

# 10-Offshore Borrow Area Fish Food Habits

## Introduction

The relative value of foraging habitats within the vicinity of the offshore borrow areas are examined with respect to potential impacts from the sand dredging operations. Comparisons of potential trophic support are made between pre-, during and post-dredging benthic results. The baseline study of offshore fish food habits established that winter flounder, *Pleuronectes americanus*, summer flounder, *Paralichthys dentatus*, and scup, *Stenotomus chrysops*, were the most common fishes occurring near the borrow areas for which potential food habits impacts could be assessed (Chapter 10, USACE 1998). Analyses revealed that small winter flounder fed primarily upon polychaetes (mainly large lumbrinerids), anthozoans (mainly cerianthid anemones, cf. *Ceriantheopsis americanus*) and bivalve siphons. Bivalve siphons were especially common in larger winter flounder. Summer flounder captured at the borrow areas fed on amphipods, squid, fishes and several large crustaceans, such as stomatopods and brachyurans. The diet of scup was similar to that of winter flounder, consisting primarily of polychaetes, anthozoans, amphipods, isopods and crangonid parts.

Comparisons of individual prey taxa contributions to the diet and the total benthos can be augmented to better determine whether limitations to prey availability occur. Based on this approach, benthic infauna and stomach contents are divided into standardized size fractions. An assumption is made that a fish of a certain size class can only capture and ingest prey of a certain size range, i.e. not too large or too small. The biomass distribution of prey items is compared with biomass measures from the benthic samples which allows evaluations of the relative value of the borrow sites as potential foraging areas for fishes.

The infaunal diet of winter flounder and their abundance in all three borrow areas make the food habits of this species of special interest for the purposes of this study. Winter flounder are considered omnivorous visual predators (Frame 1973) that feed opportunistically on benthos. For example, juvenile winter flounder fed almost exclusively on benthic amphipods that form extensive mats on bottom habitats within Jamaica Bay (Franz and Tanacredi 1992). Little information is available concerning how changes to benthic communities affect winter flounder feeding habits. Steimle et al. (1993) present the most relevant information relating how the cessation of sewage sludge disposal at an offshore site in the New York Bight Apex affected the diet of winter flounder. In that study, the diets of winter flounder reflected subtle changes in the benthic community following the cessation of disposal. This report investigates whether shifts in prey types or the size classes of prey consumed occurred either during (1997) or following (1998 and 1999) the offshore dredging operation. Such an occurrence may indicate how these fish species respond to disturbances to the benthic infaunal community.

Table 10-1. Summary of taxonomic composition of the stomach contents of winter flounder collected at the New Jersey offshore borrow areas in spring 1995. Table values are percentages of total wet weights of pooled samples within winter flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

Borrow Area	BBA3				BBA5				BBA6			
	10-15.	15-20	20-25	25-30	10-15	15-20	20-25	25-30	10-15	15-20	20-25	25-30
<b>Prey Taxon</b>												
Anthozoa	32.2	63.3	51.9	91.6	30.6	74.1	90.4	97.0	35.9	50.6	96.5	75.7
Nemertea		1.8	0.3				0.2					0.1
Polychaeta	60.6	32.2	46.0	8.0	47.6	19.4	8.9	2.6	58.4	46.5		3.9
Bivalvia			0.1	0.1			tr	tr	0.1			tr
Cephalopoda						1.4						
Brachyura		0.2	0.1	tr				tr			2.9	
Tanaidacea		tr					tr		0.2			
Cumacea		0.2						tr	tr			
Copepoda							tr	0.1				
Amphipoda	1.07	0.4	0.3	0.2	5.37	1.6	0.2	0.1	2.9	2.1		0.1
Isopoda	6.14	1.9	1.2	0.1	5.36	3.4	0.3	0.2	2.4	0.5		tr
Insecta											0.5	
Echinodermata		0.1	0.1	tr			tr			0.4	0.2	
Vertebrata												0.1
Unidentified				tr	11.15	1.6		tr	tr			19.6
<b>Prey Sieve Size</b>												
0.5	11.7	6.1	21.1	5.7	10.2	7.5	5.4	3.8	5.1	3.7	91.2	6.4
1.0	9.6	5.0	32.1	6.7	15.2	8.8	10.7	1.3	9.6	7.1	5.5	1.1
2.0	17.9	7.8	2.4	11.7	21.5	34.9	11.4	1.5	22.1	18.9	0.7	1.3
3.35	28.8	29.2	5.1	4.7	23.6	30.9	8.9	11.7	30.1	25.2	2.2	8.3
6.35	32.0	51.9	39.3	71.2	29.6	17.9	63.6	81.7	33.2	45.1	0.5	83.0
<b>Sample size</b>	30	72	152	129	7	10	62	123	50	18	40	53
<b>Wt/Stomach</b>	0.17	0.49	0.31	3.05	0.38	0.40	2.09	1.07	0.30	0.84	0.13	6.07

**Appendix Table 10-1. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.** Taxa within each taxonomic level are listed in order of relative abundance.

<b>Winter Flounder (Size Class II)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Anemones	<i>Ceriantheopsis americana</i>		<i>Ceriantheopsis americana</i>		
Amphipod	<i>Unciola irrorata</i>		<i>Unciola irrorata</i>		
	<i>Ameroculoldes edwardsi</i>				
Isopod	<i>Edotia triloba</i>		<i>Edotia triloba</i>		
			<i>Idotea balthica</i>		
Cumacea			<i>Pseudoleptocuma minor</i>		
Polychaete	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>	<i>Asabellides oculata</i>
	<i>Asabellides oculata</i>		<i>Asabellides oculata</i> ,	<i>Spiophanes bombyx</i>	<i>Nephtys picta</i>
	<i>Nephtys picta</i>		<i>Nephtys picta</i>	Polynoidae (LPIL)	
	<i>Stenalais limicola</i>		Polynoidae (LPIL)	<i>Aricidea (LPIL)</i>	
	Maldanidae (LPIL)		Maldanidae (LPIL)	<i>Asabellides oculata</i>	
			<i>Spiochaetopterus oculatus</i>		
Bivalve			<i>Tellina agilis</i>		
			<i>Nucula proxima</i>		

**Appendix Table 10-2. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.** Taxa within each taxonomic level are listed in order of relative abundance.

<b>Winter Flounder (Size Class III)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Anemones	<i>Ceriantheopsis americana</i>		<i>Ceriantheopsis americana</i>		
Crab	<i>Emerita talpoida</i>				
			<i>Pagurus longicarpus</i>		
Shrimp					<i>Crangon septemspinosa</i>
Amphipod	<i>Unciola irrorata</i>	<i>Aeginina longicornis</i>	<i>Unciola irrorata</i>		
	<i>Ameroculoldes edwardsi</i>		<i>Rhepoxynius hudsoni</i>		
			<i>Stenothoe minuta</i>		
Isopod	<i>Edotia triloba</i>	<i>Edotia triloba</i>	<i>Edotia triloba</i>		<i>Edotia triloba</i>
Cumacea	<i>Pseudoleptocuma minor</i>		<i>Pseudoleptocuma minor</i>		
Insect					Diptera (LPIL)
Polychaete	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>		<i>Scoletoma acicularum</i>
	<i>Stenalais limnicola</i>	<i>Asabellides oculata</i>	<i>Asabellides oculata</i>		<i>Nephtys picta</i>
	Maldanidae (LPIL)	<i>Nephtys picta</i>	<i>Pherusa affinis</i>		<i>Pherusa affinis</i>
		Maldanidae (LPIL)	<i>Spiophanes bombyx</i>		<i>Asabellides oculata</i>
			Cirratulidae (LPIL)		
			Phylloducidae (LPIL)		
			<i>Pectinaria gouldii</i>		
Bivalve			<i>Macoma (LPIL)</i>		
			<i>Tellina agilis</i>		
			<i>Nucula proxima</i>		

**Appendix Table 10-3. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.** Taxa within each taxonomic level are listed in order of relative abundance.

