FOOD HABITS AND FOOD RESOURCE PARTITIONING BY NORTHWEST ATLANTIC GADIFORM FISHES

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ABSTRACT

The food habits of 15 species of gadiform fishes occurring in the Northwest Atlantic, from Cape Hatteras, North Carolina, to Nova Scotia, have been investigated for the years 1969-1972. This food habits information is presented, for each species, as a summary for the entire Northwest Atlantic, and is then divided into five broad geographic areas *viz*. Middle Atlantic, Southern New England, Georges Bank, Gulf of Maine and Western Nova Scotia. The percent similarity between the diets of the 15 species of fish was calculated. It was found that the Atlantic cod, *Gadus morhua*, pollock, *Pollachius virens*, silver hake, *Merluccius bilinearis*, white hake, *Urophycis tenuis*, offshore hake, *Merluccius albidus*, and cusk, *Brosme brosme*, had reasonably similar diets, being primarily piscivorous. The red hake, *Urophycis chuss*, and spotted hake, *Urophycis regius*, also had similar diets and were identified as mixed feeders, preying on both fish and invertebrates. The final seven species, haddock, *Melanogrammus aeglefinus*, longfin hake, *Phycis chesteri*, fourbeard rockling, *Enchelyopus cimbrius*, marlin-spike, *Nezumia bairdi*, longnose grenadier, *Coelorhynchus carminatus*, fawn cusk-eel, *Lepophidium cervinum*, and ocean pout, *Macrozoarces americanus*, preyed almost exclusively on invertebrates. The major prey of each species was identified and is discussed in relation to resource partitioning between species.

INTRODUCTION

Investigations on the food habits of fish have been a major topic of research since the beginning of fishery research as a scientific discipline. Since food availability ultimately controls production the literature has become replete with papers describing, in detail, the prey of numerous species of fish. This vast literature has concentrated on the more common commercially important species, often at the expense of the lesser known but ecologically interesting fish. Among the Gadiformes described in this report the literature on the cod and haddock was found to be the most extensive (see list of references), reflecting the importance of the fishery for these two animals, while comparative data on the food habits of fish such as the spotted hake, red hake, and the grenadiers is either scanty or completely lacking, especially for fish from the Northwest Atlantic.

In recent years some authors have suggested that management of a single fish species is untenable and that, instead, the ecosystem must be considered as a whole (see Gulland 1977). The commercially important species must be considered in relation to their role in the total marine environment. Edwards (1976) has gone so far as to say that in the context of total ecosystem management, fish could be ignored as individual species and

