Dietary Overlap Between Bluefish (*Pomatomus saltatrix*), Weakfish (*Cynoscion regalis*), and Summer Flounder (*Paralichthys dentatus*) from the Inner Continental Shelf off the coast of New Jersey

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ABSTRACT

▪Bluefish (*Pomatomus saltatrix*), summer flounder (*Paralichthys dentatus*), and weakfish (*Cynoscion regalis*) were collected from the inner continental shelf off the coast of New Jersey for the purpose of a diet overlap study. This study is important because not much is known about the diets of these fish in this habitat and determining how these species partition their resources may help in management of the species. These fish were caught by otter trawl and then their stomachs were preserved in 10% formalin. Stomachs were then dissected and all prey contents were identified. The greatest number of weakfish and summer flounder were caught and therefore an in depth comparison was conducted for these species only. The majority of bluefish stomachs came from Aug/Nov of 2004. Dry weights of each individual prey item were recorded as well as its frequency of occurrence. Data was analyzed by looking at % weight that an individual prey item contributes to the diet of each species. Based on the data, it seems that there is overlap between weakfish (21-35cm) and smaller size (23-29cm) summer flounder, but not with weakfish with larger size (41-61cm) summer flounder, thus diet overlap for these species varies among species and with ontogeny. Bluefish did not overlap with weakfish or summer flounder.

INTRODUCTION AND RATIONALE

▪The landings of bluefish have declined consistently since the early 1980s (Klein-MacPhee 2002). Over this same time period, striped bass stocks have rebounded. Commercial and recreational landings of weakfish have steadily been on the decline since the 1980s (NOAA Chesapeake Bay Office, unpublished data 2005). Summer flounder populations have experienced fluctuations in the past few decades. Why is this happening? The degree of biotic interactions among these four important species across habitats remains unclear. This project will provide information that could help answer this question.

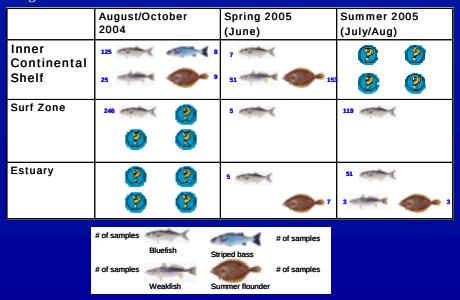
▪Bluefish are marine piscivorous predators that are found throughout the world. They are a migratory species that range off the Atlantic coast from the coast of Nova Scotia to Florida. Bluefish primarily feed on fish. They typically eat bay anchovies (*Anchoa mitchilli*), Atlantic menhaden (*Brevoortia tyrannus*), spot (*Leiostomus xanthurus*), and Atlantic silversides (*Menidia menidia*) (Harding and Mann 2001).

▪Weakfish are found off the Atlantic Coast from Nova Scotia to Florida. Weakfish also primarily feed on other fish. The types of prey it feeds on include: mysids, bay anchovies, Atlantic menhaden, and spot.

▪Summer flounder are found in estuarine and coastal waters from Nova Scotia to Florida. Smaller summer flounder typically eat shrimp and other crustaceans. Larger fish eat: Atlantic menhaden, red hake (*Urophycis chuss*), Atlantic silversides, bluefish, weakfish, and mummichogs (*Fundulus heteroclitus*).

▪My project will focus on an evaluation of the diets of these three species of fish through the process of a stomach content analysis. This analysis will show what the fish are eating and provide an estimation of dietary overlap among the species which will help determine the importance of competition on specific prey items. Bluefish samples for this project were collected from August and November of 2004. Summer flounder and weakfish samples for this project were collected from June 2005.