<b>Winter Flounder (Size Class IV)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Anemones		<i>Ceriantheopsis americana</i>	<i>Ceriantheopsis americana</i>		
Crab		Majid			
Shrimp			<i>Crangon septemspinosa</i>		
Stomatopod		<i>Platysquilla enodis</i>			
Amphipod	<i>Unciola irrorata</i>	<i>Unciola irrorata</i>	<i>Unciola irrorata</i>		
			<i>Rhepoxynius hudsoni</i>		
			<i>Stenothoe minuta</i>		
Isopod	<i>Edotia triloba</i>	<i>Edotia triloba</i>	<i>Edotia triloba</i>		<i>Edotia triloba</i>
Cumacea			<i>Pseudoleptocuma minor</i>		
Polychaete	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>		<i>Scoletoma acicularum</i>
	<i>Pherusa affinis</i>	<i>Pherusa affinis</i>	<i>Pherusa affinis</i>		Maldanidae (LPIL)
	Maldanidae (LPIL)	Maldanidae (LPIL)	Maldanidae (LPIL)		<i>Nephtys picta</i>
	<i>Stenolais limicola</i>	Cirratulidae (LPIL)	Cirratulidae (LPIL)		<i>Asabellides oculata</i>
		Terebellidae (LPIL)	<i>Stenolais limicola</i>		<i>Pherusa affinis</i>
		<i>Nephtys picta</i>			<i>Stenolais limicola</i>
		<i>Asabellides oculata</i>			
Bivalve			<i>Tellina agilis</i>		

**Appendix Table 10-4. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.** Taxa within each taxonomic level are listed in order of relative abundance.

<b>Winter Flounder (Size Class V)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Anemone	<i>Ceriantheopsis americana</i>	<i>Ceriantheopsis americana</i>	<i>Ceriantheopsis americana</i>		
Stomatopod		<i>Platysquilla enodis</i>			
Amphipod	<i>Unciola irrorata</i>	<i>Unciola irrorata</i>	<i>Unciola irrorata</i>		
	<i>Aeginina longicornis</i>	<i>Aeginina longicornis</i>	<i>Stenothoe minuta</i>		
		<i>Rhepoxynius hudsoni</i>			
		Haustoriidae (LPIL)			
Isopod	<i>Edotia triloba</i>	<i>Edotia triloba</i>	<i>Edotia triloba</i>		<i>Edotia triloba</i>
Cumacea	<i>Pseudoleptocuma minor</i>		<i>Pseudoleptocuma minor</i>		
Polychaete	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>	<i>Scoletoma acicularum</i>		<i>Scoletoma acicularum</i>
	<i>Pherusa affinis</i>	<i>Pherusa affinis</i>	Cirratulidae (LPIL)		<i>Pherusa affinis</i>
	Cirratulidae (LPIL)	<i>Asabellides oculata</i>	Phylloducidae (LPIL)		<i>Asabellides oculata</i>
	Maldanidae (LPIL)	<i>Maldanidae (LPIL)</i>			
	<i>Stenalais limicola</i>				
Bivalve			<i>Tellina agilis</i>		

<b>Appendix Table 10-5. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.</b> Taxa within each taxonomic level are listed in order of relative abundance.					
<b>Winter Flounder (Size Class VI)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Anemone		<i>Ceriantheoposis americana</i>			
Crab		<i>Pagurus longicarpus</i>			<i>Cancer irroratus</i>
Shrimp		<i>Crangon septemspinosa</i>			
Amphipod		<i>Unciola irrorata</i>			
		<i>Rhepoxynius hudsoni</i>			
		<i>Aeginina longicornis</i>			
Isopod		<i>Edotia triloba</i>	<i>Edotia triloba</i>		
		<i>Chirodotea tuftsii</i>			
Polychaete		<i>Scoletoma acicularum</i>			
		<i>Pherusa affinis</i>			
		<i>Nephtys picta</i>			
Bivalve					<i>Nucula proxima</i>

**Appendix Table 10-6. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.** Taxa within each taxonomic level are listed in order of relative abundance.

<b>Winter Flounder (Size Class VII)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Anemone		<i>Ceriantheopsis americana</i>	<i>Ceriantheopsis americana</i>		
Crab		<i>Pagurus longicarpus</i>			
Amphipod		<i>Unciola irrorata</i>			
		<i>Aeginina longicornis</i>			
Isopod		<i>Edotia triloba</i>			
Polychaete		<i>Scoletoma acicularum</i>			
		<i>Nephtys picta</i>			



**Appendix Table 10-7. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.** Taxa within each taxonomic level are listed in order of relative abundance.

<b>Summer Flounder (Size Class II)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Stomatopod			<i>Platysquilla enodis</i>		
<b>Summer Flounder (Size Class III)</b>					
Crab	<i>Cancer irroratus</i>				<i>Cancer irroratus</i>
Amphipod	<i>Gammarus annulatus</i>				
Polychaete					<i>Asabellides oculata</i>
<b>Summer Flounder (Size Class IV)</b>					
Crab	<i>Cancer irroratus</i>		<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>
Shrimp				<i>Crangon septemspinosa</i>	
Stomatopod	<i>Platysquilla enodis</i>		<i>Platysquilla enodis</i>		
Amphipod	<i>Gammarus annulatus</i>		<i>Unciola irrorata</i>		
Mysid	<i>Mysidopsis bigelowi</i>				
Polychaete					<i>Asabellides oculata</i>
Squid	<i>Loligo pealeii</i>				<i>Loligo pealeii</i>
Bivalve			<i>Nucula proxima</i>		
Crab	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>
				<i>Pagurus longicarpus</i>	
Shrimp		<i>Crangon septemspinosa</i>		<i>Crangon septemspinosa</i>	<i>Crangon septemspinosa</i>
Stomatopod		<i>Squilla empusa</i>		<i>Platysquilla enodis</i>	
Amphipod	<i>Gammarus annulatus</i>	<i>Gammarus annulatus</i>		<i>Gammarus annulatus</i>	<i>Gammarus annulatus</i>
Mysid		<i>Neomysis americana</i>			
Squid	<i>Loligo pealeii</i>	<i>Loligo pealeii</i>		<i>Loligo pealeii</i>	<i>Loligo pealeii</i>

**Appendix Table 10-8. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.** Taxa within each taxonomic level are listed in order of relative abundance.

<b>Summer Flounder (Size Class VI)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Anemone			<i>Ceriantheopsis americana</i>		
Crab	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>
Shrimp		<i>Crangon septemspinosa</i>	<i>Crangon septemspinosa</i>	<i>Crangon septemspinosa</i>	<i>Crangon septemspinosa</i>
Amphipod	<i>Gammarus annulatus</i>	<i>Gammarus annulatus</i>			
Mysid		<i>Neomysis americana</i>			
Polychaete		<i>Nephtys picta</i>	<i>Scoletoma acicularum</i>		
Squid	<i>Loligo pealeii</i>	<i>Loligo pealeii</i>		<i>Loligo pealeii</i>	<i>Loligo pealeii</i>
Bivalve				<i>Spisula solidissima</i>	<i>Nucula proxima</i>
<b>Summer Flounder (Size Class VII)</b>					
Crab		<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>	<i>Cancer irroratus</i>
Amphipod		<i>Gammarus annulatus</i>			
Squid		<i>Loligo pealeii</i>	<i>Loligo pealeii</i>	<i>Loligo pealeii</i>	<i>Loligo pealeii</i>
Mysid		<i>Neomysis americana</i>			
Shrimp			<i>Crangon septemspinosa</i>		
Isopod					<i>Edotia triloba</i>

**Appendix Table 10-9. Taxonomic Identifications of Offshore Borrow Area Fish Food Habits.** Taxa within each taxonomic level are listed in order of relative abundance