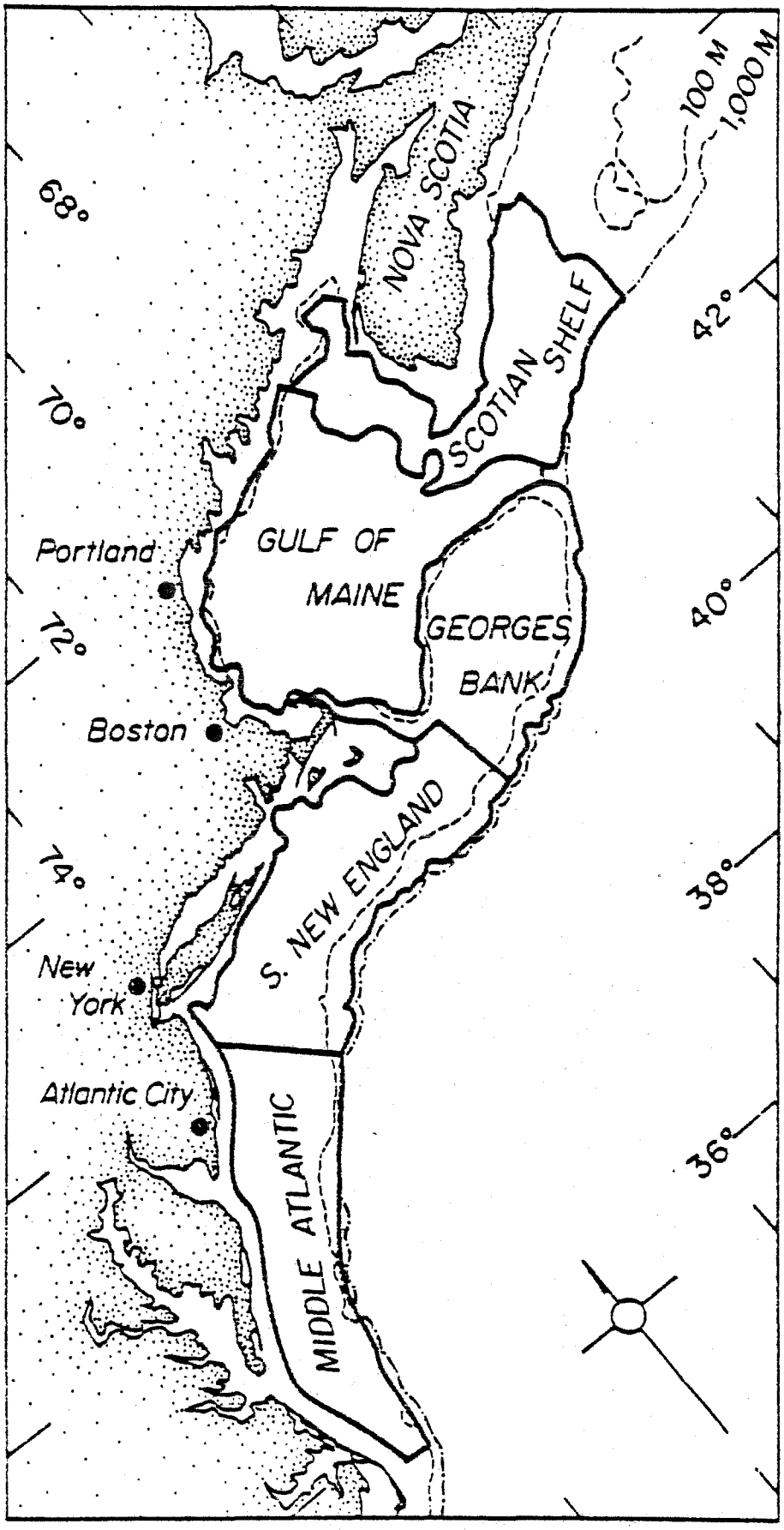


Figure 1. The five geographic areas of the Northwest Atlantic sampled from 1969 through 1972 by the Resource Surveys Investigation, NEFC, Woods Hole, Massachusetts USA.

considered as a group occupying a specified feeding niche. These niches are dependent upon the fishes' food habits and may in turn be related to the size of the fish. Food related size classes for fish have been identified as "threshold lengths" by Parker and Larkin (1959) or "feeding stanzas" by Paloheimo and Dickie (1965), and Tyler (1972). In order to develop such a management plan, however, it is first necessary to quantitatively describe the food habits of all the major fish populations occurring within the bounds of the ecosystem and evaluate the role of each stock relative to the other fish in that same system.

This report is the first in a series of papers to describe the food habits of various Northwest Atlantic fish populations. It concentrates on the Gadiformes collected during the years 1969-1972 and, after quantitatively describing the food habits of each of the 15 species collected, it evaluates the food habits of each species in relation to the other gadoid fishes.

MATERIALS AND METHODS

Fish utilized for stomach contents analysis were collected by bottom trawl during six of the annual spring and autumn bottom trawl survey cruises of R/V Albatross IV carried out by the Northeast Fisheries Center, from 1969 through 1972. The cruises during which food habits data were collected are as follows: autumn 1969, 8 Oct.-8 Nov.; autumn 1970, 15 Oct.-20 Nov; sprin 1971, 9 March - 1 May; autumn 1971, 30 sept.-19 Nov.; spring 1972, 8 March-24 April; and autumn 1972, 27 Sept.-20 Nov. Collections were made with a #36 Yankee otter trawl with rollers, 9 m legs, and standard 544 kg oval doors. The cod end and upper belly were lined with 13 mm mesh netting

Table 1. Number of stomachs analyzed from each of the fifteen species of fish in each geographic area in the Northwest Atlantic for the years 1969-1972.

