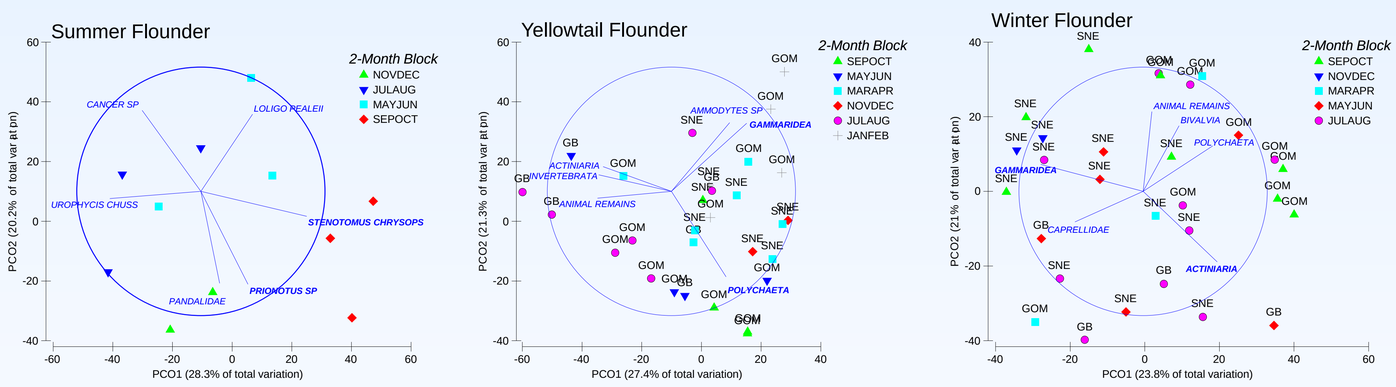
RESULTS: Diet Composition



Error bars represent 2X SE

- The feeding habits of summer flounder included squid (*L. pealeii*) and various fishes (e.g. silver hake [*M. bilinearis*], scup [*S. chrysops*], and red hake [*U. chuss*]).
- In contrast, yellowtail and winter flounders fed primarily on benthic invertebrates (i.e. polychaetes, gammarids, and sea anemones [Order: Actiniaria]).

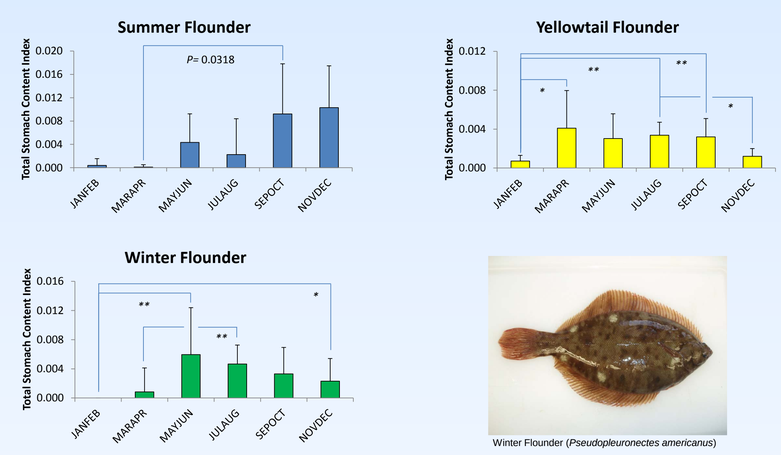
RESULTS: Prey Variability



- The bimonthly variability in prey for summer flounder was moderately explained by two taxa: scup (*S. chrysops;* primarily observed in SEPOCT), and searobins (*Prionotus* spp.; SEPOCT/NOVDEC).
- Interestingly, prey variability for yellowtail and winter flounder was largely driven by geographic region with gammarids, and polychaetes or sea anemones (Order: Actiniaria) explaining a large portion of the total variance (combined >45%). In Southern New England (SNE) and the Gulf of Maine (GOM), polychaetes and to a larger degree, gammarids dominated the diets of both flatfishes. On Georges Bank (GB), sea anemones and caprellids (winter flounder only) were prominent prey taxa.

RESULTS: Total Stomach Contents

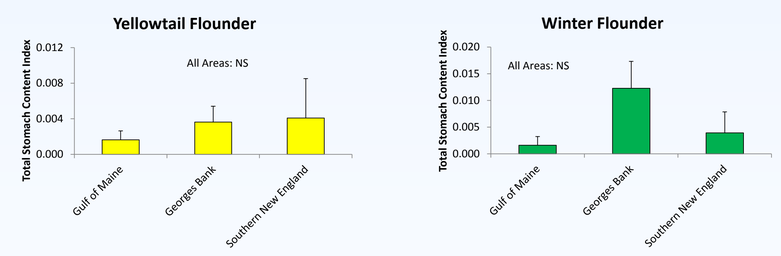
2-Month Block



Winter Flounder (*Pseudopleuronectes americanus*)

*P< 0.05; ** P< 0.01; NS= Not Significant
Error bars represent bootstrapped 95% CI

Geographic Region



- A significant bimonthly effect on the total amount of food consumed by flatfishes was present with greater amounts of food eaten SEPT-DEC for summer flounder, during the MAR-OCT period for yellowtail flounder, and MAY-OCT for winter flounder.
- Conversely, the effect of geographic region on total stomach content for yellowtail and winter flounder was not significant.

CONCLUSIONS

- Although bimonthly trends in total stomach contents were observed for all species, yellowtail and winter flounder diets were predominantly benthivorous; thus, their variability in diet compositions largely explained by geographic region. Bimonthly trends in summer flounder diet composition were evident, albeit, multiple geographic regions were not available to examine.
- This project highlights the benefits of sampling flatfish feeding habits on a finer temporal (bimonthly) scale particularly for summer flounder (highly piscivorous), and using in-lab stomach processing for benthic invertebrate feeders.
- Given the results shown here, future work will examine the interplay among flatfish diet, reproduction, and bioenergetics.

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