<b>Scup (Size Class I)</b>					
<b>Taxon</b>	<b>1995</b>	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>
Crab					<i>Pagurus longicarpus</i>
					Megalopal Stage Larvae
Shrimp					<i>Crangon septemspinosa</i>
Amphipod					<i>Gammarus annulatus</i>
Isopod					<i>Edotia triloba</i>
Polychaete					<i>Stenalais limicola</i>
					<i>Nepthys bucera</i>
					<i>Asabellides oculata</i>
					<i>Glycera (LPIL)</i>
					<i>Scoletoma acicularum</i>
					Cirraulidae (LPIL)
					<i>Pherusa affinis</i>
					Maldanidae (LPIL) ,
					Phllyoducidae (LPIL)
					<i>Drilonereis longa</i>
<b>Scup (Size Class II)</b>					
Shrimp					<i>Crangon septemspinosa</i>
Isopod					<i>Edotia triloba</i>
Amphipod					<i>Gammarus annulatus</i>
Crabs					<i>Pagurus longicarpus</i>
Polychaete					<i>Stenalais limicola</i>
					<i>Scoletoma acicularum,</i>
					Maldanidae (LPIL)
					<i>Pherusa affinis</i>
					<i>Nepthys bucera,</i>
					Orbiniidae (LPIL)
					Paraoniidae (LPIL)
					Cirratulidae (LPIL)
					Phylloducidae (LPIL)
<b>Scup (Size Class III)</b>					
Polychaete					<i>Stenalais limicola</i>

Table 10-2. Summary of taxonomic composition of the stomach contents of winter flounder collected at the New Jersey offshore borrow areas in spring 1996. Table values are percentages of total wet weights of pooled samples within winter flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

Borrow Area	BBA3					BBA5					BBA6				
	15-20	20-25	25-30	30-35	>35	15-20	20-25	25-30	30-35	>35	10-15	15-20	20-25	25-30	>35
<b>Prey Taxon</b>															
Anthozoa	93.0	87.4	71.7	76.6	87.2	68.7	76.6	83.5	80.6	84.2	48.6	68.6	59.5	67.7	86.4
Nemertea		0.6	0.2					0.4	0.8				2.1	0.9	1.4
Polychaeta	6.2	13.8	7.1	5.8		26.9	2.5	5.1	3.9			5.3	11.1	6.5	7.4
Bivalvia		0.1	tr	tr	0.1				0.2			tr	tr	0.1	0.1
Gastropoda															tr
Brachyura		tr												0.1	0.4
Crangonid											0.2		tr	0.1	
Cumacea												tr		tr	
Copepoda						1.0			tr						
Amphipoda	0.1	0.1	tr	0.5		2.0	0.1	tr	tr	0.1	0.1	0.1	0.1	0.1	1.3
Isopoda	0.8	0.2	0.1	0.1	0.1	1.3	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.2	tr
Stomatopoda		0.5	tr												
Insecta			tr												
Echinoidea													tr		
Tunicata		tr									2.4	7.7	6.0	3.1	
Unidentified			20.9	17.4	12.1		20.8	11.0	14.4	15.6	50.8	23.5	19.5	18.5	
<b>Prey Sieve Size</b>															
0.5	2.4	7.3	3.9	5.2	6.0	5.2	3.8	2.1	3.9	2.5	8.0	11.6	5.6	7.1	0.4
1.0	4.7	3.3	2.5	2.7	3.8	8.2	3.9	2.0	2.8	1.4	11.8	15.4	4.3	4.8	0.3
2.0	5.2	1.2	1.5	0.5	5.0	2.8	3.7	1.7	3.0	1.3	14.9	7.5	1.5	1.6	0.8
3.35	20.0	2.4	5.0	0.8	14.0	17.4	23.5	6.8	11.4	2.3	29.9	23.1	2.9	4.2	1.8
6.35	67.7	85.7	87.0	90.9	71.3	66.4	65.1	87.4	78.9	92.6	35.4	42.3	85.8	82.3	96.8
<b>Sample size</b>	8	63	106	30	3	3	10	34	15	2	11	50	51	20	4
<b>Wt/Stomach</b>	2.49	2.57	4.25	9.77	8.32	0.75	3.26	4.77	5.96	14.9	0.44	1.78	4.89	9.82	8.30

Table 10-3. Summary of taxonomic composition of the stomach contents of winter flounder collected at the New Jersey offshore borrow areas in spring 1997. Table values are percentages of total wet weights of pooled samples within winter flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

<b>Borrow Area</b>	<b>BBA5</b>		<b>BBA6</b>		
<b>Size Class</b>	<b>10-15</b>	<b>25-30</b>	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>
<b>Prey Taxon</b>					
Anthozoa		84.3	84.4	94.0	42.4
Polychaete			3.4	1.5	2.5
Mysidacea			0.1		
Vertebrata					48.6
Amphipoda			0.5		
Bivalvia			0.2		
Other	100	15.7	11.5	4.5	6.4
<b>Prey Sieve Size</b>					
0.5			1.2		
1.0			4.6		
2.0			21.7		
3.35			25.0		1.0
6.35	100	100	47.4	100	99.0
<b>Sample size</b>	1	1	5	42	16
<b>Wt/Stomach</b>	0.15	8.81	1.10	3.99	5.23

Table 10-4. Summary of taxonomic composition of the stomach contents of winter flounder collected at the New Jersey offshore borrow areas in spring 1998. Table values are percentages of total wet weights of pooled samples within winter flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

Borrow Area	BBA3				BBA5				BBA6				
	10-15	15-20	20-25	25-30	10-15	15-20	20-25	25-30	10-15	15-20	20-25	25-30	30-35
<b>Prey Taxon</b>													
Annelid	21.5	72.2				48.2	30.0	4.4	72.0	12.1	10.9	1.0	
Anthozoa	42.5	3.5		18.8	11.2	17.9	47.7	83.1		62.4	75.5	97.7	38.1
Isopod		5.2			10.0	3.8	2.1	0.9	7.2	2.3	1.5		4.8
Amphipod					4.4	1.0			4.0	2.2			
Shrimp							2.3						
Bivalve					1.0	1.1	1.7	0.9	1.6				
Cumacea		4.5			1.5	1.0							
Echinodermata					2.3								
Other	36.0	15.2	100	75.8	69.3	26.1	15.7	10.0	15.2	21.0	12.0	1.5	57.1
<b>Prey Sieve Sizes</b>													
0.5		6.5			0.3		0.8	7.1	13.6	0.7	0.1		
1.0		19.8			1.9	1.0	1.3	1.5	15.6	2.0	0.5	0.3	
2.0		15.2			11.1	5.1	6.1	1.6	5.6	3.5	1.0	0.6	4.8
3.35	7.5	23.9		4.8	16.5	3.3	19.9	25.1	5.2	3.1	1.4	0.6	38.1
6.35	92.5	34.6	100	95.2	69.6	90.5	71.3	64.3	60.0	90.4	97.0	98.5	57.1
<b>Sample size</b>	3	3	2	1	17	39	28	11	14	62	98	22	3
<b>Wt/Stomach</b>	0.31	1.32	0.02	0.99	0.15	0.46	0.53	1.39	0.18	0.59	0.79	0.81	0.21

Table 10-5. Summary of taxonomic composition of the stomach contents of winter flounder collected at the New Jersey offshore borrow areas in spring 1999. Table values are percentages of total wet weights of pooled samples within winter flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

<b>Borrow Area</b>	<b>BBA3</b>		<b>BBA5</b>			<b>BBA6</b>				
<b>Size Class</b>	<b>20-25</b>	<b>25-30</b>	<b>15-20</b>	<b>20-25</b>	<b>25-30</b>	<b>10-15</b>	<b>15-20</b>	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>
<b>Prey Taxon</b>										
Annelid	43.5	39.8	58.9	76.6	22.5	28.8	15.5	10.0	7.8	12.3
Anthozoa	51.8	60.1	34.8	19.4	42.0	65.4	75.5	88.6	91.2	61.1
Isopod	0.4		4.6	1.4	0.3		1.4	0.8	0.7	
Amphipod			1.4	1.5	2.1	5.9	1.5	0.3		
Shrimp							1.0			
Bivalve	4.2				0.8		2.1	0.3	0.3	4.8
Cumacea							1.5			
Other			0.3	1.1	30.8		1.4			21.7
<b>Prey Sieve Sizes</b>										
0.5	9.7	5.3		1.6	4.2	4.8	5.8	3.0	1.1	14.2
1.0	5.2	9.8	5.6	3.2	6.2	11.4	8.4	4.8	0.8	15.0
2.0	11.7	11.9	11.4	9.0	16.2	83.8	8.0	5.0	1.3	12.2
3.35	28.2	11.4	22.6	18.4	24.4		33.5	5.5	4.3	36.9
6.35	45.1	61.4	60.4	67.8	49.0		44.2	81.7	92.4	21.7
<b>Sample size</b>	3	2	9	9	4	2	13	27	34	2
<b>Wt/Stomach</b>	1.89	1.98	0.76	1.00	3.20	0.26	0.53	1.30	2.10	1.28