Species	Geographic Area					
	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia	Total
Atlantic cod	7	79	666	348	441	1541
Pollock	5	1	206	203	229	644
Silver hake	465	688	248	453	282	2136
White hake	0	95	173	475	164	907
Offshore hake	4	46	23	0	0	73
Cusk	0	6	4	51	11	72
Red hake	213	600	208	72	17	1110
Spotted hake	689	183	4	0	0	876
Haddock	10	27	352	232	510	1131
Longfin hake	6	12	64	16	28	126
Fourbeard rockling	0	3	27	18	0	48
Marlin spike	0	6	0	2	15	23
Longnose grenadier	4	5	2	0	0	11
Fawn cusk-eel	68	37	2	2	0	109
Ocean pout	14	187	110	34	6	351

to retain smaller fish. A scheme of stratified random sampling was carried out within the five geographic areas of the Northwest Atlantic (Figure 1, Table 1) and sampling continued over 24 hours per day. Further details of the bottom trawl survey techniques may be obtained from the Resource Surveys Investigation, National Marine Fisheries Service, Northeast Fisheries Center, Woods Hole, Massachusetts, USA 02543.

A total of 9,158 stomachs were collected from 15 species of the Gadiformes. The fish were selected randomly from the bottom trawl survey catch. Stomachs were excised aboard ship, labeled according to species cruise and station, and in some instances sex, and preserved in 10% Formalin[1]. The general plan was to obtain a random sample of the population for each species, without bias towards a specified length or sex. Juvenile fish were preserved whole. Very young fish will be treated in a separate report, thus only fish above a specified length are considered in this paper. The species collected and minimum fork lengths are as follows: Atlantic cod, Gadus morhua, >20 cm; haddock, Melanogrammus aeglefinus, >20 cm; silver hake, Merluccius bilinearis, >20 cm; pollock, Pollachius virens, >20 cm; red hake, Urophycis chuss, >20 cm; white hake, Urophycis tenuis, >20 cm; spotted hake, Urophycis regius, >10 cm; longfin hake, Phycis chesteri, >10 cm; offshore hake, Merluccius albidus, >20 cm; fourbeard rockling, Enchelyopus cimbrius, >10 cm; cusk, Brosme brosme, >20 cm; marlin-spike, Nezumia bairdi, >10 cm; longnose grenadier,

[1]Reference to trade names does not imply endorsement by the National Marine Fisheries Service, NOAA.

Coelorhynchus carminatus, >10 cm; fawn cusk-eel, Lepophidium cervinum, >10 cm; and the ocean pout, Macrozoarces americanus, >10 cm. The common and scientific names used for all fish discussed in this paper are in accordance with those names recommended by the American Fisheries Society (Bailey, 1970).

In the laboratory, the preserved stomachs were opened and the contents emptied onto a fine mesh screen to permit washing without loosing any food items. The various prey items were manually sorted, identified to the lowest possible taxa (using a dissecting microscope when necessary) and damp dried on bibulous paper. Each taxonomically distinct group was weighed to the nearest 0.01 g on a Mettler[1] balance, immediately after blotting. Parasites in the stomach were included as part of the stomach contents and are incorporated in the tables under "Other Phyla."

FOOD HABITS

Weight is a more meaningful method of quantifying food habits data than numbers because of the large difference in size between prey organisms. For this reason the food habits of each species of fish are summarized as percent weight. The percent weight is calculated by dividing the weight of each prey group by the total weight of the prey and multiplying by 100. The actual weight of any prey consumed may be computed by multiplying the mean weight per stomach by the percent weight and then by the number of fish examined. The mean weight per stomach was calculated by dividing the total stomach contents weight by the total number of stomachs examined.