Fig. 1- Distribution of fish



METHODS

▪The fish for this experiment were collected from the inner continental shelf off the coast of New Jersey from an area of 4600 km2 (Fig. 7) from the entrance of the New York Harbor to the entrance of the Delaware Bay. Fish were collected with an otter trawl net (Picture 2) aboard the R/V Seawolf (Picture 1). One tow with duration of 20 minutes was conducted at each site. The otter trawl net used is 12-cm, 3-mm Euroline and 8-cm, 3-mm braided poly hung on ¾" tenex at the top and bottom. Target species were taken from the catch (Picture 3,4) and their stomachs removed (Picture 5).

▪Fish were also collected from two other habitats. These habitats are the surf-zone and estuary. Fig. 1 shows that there were not enough samples for a productive comparison in June. Therefore because we caught a large number of weakfish and summer flounder from the inner continental shelf, an in depth comparison was conducted for these samples only.

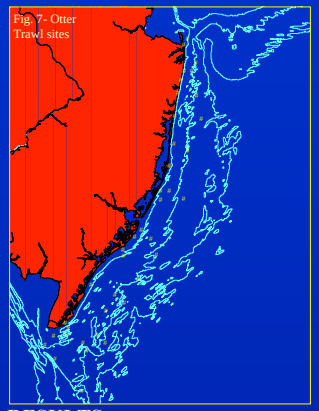
▪Fish caught were measured to the nearest 1.0 mm for length. Bluefish, weakfish, and summer flounder stomachs were carefully removed and anything remaining in the esophagus placed in a "whirl" pack (Picture 6, 7, 8) with 10% formalin to preserve the contents. Back at the lab the stomachs were examined individually (Picture 9). Stomach contents were examined under a dissecting microscope (Picture 10) to identify prey types. The prey types were identified to the lowest possible taxonomic unit. Recent studies have shown that unless there is a specific need for identification to species, higher taxonomic levels of identification are adequate to produce the most useful data per unit time invested (Nielsen and Johnson 1983).

▪The contents were sorted by type of prey item and then placed on separate preweighed aluminum foil pans (larger prey items) and filter papers (smaller prey items) (Picture 11, 12). Dry weights were measured on an electronic balance for each sample (prey category) after 48 hrs to ensure a constant weight (Nielsen and Johnson 1983).

▪ Diet overlap was analyzed to give a quantitative description of the diet in two ways. The two values found in this study were frequency of occurrence (Fig. 2) and percent composition by weight (Fig. 3,4,5).

▪ A calculation of niche overlap was also calculated for weakfish vs. summer flounder (Fig. 6). This was found by a calulation known as Schoener's index. The formula is $C(xy) = 1 - 0.5(\sum |p(xi) - p(yi)|)$, where p(xi) and p(yi) are proportions that a given prey species occurs (Schreck and Moyle 1990).

Fig. 7- Otter Trawl sites



RESULTS

▪ Out of 66 weakfish (otter trawl), 46 had contents. Of 160 summer flounder (otter trawl), 104 had contents.

▪The most common prey items found in weakfish were mysid shrimp. For summer flounder it was sand lance, crangon shrimp, and squid. For bluefish the most common prey item was anchovy (Fig. 1).

▪ Percent composition by weight data suggests the relative importance of individual food types in the nutrition of the fish (Nielsen and Johnson 1983). Based on this for summer flounder (23-29cm) crangon shrimp is the most important food item. For 30-40cm summer flounder the most important food item seems to be sand lance. Lastly, for the 41-61cm summer flounder the item of most importance is the squid. For the weakfish, the most important prey item was the mysid shrimp and for the bluefish it was anchovy.

▪Schoener's index gives a value of overlap of two species in a niche with a 0 being their diets do not overlap at all and a 1 meaning their diets completely overlap. Based on this Fig. 5 shows that weakfish overlap with smaller flounder but not so much with the larger flounder. Also, the two larger classes of flounder in this study show the highest level of overlap.