Table 10-6. Summary of taxonomic composition of the stomach contents of summer flounder collected at the New Jersey offshore borrow areas in fall 1995. Table values are percentages of total wet weights of pooled samples within summer flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

<b>Borrow Area</b>	<b>BBA3</b>			<b>BBA5</b>				<b>BBA6</b>		
	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>	<b>15-20</b>	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>
<b>Prey Taxon</b>										
Anthozoa			0.3		1.1					
Cephalopoda		6.2	72.3			9.1	30.3		19.5	69.5
Brachyura		2.0		1.5		0.1			3.4	1.3
Amphipoda	62.1	36.4	6.9	95.7	89.0	86.9	59.1	91.8	68.3	28.4
Mysidacea	2.1		0.1		tr					
Stomatopoda	7.2				4.8			5.2		
Vertebrata	28.6	54.2	19.7		2.5	2.5	9.8	3.0		
Unidentified		1.1	0.7	2.8	2.5	1.4	0.8		8.8	0.9
<b>Sample size</b>	26	67	3	5	26	114	13	38	88	18
<b>Wt/Stomach</b>	1.22	1.53	9.33	0.96	1.65	2.76	2.95	0.85	1.81	6.95



Table 10-7. Summary of taxonomic composition of the stomach contents of summer flounder collected at the New Jersey offshore borrow areas in fall 1996. Table values are percentages of total wet weights of pooled samples within summer flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

Borrow Area	BBA3			BBA5			BBA6		
	25-30	30-35	>35	25-30	30-35	>35	25-30	30-35	>35
<b>Prey Taxon</b>									
Polychaeta					0.1				
Bivalvia				tr					
Cephalopoda	6.6	47.6	22.8	15.3	35.0	49.1		60.2	
Brachyura	8.5	11.5	5.2	35.3	29.1	43.4	1.4	4.8	6.2
Amphipoda	50.4	19.9	3.7	13.1	11.0	0.1	29.6	20.6	0.2
Crangonidae		tr		0.3	0.4				
Mysidacea	7.4	1.1	tr	7.8	7.0	tr	tr		tr
Stomatopoda	1.3			2.1			3.4		
Echinodermata						0.7			
Tunicata				tr					
Vertebrata	20.4	17.3	66.0	22.8	16.7	1.7	64.6	11.5	91.8
Unidentified	5.5	2.6	2.3	3.3	0.6	4.6	1.0	2.8	1.8
<b>Sample size</b>	170	75	10	82	90	9	65	64	7
<b>Wt/Stomach</b>	2.32	5.22	9.19	2.98	2.63	3.16	0.99	1.47	12.62

Table 10-8. Summary of taxonomic composition of the stomach contents of summer flounder collected at the New Jersey offshore borrow areas in spring 1997. Table values are percentages of total wet weights of pooled samples within summer flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

Borrow Area	BBA3			BBA5			BBA6	
	25-30	30-35	>35	30-35	>35	25-30	30-35	>35
<b>Prey Taxon</b>								
Anthozoa						35.3	2.2	
Cephalopoda					65.0	3.9	15.9	49.1
Brachyura							0.1	0.7
Mysidacea				3.4				
Vertebrata	94.2	91.5	91.7		29.0	46.1	66.8	45.1
Shrimp				50.2		tr	0.5	
Polychaete				46.4		tr		
Nematoda	tr	tr						tr
Other	5.8	8.5	8.3		6.0	14.6	14.5	5.1
<b>Prey Sieve Sizes</b>								
0.5								
1.0							3.8	
2.0	3.4			20.7			1.2	1.1
3.35	4.6			79.3		0.3	2.0	2.3
6.35	91.9	100	100		100	99.7	92.4	96.0
<b>Sample size</b>	1	2	3	7	5	7	55	27
<b>Wt/Stomach</b>	4.29	4.87	2.56	.03	17.75	3.32	5.19	14.80

Table 10-9. Summary of taxonomic composition of the stomach contents of summer flounder collected at the New Jersey offshore borrow areas in fall 1997. Table values are percentages of total wet weights of pooled samples within summer flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

<b>Borrow Area</b>	<b>BBA3</b>			<b>BBA5</b>				<b>BBA6</b>		
	<b>25-30</b>	<b>30-35</b>	<b>&gt;35</b>	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>	<b>&gt;35</b>	<b>25-30</b>	<b>30-35</b>	<b>&gt;35</b>
<b>Prey Taxon</b>										
Cephalopoda	45.0	64.6	89.3	20.8	8.7	45.9	48.0	36.2	27.1	71.0
Brachyura	17.4	3.1		30.7	30.0	15.6	6.6	9.0	7.4	4.0
Mysidacea	0.3		tr	0.5				6.6	1.2	
Vertebrata	32.1	29.2	7.3	45.4	56.9	34.4	40.2	47.1	59.5	18.0
Shrimp	0.2					0.1		0.1	0.1	
Polychaeta	tr									
Schyphozoa	0.4									
Insecta						tr				
Other	4.6	3.1	3.2	2.3	4.2	4.0	5.1	1.0	4.6	7.0
<b>Prey Sieve Sizes</b>										
0.5										
1.0								2.7	1.1	
2.0	0.3	0.4		1.1	1.4	0.1	0.2	2.7		
3.35	2.1	0.2		15.5	6.9	0.3	0.7	3.2		
6.35	97.0	99.4	100	82.8	91.0	99.6	99.1	89.9	98.6	100
<b>Sample size</b>	36	18	10	4	44	22	13	27	17	11
<b>Wt/Stomach</b>	75.1	32.5	65.6	3.1	92.5	66.5	43.0	36.8	41.7	25.6

Table 10-10. Summary of taxonomic composition of the stomach contents of summer flounder collected at the New Jersey offshore borrow areas in spring 1998. Table values are percentages of total wet weights of pooled samples within summer flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

<b>Borrow Area</b>	<b>BBA3</b>				<b>BBA5</b>				<b>BBA6</b>		
	<b>10-15</b>	<b>20-25</b>	<b>30-35</b>	<b>&gt;35</b>	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>	<b>&gt;35</b>	<b>20-25</b>	<b>30-35</b>	<b>&gt;35</b>
<b>Prey Taxon</b>											
Cephalopoda								61.2			93.6
Brachyura						100	22.8	8.9	69.3		2.4
Mysidacea									16.0		
Vertebrata			100	100	100		62.2	26.4		65.1	0.7
Shrimp								0.2			
Polychaeta										3.2	
Bivalve									5.3		
Cumacea									8.5		
Anthozoa										20.0	
Stomapoda	100	100									
Other							14.5	3.3		11.7	3.3
<b>Prey Sieve Sizes</b>											
0.5											
1.0							11.3		20.2		
2.0							9.1		8.8		
3.35					100		14.3		0.8	3.2	
6.35	100	100	100	100			65.2	100	100	69.3	96.8
<b>Sample size</b>	1	1	5	3	1	5	5	5	4	2	4
<b>Wt/Stomach</b>	1.12	0.68	0.74	5.11	0.13	0.46	2.25	13.8	0.09	2.65	20.5

Table 10-11. Summary of taxonomic composition of the stomach contents of summer flounder collected at the New Jersey offshore borrow areas in fall 1998. Table values are percentages of total wet weights of pooled samples within summer flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