In the tables the subtotals for the major prey categories, i.e. subtotals for the major taxa, are offset and underlined. The tables follow a standard format to facilitate comparison of food habits between

species. In the text the broader groupings of prey, as presented in the tables, are discussed in detail. The percent weight is included in parentheses after the first mention of a prey group in order to quantify that particular prey's significance in the diet at that taxonomic level.

FOOD RESOURCE PARTITIONING

Diet Overlap

Percent similarity, as a measure of diet overlap, was calculated according to the formula given by Whittaker and Fairbanks (1958) as follows:

$$P.S. = 100-.5\Sigma |a-b|$$

or, more simply, by summing the smaller value, in this case the percent weight, for all prey shared by the two predators. Accordingly:

$$P.S. = \Sigma \min (a,b)$$

where:

P.S. = percent similarity

a = percent weight for a given prey group for predator A.

b = percent weight of the same prey group for predator B.

The percent similarity between the diets was calculated by summing the smallest percent weight for each prey group for all predator combinations. If a +, indicating <0.1% weight, was the smallest value for any prey group in the food habits table it was arbitrarily assigned a value equal to 0.05% for the calculations. After all possible combinations were computed the values were arrayed in a trellis diagram. The closer

a value is to 100% the more similar the diet of the two predators and conversely a value of 0 implies that the food habits of the two fish are mutually exclusive.

Partition Plot

Another way of evaluating food resource subdivisioning is to identify major food-energy sources and present the data in partition plots as outlined by Tyler (1972). In this paper major food-energy sources are defined as any prey constituting $\geq$10% of the total diet by weight for any one predator. Although this definition is arbitrary it serves to highlight what Tyler (1972) refers to as "principal prey." These major prey are, of course, dependent upon the actual grouping of the prey categories. Thus, in this paper categories of broad taxonomic significance may occur, such as "Other Pisces" or "Other Crustacea." Nevertheless, when food habits for a number of fish are divided into a specified group of prey categories a partition plot will identify what prey groups the fish share in common. A more detailed examination of the food habits of the fish sharing a broad taxonomic prey group will elucidate what specific prey they do or do not share in common and consequently how specialized their resource partitioning is.

RESULTS

Food Habits

Table 2 and Figure 2 summarize the food habits of 15 species of the Gadiformes collected during the bottom trawl survey cruises 1969-1972. The table and figure combine the data for all fish collected in the five geographical areas of the Northwest Atlantic for both spring and autumn cruises. The number of fish examined, together with the average length

of each species for those years of the groundfish survey are also given in the table. The figure condenses the prey into major taxonomic groups with the actual values plotted being those offset and underlined in the table. However, the three groups, other phyla, animal remains and sand and rocks have been combined under the heading - miscellaneous.

Since the data are presented as a percentage it is possible to compare the food habits of each species directly and independently of the sample size but comparison of food habits between species will be discussed in detail in later sections. Below, the food habits of each species are considered separately and the major prey identified to the lowest possible taxonomic level.

Atlantic Cod, Gadus morhua

Atlantic cod preyed most heavily on fish(64.0%). The Clupeidae (27.4%) were the most important prey with the Atlantic herring, Clupea harengus (16.7%), being the largest single contributor. The Gadidae made up 3.7% of the diet while the Scombridae, represented exclusively by the Atlantic mackerel, Scomber scombrus, comprised 3.1% of the diet. The Scorpaendiae contributed 3.2% to the diet, of which 2.6% was identified as the redfish, Sebastes marinus. After fish, the crustaceans were the next most important prey group, making up 20.7% of the diet by weight. Decapods were the most important crustaceans totaling 16.6% of the diet. The Cancridae, represented by both species of Cancer, i.e. C. borealis (1.5%) and C. irroratus (1.4%), constituted a major part of the decapod prey totaling 4.7% of the diet. Pandalid shrimp (2.9%), particularly Dichelopandalus leptocerus (1.3%), and the toad crabs (2.1%) (family Majidae), of the

genus Hyas also accounted for part of the decapod prey. Other phyla played a less important role. Mollusca comprised only 7.6% of the prey with the pelecypods Placopecten (2.9%) and Pecten (1.2%) contributing the major fraction. Scallops were important only on Georges Bank and may represent the remains of scallops discarded by fishermen which were then preyed upon by cod. A similar situation was observed for Georges Bank haddock by Wigley (1956). Polychaetes and echinoderms comprised an even smaller percentage of the diet, 1.3% and 1.2%, respectively.