Fig. 8 Prey items

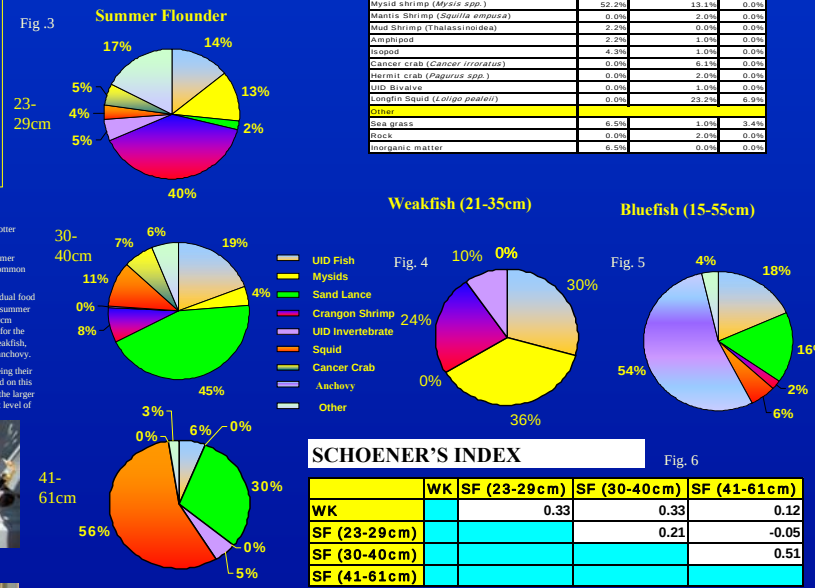
FREQUENCY OF OCCURENCE

Fig. 2

Prey Items	Weakfish	Summer flounder	Bluefish
Pisces			
UID Fish	47.8%	32.3%	34.5%
Anchovy (*Anchoa spp.*)	0.0%	3.0%	62.1%
Sand Lance (*Ammodytes hexapterus*)	0.0%	30.3%	17.2%
Windowpane flounder (*Scpothalmus aquosus*)	8.7%	0.0%	0.0%
Butterfish (*Peprilus triacanthus*)	0.0%	1.0%	6.9%
Jack (*Caranx spp.*)	0.0%	0.0%	3.4%
Lookdown (*Selene vomer*)	0.0%	0.0%	3.4%
Invertebrates			
UID Invertebrates	26.1%	12.1%	0.0%
Shrimp (*Crangon septemspinosa*)	39.1%	34.3%	3.4%
Mysid shrimp (*Mysis spp.*)	52.2%	13.1%	0.0%
Mantis Shrimp (*Squilla empusa*)	0.0%	2.0%	0.0%
Mud Shrimp (Thalassinoidea)	2.2%	0.0%	0.0%
Amphipod	2.2%	1.0%	0.0%
Isopod	4.3%	1.0%	0.0%
Cancer crab (*Cancer irroratus*)	0.0%	6.1%	0.0%
Hermit crab (*Pagurus spp.*)	0.0%	2.0%	0.0%
UID Bivalve	0.0%	1.0%	0.0%
Longfin Squid (*Loligo pealeii*)	0.0%	23.2%	6.9%
Other			
Sea grass	6.5%	1.0%	3.4%
Rock	0.0%	2.0%	0.0%
Inorganic matter	6.5%	0.0%	0.0%

DIET COMPOSITION BY % WEIGHT

Fig .3



SCHOENER'S INDEX

Fig. 6

	WK	SF (23-29cm)	SF (30-40cm)	SF (41-61cm)
WK		0.33	0.33	0.12
SF (23-29cm)			0.21	-0.05
SF (30-40cm)				0.51
SF (41-61cm)				

Picture 1

Picture 2

Picture 3

Picture 4

Picture 5

Picture 6

Picture 7

Picture 8

Picture 9

Picture 10

Picture 11

Picture 12

CONCLUSIONS:

▪The three species overlap at various times and habitats, and share some common prey items

▪Summer flounder showed clear ontogenetic shifts in diet

▪In summary, on the inner continental shelf, weakfish diets overlapped with the smallest size class of summer flounder, but less with larger sizes. There is little overlap between bluefish and the other two species.

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