<b>Borrow Area</b>	<b>BBA3</b>				<b>BBA5</b>			<b>BBA6</b>	
	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>	<b>&gt;35</b>	<b>25-30</b>	<b>30-35</b>	<b>&gt;35</b>	<b>30-35</b>	<b>&gt;35</b>
<b>Prey Taxon</b>									
Cephalopoda			1.4	0.3	1.5	1.8	58.3		35.6
Brachyura	10.5	33.0	19.2	54.4	7.5	18.0	4.3	20.6	1.4
Mysidacea									
Vertebrata	57.8	58.8	79.4	45.3	91.0	80.1	37.3	79.4	63.0
Shrimp	31.4								
Stomapod		8.2							
<b>Prey Sieve Sizes</b>									
0.5	2.8	0.1				0.1	0.1	3.7	0.2
1.0	12.9	6.8	0.2	0.9		0.1	0.2	3.7	0.7
2.0	25.2	1.9		1.1		0.2	0.3	0.6	0.5
3.35	42.8	3.2	0.6	2.0	0.9	0.1	0.9	16.5	0.9
6.35	15.7	87.1	99.2	96.0	99.1	99.5	98.5	75.5	97.7
<b>Sample size</b>	2	14	20	8	9	24	14	5	9
<b>Wt/Stomach</b>	1.62	1.94	3.07	1.56	4.96	2.94	3.58	1.88	7.89

Table 10-12. Summary of taxonomic composition of the stomach contents of summer flounder collected at the New Jersey offshore borrow areas in spring 1999. Table values are percentages of total wet weights of pooled samples within summer flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

<b>Borrow Area</b>	<b>BBA3</b>			<b>BBA5</b>				<b>BBA6</b>		
	<b>20-25</b>	<b>30-35</b>	<b>&gt;35</b>	<b>20-25</b>	<b>25-30</b>	<b>30-35</b>	<b>&gt;35</b>	<b>25-30</b>	<b>30-35</b>	<b>&gt;35</b>
<b>Prey Taxon</b>										
Cephalopoda		96.9	96.6		17.0	94.4	98.6	92.0	11.1	98.8
Brachyura	28.9	1.4		68.7	68.3	1.1	1.2	8.0	83.3	0.8
Mysidacea										
Vertebrata	70.3	1.7	3.4	20.3		4.4	0.1		2.1	0.4
Shrimp	0.5			11.0					3.5	
Polychaeta										
Schyphozoa										
Insecta										
Other	0.2				14.6					
<b>Prey Sieve Sizes</b>										
0.5				1.1	1.1				0.2	
1.0				1.6	0.5				0.3	
2.0	0.3			0.1	0.8				1.9	0.1
3.35		0.3		0.2	4.9				6.6	0.1
6.35	99.7	99.7	100	97.1	92.3	100	100	100	90.9	99.8
<b>Sample size</b>	7	13	10	5	7	9	5	2	6	6
<b>Wt/Stomach</b>	0.93	6.2	21.7	3.48	2.10	9.63	13.3	1.82	1.71	30.4

Table 10-13. Summary of taxonomic composition of the stomach contents of summer flounder collected at the New Jersey offshore borrow areas in fall 1999. Table values are percentages of total wet weights of pooled samples within summer flounder size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

Borrow Area	BBA3					BBA5					BBA6				
	15-20	20-25	25-30	30-35	>35	15-20	20-25	25-30	30-35	>35	15-20	20-25	25-30	30-35	>35
<b>Prey Taxon</b>															
Cephalopoda		3.4	38.6	0.9					23.1			100	93.6	32.2	1.2
Brachyura	49.4	11.5		1.0	0.9									0.3	
Vertebrata	45.3	84.1	54.3	93.8	99.1	100	100	88.3	76.9	100	92.8		6.4	65.3	98.7
Shrimp		0.8	0.3								7.2				
Polychaeta															
Other	5.3		6.8	4.2										2.3	
<b>Prey Sieve Sizes</b>															
0.5			0.2	1.6				0.8							
1.0			0.5	0.6				0.7			5.4				
2.0	5.2	0.8	2.2	1.5				0.7				3.3		0.4	0.1
3.35	41.8	3.8	1.6	0.6				0.9				74.8		0.5	
6.35	53.0	95.3	95.5	95.7	100	100	100	96.8	100	100	93.8	21.9	100	99.1	99.9
<b>Sample size</b>	3	6	8	9	5	1	2	12	11	6	2	1	6	9	4
<b>Wt/Stomach</b>	0.18	0.73	2.64	6.94	8.14	0.14	0.41	3.26	5.55	18.4	10.5	0.29	9.47	6.0	27.5

Table 10-14. Summary of taxonomic composition of the stomach contents of scup flounder collected at the New Jersey offshore borrow areas in spring and fall 1995. Table values are percentages of total wet weights of pooled samples within scup size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

	Spring 1995	Fall 1995	Sieve Size (mm)							
				0.50	1.00	2.00	3.35	6.35	Total	%
<b>Prey Taxon</b>	%	%								
Anthozoa	15.1	45.6		2.09	3.49	6.67	16.13	5.57	33.95	45.07
Polychaeta	53.3	26.9		0.52	0.36	0.93	7.19	11.12	20.12	26.72
Cephalopoda		1.6						1.20	1.20	1.59
Brachyura		5.6		0.16	0.16	0.22	1.23	2.38	4.14	5.50
Crangonidae	2.4			0.10	tr	0.01			0.12	0.16
Amphipoda	10.5	0.7			0.11	0.10	0.05	0.41	0.67	0.88
Isopoda	1.5	0.1			0.07	0.07			0.15	0.19
Vertebrata		13.9		0.06	tr	0.04	0.11	10.00	10.21	13.56
Unidentified	25.3	5.6		1.28	1.41	0.28	1.44	0.37	4.78	6.34
<b>Sample size</b>	124	159	<b>Total</b>	4.22	5.60	8.30	26.16	31.05	75.32	
<b>Wt/Stomach</b>	0.04	0.46	<b>%</b>	5.60	7.43	11.02	34.73	41.22		



Table 10-15. Summary of taxonomic composition of the stomach contents of scup collected at the New Jersey offshore borrow areas in spring 1999. Table values are percentages of total wet weights of pooled samples within size classes (SL in cm). Sample size indicates the number of pooled stomachs within each size category. Prey weight per stomach is given as wet weight in grams.

<b>Borrow Area</b>	<b>BBA3</b>		<b>BBA5</b>		<b>BBA6</b>		
<b>Size Class</b>	<b>5-10</b>	<b>10-15</b>	<b>5-10</b>	<b>10-15</b>	<b>5-10</b>	<b>10-15</b>	<b>15-20</b>
<b>Prey Taxon</b>							
Copepoda	70.1	19.4	17.6	0.6	16.1	0.6	28.4
Crab	1.3	-	1.6	-	2.0	5.9	
Shrimp	1.4	3.6	7.0	0.9	4.1	0.5	
Isopoda	1.3	2.5	tr	1.9	0.7	tr	
Amphipoda	0.9	3.7	0.1	2.9	4.4	0.4	
Polychaeta	20.0	47.4	48.6	51.9	39.2	25.0	40.7
Bivalvia	tr	0.5	1.0	-	1.5	-	
Anthozoa	4.4	22.8	23.1	8.5	16.9	28.6	
Fish	0.1	-	0.3	tr	0.6	-	
Cumacea	0.3	-	0.5	-	0.7	-	
Other		-	-	33.2	13.8	37.0	30.8
<b>Prey Sieve Sizes</b>							
0.5	72.7	26.7	23.0	5.1	24.4	11.8	28.4
1.0	4.3	12.6	11.6	11.4	20.9	25.8	
2.0	6.0	24.4	18.1	19.7	18.6	19.0	30.8
3.35	7.5	19.8	18.1	28.4	24.4	29.8	40.7
6.35	9.5	16.5	29.2	35.3	11.7	13.5	
<b>Sample size</b>	496	51	514	91	369	82	1
<b>Wt/Stomach</b>	0.12	0.15	0.05	0.20	0.06	0.10	0.39

Table 10-16. Comparative potential trophic support values (grams wet-weight biomass/m<sup>2</sup>) for winter and summer flounder at offshore borrow areas in the spring of 1995-1999. Mollusc biomass in the 6.35 mm category was excluded because it was not found in stomach samples. Avail. Bio. = Available Biomass.