Pollock, Pollachius virens

Almost one half of the pollock's diet was fish (47.0%). The majority were clupeids (19.2%) which were identified as the Atlantic herring, Clupea harengus (14.3%). Gadids (1.4%) were also preyed on, especially silver hake (1.2%), and in one instance a juvenile pollock was identified as part of the stomach contents. A small percentage of the stomach contents were made up of the scorpaenid, Sebastes marinus (1.5%). "Other Pisces" (24.9%) accounted for over half the fish, and in this category eels (5.7%), lanternfish (2.0%), and the American sand lance, Ammodytes americanus (0.1%) could be identified. The remaining half of the diet consisted exclusively of crustaceans (50.8%). Euphausiids (35.3%) made up the majority of the Crustacea, with Meganyctiphanes norvegica contributing 26.5% of the diet by weight. Other species of euphausiids such as Thysanoessa inermis, T. longicaudata, and Euphausia krohnii were also identified in the stomach contents, but each of these species contributed less than 1% to the total weight of the prey consumed. Pandalid shrimp (2.5%) of the genera Pandalus (1.8%) and Dichelopandalus (0.5%) were of secondary importance, while

Pasiphaea multidentata (10.0%), a pelagic shrimp, listed under "Other Decapoda" was of major significance. Polychaetes, molluscs, echinoderms, and other phyla constituted only 1% of the total diet.

Silver hake, Merluccius bilinearis

The major proportion of the silver hake's diet was fish (70.9%). These hake preyed heavily on the Atlantic mackerel, Scomber scombrus (18.9%), and on clupeids (14.6%) such as the Atlantic herring, Clupea harengus (10.4%) and the alewife, Alosa pseudoharengus (4.2%). Silver hake were also cannabalistic; 3.4% of the Gadidae (7.1%) were silver hake. A large part of the fish could not be identified due to their state of digestion. Consequently, 30.1% of the prey was included under "Other Pisces." However, two groups in this category that could be recognized were the butterfish, Peprilus triacanthus (1.5%), and the lanternfish (family Myctophidae) (1.1%). Crustaceans formed the remaining bulk of the diet, 25.0%. Euphausiids (12.6%), such as Meganyctiphanes norvegica (7.4%), were the single most important crustaceans, but the pandalid shrimp, Dichelopandalus leptocerus (3.2%), was also of some importance. Other crustaceans which contributed to the diet were the two caridean shrimp Crangon septemspinosa (1.4%) and Pasiphaea (2.0%). The only molluscs of any note were the cephalopods (2.2%) such as the squid Loligo (1.5%).

White hake, Urophycis tenuis

White hake preyed heavily on fish (78.2%). The clupeids (12.5%) were the single most important group, with the Atlantic herring, Clupea harengus, making up 4.8% of the total diet. Gadids (10.7%) were also important, with silver hake (3.0%), red hake (0.8%), Atlantic cod (0.5%), haddock (0.5%), longfin hake (0.3%), and white hake (0.2%) all having been identified in the stomach contents.