	BBA3						BBA5						BBA6					
	Sieve Size (mm)						Sieve Size (mm)						Sieve Size (mm)					
	0.05	1.00	2.00	3.35	6.35	Total	0.05	1.00	2.00	3.35	6.35	Total	0.05	1.00	2.00	3.35	6.35	Total
<b>Spring 1995</b>																		
Annelida	0.70	1.34	2.64	5.46	11.06	21.20	0.09	0.27	0.46	2.10	3.48	6.40	0.08	0.25	0.83	2.20	3.29	6.65
Crustacea	0.12	1.36	0.45	0.64	3.77	6.34	0.02	1.53	0.38	0.24	2.40	4.57	0.05	1.19	0.08	0.20	0.65	2.17
Mollusca	0.01	0.20	0.87	1.93	7.02	3.01	-	0.05	0.65	2.39	8.55	3.09	0.01	0.05	0.61	4.95	14.73	5.62
Total	0.83	2.90	3.96	8.03	14.83		0.11	1.85	1.48	4.73	5.88		0.14	1.49	1.52	7.35	3.94	
<b>Avail. Bio.</b>	30.55						14.05						14.44					
<b>Spring 1996</b>																		
Annelida	0.23	0.30	0.70	1.93	2.11	5.27	0.06	0.11	0.25	0.68	0.88	1.98	0.15	0.21	0.54	1.49	0.92	3.31
Crustacea	0.03	0.67	0.18	0.10	0.88	1.86	0.02	0.34	0.15	0.08	0.18	0.77	0.02	0.13	0.04	0.20	0.03	0.42
Mollusca	0.02	0.11	0.47	0.59	1.88	1.19	0.01	0.08	0.30	0.53	5.31	0.92	0.01	0.02	0.04	0.10	1.69	0.17
Total	0.28	1.08	1.35	2.62	2.99		0.09	0.53	0.70	1.29	1.06		0.18	0.36	0.62	1.79	0.95	
<b>Avail. Bio.</b>	8.32						3.67						3.90					
<b>Spring 1997</b>																		
Annelida	0.19	0.31	0.60	0.11	0.12	1.33	0.17	0.22	0.24	0.71	0.49	1.83	0.30	0.54	0.89	1.45	2.58	5.76
Crustacea	0.08	0.04	0.03	0.02	0.03	0.20	0.06	0.48	0.16	0.08	-	0.78	0.06	0.37	0.21	0.17	0.38	1.19
Mollusca	0.03	0.05	0.35	0.52	3.06	0.95	-	0.06	0.34	0.64	.06	1.04	0.01	0.07	0.29	0.36	5.88	0.73
Total	0.30	0.40	0.98	0.65	0.15		0.23	0.76	0.74	1.43	0.49		0.37	0.98	1.39	1.98	2.96	
<b>Avail. Bio.</b>	2.48						3.65						7.68					
<b>Spring 1998</b>																		
Annelida	0.41	0.34	0.25	0.71	0.44	2.15	0.16	0.15	0.16	0.94	0.88	2.29	0.50	0.30	0.55	0.85	1.10	3.30
Crustacea	0.04	0.28	0.50	0.02	0	0.84	0.02	0.32	0.10	0.25	0.23	0.92	0.03	0.08	0.10	0.08	0.09	0.38
Mollusca	0.05	0.22	1.07	1.82	0.98	3.16	0.01	0.12	0.20	0.35	3.58	0.68	0.03	0.17	0.24	0.48	0.26	0.92
Total	0.5	0.84	1.82	2.55	0.44		0.19	0.59	0.46	1.54	1.11		0.56	0.55	0.89	1.41	1.19	
<b>Avail. Bio.</b>	6.15						3.89						4.60					
<b>Spring 1999</b>																		
Annelida	0.74	0.60	0.81	3.21	2.37	7.73	0.17	0.42	0.54	1.15	1.07	3.35	0.34	0.66	1.30	1.96	2.58	6.84
Crustacea	0.16	0.86	0.68	0.50	tr	2.20	0.15	1.27	0.82	0.24	0.74	3.22	0.10	0.12	0.08	0.16	0.25	0.71
Mollusca	0.43	0.39	0.60	7.53	1.41	8.95	0.26	0.29	0.14	0.22	1.16	0.91	0.29	0.14	0.17	0.42	3.11	1.02
Total	1.33	1.85	2.09	11.2	2.37		0.58	1.98	1.50	1.61	1.81		0.73	0.92	1.55	2.54	2.83	
<b>Avail. Bio.</b>	18.88						7.48						8.57					

Table 10-17. Comparative potential trophic support values (grams wet-weight biomass/m<sup>2</sup>) for winter and summer flounder at offshore borrow areas in the fall of 1995-1999. Mollusc biomass in the 6.35 mm category was excluded because it was not found in stomach samples. Avail. Bio. = Available Biomass.

	BBA3						BBA5						BBA6					
	Sieve Size (mm)						Sieve Size (mm)						Sieve Size (mm)					
	0.05	1.00	2.00	3.35	6.35	Total	0.05	1.00	2.00	3.35	6.35	Total	0.05	1.00	2.00	3.35	6.35	Total
<b>Fall 1995</b>																		
Annelida	0.13	0.23	0.42	1.92	1.74	4.44	0.07	0.26	0.40	1.53	1.96	4.22	0.11	0.19	0.49	2.01	2.16	4.96
Crustacea	0.30	0.73	0.27	0.72	1.85	3.87	0.58	0.90	0.29	0.34	4.59	6.70	0.35	0.47	0.17	0.34	0.82	2.15
Mollusca	0.02	0.35	0.98	1.19	13.51	2.54	0.03	0.61	2.52	2.67	1.99	5.83	0.02	0.13	0.17	0.98	9.77	1.30
Total	0.45	1.31	1.67	3.83	3.59		0.68	1.77	3.21	4.54	6.55		0.48	0.79	0.83	3.33	2.98	
<b>Avail. Bio.</b>	10.85						16.75						8.41					
<b>Fall 1996</b>																		
Annelida	0.14	0.17	0.28	1.49	0.89	2.97	0.09	0.24	0.18	0.89	1.19	2.59	0.16	0.22	0.73	2.11	1.70	4.92
Crustacea	0.09	0.37	0.21	0.25	0.36	1.28	0.07	0.31	0.19	0.46	0.21	1.24	0.04	0.12	0.09	0.13	0.22	0.60
Mollusca	0.02	0.14	1.13	1.54	7.15	2.83	0.03	0.18	1.04	0.66	8.09	1.91	0.02	0.06	0.16	0.36	9.68	0.60
Total	0.25	0.68	1.62	3.28	1.25		0.19	0.73	1.41	2.01	1.40		0.22	0.4	0.98	2.6	1.92	
<b>Avail. Bio.</b>	7.08						5.74						6.12					
<b>Fall 1997</b>																		
Annelida	0.14	0.24	0.28	0.88	1.26	2.80	0.04	0.07	0.24	0.69	0.92	1.96	tr	tr	tr	0.05	0.07	0.12
Crustacea	0.06	0.23	0.23	0.08	0.31	0.70	0.04	0.09	0.10	0.13	-	0.36	tr	0.01	0.01	0.03	0.38	0.43
Mollusca	0.51	1.38	1.14	1.07	2.58	4.10	0.13	0.32	0.19	0.48	6.50	1.12	0.04	0.06	0.03	tr	0.31	0.13
Total	0.71	1.64	1.65	2.03	1.57		0.21	0.48	0.53	1.3	0.92		0.04	0.07	0.04	0.08	0.45	
<b>Avail. Bio.</b>	7.60						3.44						0.68					
<b>Fall 1998</b>																		
Annelida	0.42	1.46	1.38	1.80	2.18	7.24	0.14	0.23	0.21	0.84	0.72	2.14	1.40	2.18	1.52	2.05	1.61	8.76
Crustacea	0.17	0.40	0.24	0.20	1.27	2.28	0.24	0.70	0.54	0.39	1.07	2.94	0.05	0.12	0.20	0.22	0.28	0.87
Mollusca	0.08	0.25	1.34	5.16	5.12	6.83	0.54	0.46	0.61	0.71	9.25	2.32	0.07	0.25	0.45	0.35	7.19	1.12
Total	0.67	2.11	2.96	7.16	3.45		0.92	1.39	1.36	1.94	1.79		1.52	2.55	2.17	2.62	1.89	
<b>Avail. Bio.</b>	16.35						7.40						10.75					
<b>Fall 1999</b>																		
Annelida	1.33	2.66	1.72	1.76	2.85	10.32	0.12	0.17	0.18	0.10	0.42	0.99	0.91	0.71	0.76	1.16	1.24	4.78
Crustacea	0.16	0.89	1.69	0.30	0.73	3.77	0.08	0.15	0.09	0.27	0.25	0.84	0.24	0.20	0.15	0.28	0.56	1.43
Mollusca	0.06	0.37	1.21	1.18	2.54	2.82	0.17	0.09	0.05	0.18	0.38	0.49	0.66	1.03	1.20	1.61	104.5	4.50
Total	1.55	3.92	4.62	3.24	3.58		0.37	0.41	0.32	0.55	0.67		1.81	1.94	2.11	3.05	1.80	
<b>vail. Bio.</b>	16.91						2.32						10.71					

## Methods

Fish were sampled in the spring and fall of 1995-1999 by otter trawling. Prey biomass was pooled by size class of target predator species based on a technique developed by Borgeson (1963) and modified by Carr and Adams (1973) and Sheridan (1979). Stomach contents were removed from fishes immediately after capture. This was necessary to retain size characteristics of the prey items for analysis as described below. Fish were dissected in the field within 15 minutes of capture and their stomach contents preserved in 10% buffered formalin. Stomachs were pooled in the field within each combination of area x species x size class ( $\leq 10.0$ , 10.1-15.0, 15.1-20.0, 20.1-25.0, 25.1-30, 30.1-35, and  $>35.1$ . cm standard length (SL)). In the lab at the Waterways Experiment Station, Vicksburg, MS, the material in each pooled sample was rinsed through a series of nested sieves (6.35, 3.35, 2.0, 1.0, and 0.5-mm mesh), sorted by prey taxonomic category, and weighed to the nearest 0.1 mg after vacuum filtration.

To estimate comparative values of potential trophic support (i.e. the amount of benthic biomass available on a  $\text{g/m}^2$  basis) in each borrow area during each season, the offshore benthic data described in Chapter 8 were treated in the following manner. Tables were arranged of biomass values for major taxonomic groups sorted by size categories measured using the same nested sieve series used to analyze the stomach contents data (6.35, 3.35, 2.00, 1.00, and 0.50-mm mesh). Separate tables were prepared for each each sampling date. Examination of the stomach contents data was then used to determine those categories of benthic taxa and specific prey size intervals that were essentially absent ( $< 5$  percent) from the diets of target predators. These categories were eliminated from the basic tables of benthic data. The remaining categories were summed to obtain a cumulative biomass value representing potentially available prey at each borrow area on each date.

## Results and Discussion

The taxonomic identities of prey items for all years of sampling and fish size classes are given in Appendix Tables 10-1 to 10-9. The prey are listed in order of their relative abundance as a prey item within each taxonomic category. There was a great deal of consistency between years in the dietary makeup of each taxonomic prey category, which are summarized in tables by fish species and size class.

**Winter Flounder Summary:** Spring 1995 trawling efforts aboard the R/V Argo Maine were successful in obtaining relatively large samples of winter flounder (795 specimens) covering several size classes in each of the three borrow areas (Table 10-1). Winter flounder fed primarily upon anemones *Ceriantheopsis americana* and polychaetes *Scoletoma acicularum* (Appendix 10-1). Winter flounder in the largest size class tended to contain prey in the largest size class, whereas smaller flounder contained prey items from a broader size spectrum.

A similar pattern in prey utilization was evident for flounder taken from all three borrow areas (Table 10-1). Four prey items account for the majority of the diets of all flounder size classes: anthozoans, polychaetes, amphipods, and isopods. Anemone crowns and polychaetes combined represented between 75 and 99 percent of the prey biomass in all flounder size classes. Amphipods and isopods tended to be more important (between 5 and 10 percent of total prey biomass) in winter flounder less than 15 cm SL. In each flounder size class there appeared to be a consistent pattern of increasing anemone contribution to the diet with increasing predator size class. Conversely, the percentage contribution of polychaetes to the diet tended to decrease with increasing flounder size class (45 to 60 percent of the diet of flounder 10 to 15 cm SL, and 8 percent or less of flounder in the 25 to 30 cm size range), while anemones became more prominent (30 to 35 percent in 10 to 15 cm SL flounder, and 75 to 97 percent in 25 to 30 cm SL flounder).

During 1996 spring trawling, 410 winter flounder containing identifiable food items were collected. Their distribution among borrow areas and size classes is given in Table 10-2. With respect to taxonomic composition, the diets of winter flounder size classes in 1996 strongly resembled those of 1995 samples (Table 10-1). Anemone crowns once again were a dominant prey item in terms of proportional biomass, but were much more evenly distributed among predator size classes than in 1995. Polychaetes were the only additional food item contributing more than one percent to the total diet of any predator size class with the exception of tunicates that occurred in the diets of winter flounder from Belmar Borrow Area (BBA) 6.

With respect to prey size characteristics, as determined by nested sieve series analysis, winter flounder in the smaller size classes tend to feed across a broad spectrum of prey sizes. In contrast, winter flounder in the largest size class (25 to 30 cm SL), fed predominantly on large prey items, i.e. those retained on a 6.35 mm sieve. This pattern was relatively consistent for flounder caught in all three borrow areas in both years, with some divergence by 20-25 cm flounder at BBA3 and BBA6 in 1995.

Winter flounder were collected in small numbers in 1997. During the spring, winter flounder were not captured at BBA3, only two were captured at BBA5, and 63 at BBA6 (Table 10-3). This may reflect increasing abundance with distance offshore and water depth as the locations of the three borrow areas lie along a depth gradient. Among the 65 fish collected in the spring of 1997, fish less than 30 cm SL fed predominantly on anthozoans, mainly cerianthid anemones. Larger winter flounder fed both on anemones and fish in the largest prey size category (Table 10-3). Winter flounder were not collected at any site in the fall of 1997.

A total of 303 winter flounder were captured in the spring of 1998, predominantly at BBA6 (Table 10-4). These winter flounder abundances are considerably smaller than

the 795 and 407 fish captured during spring baseline sampling in 1995 and 1996, respectively (USACE 1998). In the spring of 1998, anemones and polychaetes were the major prey items (Table 10-4). Amphipods and isopods were a consistent, but small ( $\leq 10\%$  biomass), component of the diets of winter flounder  $< 25$  cm SL. As was observed during the baseline study period, the percentage contribution of polychaetes to the diet of winter flounder decreased with increasing winter flounder size (Table 10-4). Another result consistent with the baseline observations is the dominant contribution of anemone crowns to the diets of winter flounder in all size classes, where substantial samples sizes were obtained. Winter flounder prey size characteristics remained unchanged from baseline conditions and did not appear to differ among borrow area types. Large prey items (i.e., those retained by the 6.35 mm sieve) were the most dominant size class consumed, comprising the majority of all prey biomass for nearly every size class of predator. Three winter flounder were captured in the fall of 1998.

Winter flounder were collected at all three borrow areas in the spring of 1999, but were not captured in the fall. More winter flounder were captured at BBA6 ( $n = 78$ ) than at BBA5 ( $n = 22$ ) or BBA3 ( $n = 5$ ; Table 10-5). Among the 105 winter flounder collected in the spring of 1999, fish less than 30 cm SL fed predominantly on polychaetes and anthozoans, which were mainly cerianthid anemones. Amphipods and isopods were a consistent, but small ( $\leq 10\%$  biomass) component of the diets of winter flounder in most size classes. The percentage contribution of polychaetes to the diet of winter flounder tended to decrease with increasing winter flounder size (Table 10-5). Winter flounder prey size characteristics did not appear to differ among the borrow areas. Large prey items (i.e., those retained by the 6.35 mm sieve) were the most dominant size class consumed, comprising the majority of all prey biomass for nearly every winter flounder size class.

**Summer Flounder Summary:** A total of 398 summer flounder was collected in fall 1995 trawling efforts (Table 10-6), and 572 were collected in fall 1996 (Table 10-7). The specimens were generally larger in 1996 samples, but were relatively evenly distributed among borrow areas in both years. Amphipods were the dominant prey item in most samples of summer flounder within the 15-30 cm SL size range. This pattern was masked in several predator size class samples by the occurrence of squid or fish, both of which represented appreciable quantities of biomass, particularly for larger summer flounder. Larger crustaceans (stomatopods and brachyurans) were notable food items in several size class samples, mantid shrimp were more common in stomachs of smaller flounder and crabs in all size classes.

Summer flounder captures totaled 107 in the spring of 1997 (Table 10-8) and 202 in the fall (Table 10-9). In 1998, 36 summer flounder stomachs were analyzed in the spring (Table 10-10) and 105 stomachs in the fall (Table 10-11). The abundances of summer flounder were considerably lower in 1997 and 1998 than during the baseline years (Chapter 10, USACE 1998). The food habits of summer flounder were diverse and primarily composed of epibenthic organisms. In general, squid, fish and crabs comprised

the majority of prey items. Squid were especially common in the diets of summer flounder captured in the fall of 1997 (Table 10-9) and were common only in the diets of the larger summer flounder during other sampling periods. Infaunal prey items were not commonly consumed by summer flounder in any size class. Small sample sizes prevent statistical analyses of whether food habits differed by size class and borrow area site. Examination of the summary tables (Tables 10-6 to 10-11), however, suggests summer flounder food habits were similar across fish size class and among borrow area locations.

A total of 70 summer flounder was collected in the spring of 1999 (Table 10-12) and 85 summer flounder were collected in the fall of 1999 (Table 10-13). The stomach contents of summer flounder were comprised primarily of epibenthic organisms. In general, squid (*Loligo pealeii*), fishes and crabs (*Cancer irroratus*) comprised the majority of prey items. Squid were especially common in the diets of summer flounder captured in the spring of 1999 (Table 10-12). Infaunal prey items were not commonly consumed by summer flounder in any size class. Small sample sizes prevent statistical analyses of whether food habits differed by size class and borrow area site, however summer flounder food habits appear similar across fish size class and among borrow area locations. Fish were a major component of summer flounder food habits in the fall 1999 for most summer flounder size classes on all three borrow areas (Table 10-13). Squid were present as prey items, but were not as prevalent as they were in the spring. Likewise, crab were not a major food item during the fall. The majority of prey consumed by summer flounder in both the spring and fall were retained by the largest sieve size (6.35 mm).

**Scup Summary:** A total of 124 scup were collected in spring 1995 sampling efforts, and 159 taken in fall 1995 (Table 10-14). Scup captured in spring 1995 samples were primarily taken from BBA3. The overall diet for pooled spring and fall samples was very similar to the diet of winter flounder, consisting mainly of polychaetes, anthozoans, amphipods, and isopods as well as crangonid parts (Table 10-14). Scup tended to consume larger prey items, mainly in those retained by the 3.35 and 6.35 sieves (Table 10-14). However, this may be an artifact of general condition of the prey items in the samples. It must be noted that the absolute weights of prey in scup stomachs was very small, which hinders meaningful interpretation of patterns. Scup were not captured during the offshore trawling efforts of 1997 and 1998.

A total of 1,604 scup was captured during the spring sampling period of 1999 (Table 10-15). Most of these fish were in the smallest size class (5-10 cm SL) at all three borrow areas (Table 10-15). Scup fed on a very diverse array of prey, with copepods, polychaetes and cerianthid anemones comprising the majority of the identifiable food items. Prey size was also relatively diverse with fairly even distributions of biomass by sieve size (Table 10-15). One exception is the predominance of copepods in the stomachs of small scup captured at BBA3, which were retained by the smallest sieve (0.5 mm).

## Potential Trophic Support

Potential trophic support was estimated for winter flounder, which consumed prey in all size classes. Because echinoderms and taxa pooled in the miscellaneous benthos biomass categories were rarely present in winter flounder stomach contents samples, their corresponding biomass values were not included in the formulation of estimates of the available benthic prey biomass. Also, because it was noted that bivalve prey items consisted primarily of siphons grazed from smaller species, biomass of larger bivalves (in the 6.35 mm sieve category) was eliminated. Results of this process are shown in Tables 10-16 to 10-17.

The available benthic prey biomass provided by annelids, crustacea, and molluscs (excluding molluscs in the 6.35 mm size class) sampled during the spring sampling periods of 1995 to 1999 ranged from 2.48 to 30.55 g/m<sup>2</sup> (Table 10-16). Overall, the available benthic biomass was greatest in 1995 in all three borrow areas. The spring available benthic prey biomass was highest in borrow area BBA3 for four of the five years sampled. Although anemones were an important prey item for winter flounder, they were rarely captured in the benthic samples of the borrow areas. Winter flounder, therefore, appear to either be selectively feeding on anemones within the study area or foraging on anemones at some location outside the borrow areas prior to being captured.

Borrow area BBA3 also provided the most available benthic prey biomass during the fall sampling periods of each year (Table 10-17). Available prey biomass in the fall was comparable to the values measured for the spring sampling periods. Annelids continued to be the most available prey taxon by weight during most sampling periods. Available prey biomass values were among the lowest recorded for all three stations in the fall of 1997, which is the first time the areas were sampled after the dredging operation was conducted. By the spring of 1998, available benthic prey biomass was similar to values measured in other years with the exception of borrow area BBA3, which was lower. Available benthic prey biomass at the borrow area was elevated again in the fall of 1998 (Table 10-17).

Results of this study indicate that the food habits of winter flounder, a benthic omnivore, and summer flounder, an epibenthic feeder, did not change appreciably between the baseline time period and the during-dredging (1997) and post-dredging (1998 and 1999) time periods. Winter flounder continued to feed primarily on anemones, which were not common at any of the borrow areas. The available benthic biomass of the prey consumed by winter flounder was greatest at BBA3, which is to the south and closer to shore than BBA5 and BBA6.



## Literature Cited

- Borgeson, D. P. 1963. A rapid method for food habit studies. Transactions of the American Fisheries Society 92(4):434-435.
- Carr, W. E. S. and C. A. Adams. 1973. Food habits of juvenile marine fishes occupying seagrass beds in the estuarine zone near Crystal River, Florida. Transactions of the American Fisheries Society 102:511-540.
- Frame, D. W. 1973. Conversion efficiency and survival of young winter flounder (*Pseudopleuronectes americanus*) under experimental conditions. Transactions of the American Fisheries Society 102:614-617.
- Franz, D. R. and J. T. Tanacredi. 1992. Secondary production of the amphipod *Ampelisca abdita* Mills and its importance in the diet of juvenile winter flounder (*Pseudopleuronectes americanus*) in Jamaica Bay, New York. Estuaries 15:193-203.
- Sheridan, P. F. 1979. Trophic resource utilization by three species of sciaenid fishes in a northwest Florida estuary. Northeast Gulf Science 3:1-5.
- Steimle, F. W., D. Jeffress, S. A. Fromm, R. N. Reid, J. J. Vitaliano and A. Frame 1994. Predator-prey relationships of winter flounder, *Pleuronectes americanus*, in the New York Bight apex. Fishery Bulletin 92:608-619.
- U.S. Army Corps of Engineers. 1998. The New York District's Biological Monitoring Program for the Atlantic Coast of New Jersey, Asbury to Manasquan Section Beach Erosion Control Project. Phase I. Pre-Construction Baseline Studies. Report to the U.S. Army Engineer New York District. U.S. Army Engineer Waterways Experiment Station, Vicksburg, MS.