The Atlantic mackerel, Scomber scombrus (7.3%) was also important prey. Many of the fish in the category "Other Pisces" (46%) were identified. Among those fish that could be identified to species were the argentine, Argentina silus (8.9%), wrymouth, Cryptocanthodes maculatus (0.8%), sand lance, Ammodytes americanus (0.7%), and the butterfish, Poronotus triacanthus (0.4%). Crustacea (17.3%) constituted most of the remainder of the diet. Of primary importance in this group were the pandalid shrimp of which four species have been identified, Pandalus borealis (2.2%), Dichelopandalus leptocerus (0.8%), P. montagui (0.5%), and P. propinquus (<0.1%). Euphausiids such as Meganyctiphanes (2.1%) and Thysanoessa inermis (0.3%) were also of some significance. Rock crabs of the family Cancridae, i.e., C. borealis (0.2%) and C. irroratus (0.1%), were also identified as prey. Similarly, Crangon (0.2%) was identified as being of minor dietary importance. Among the "Other Decapoda" the red crab, Geryon (0.9%) was the most important. The only other category that contributed to the diet to any degree were cephalopods (2.1%) of the genus Loligo (1.2%) and Rossia (0.1%).

Offshore hake, Merluccius albidus

Offshore hake preyed most heavily on fish, which accounted for 93.4% of the diet. The Gadidae contributed 59.9% of the diet by weight but none of the remains in the stomachs could be identified to lower than the family level. None of the fish remains in the "Other Pisces" category (33.5%) could be identified. Crustaceans were of secondary importance (5.5%) and those that could be identified were the two genera of pandalid shrimp (2.5%),

Dichelopandalus leptocerus (2.4%) and Pandalus (0.1%). Euphausiids (1.1%), in particular Meganyctiphanes norvegica (0.9%), were of little dietary significance. The only other decapod identified was the pelagic shrimp Pasiphaea (0.9%).

Cusk, Brosme brosme

Cusk are primarily fish eaters (71.5%) but none of the prey species could be identified from the digested remains found in the stomachs. Crustaceans are also a major prey category, 20.4%. Within this group the spider crab (Majidae), Hyas coarctatus (1.7%) and several species of pandalid shrimp (4.1%), Pandalus borealis (3.3%), P. propinquus (0.1%), and Dichelopandalus leptocerus (0.7%) were identified. The Penaeidea (1.3%) also contributed a small amount to the diet. The brittle star, Ophiopholus aculeata (6.8%) was the only echinoderm preyed upon.

Red hake, Urophycis chuss

Crustaceans (54.1%) were the major prey of red hake. A number of different families contributed to the diet, with the Pandalidae (12.1%), especially of the genus Dichelopandalus (7.1%), being of primary importance. The galatheid crab, Munida (10.2%), which is included under "Other Decapoda," was also a major dietary component. Of secondary importance were the Cancridae (5.3%), particularly C. irroratus (2.1%), the Crangonidae (3.0%), the Axiidae (2.0%), Axius (0.6%), Calocaris (1.2%), and a variety of different species of amphipods (7.4%). Fish were also important prey (25.3%). Clupeids (0.5%), Atlantic mackerel, Scomber scombrus (0.4%), and the gadids such as silver hake (0.2%) and other red hake (0.2%) all contributed to the diet. The flatfish prey included

Gulf stream flounder, Citharichthys arctifrons (0.5%) and the American plaice Pseudopleuronectes americanus (0.1%). Among the category "Other Pisces" (23.5% the wrymouth, Cryptocanthodes maculatus (1.1%) and the snake eel, Omochelys ementifer (0.9%) were identified. The Mollusca also contributed to the diet (6.3%), however, most of them were not identifiable to below the class level. Of the gastropods consumed, only Buccinium (0.2%) was identified to the genus level. Polychaetes were also a minor prey group (2.9%), but identifications below the family level were impossible from the partially digested remains.

Spotted hake, Urophycis regius

Crustacea (47.5%) form almost half the diet of spotted hake. Among the most important contributors to this assemblage of crustaceans were the galatheid crabs, Munida iris (8.8%), M. valida (4.5%), remains of Munida (3.1%) that could not be identified to species, and other galatheids of the genus Munidopsis (1.7%). These crabs form the majority of the animals in the category "Other Decapoda," and were the single most important prey. Other crustaceans of some significance were amphipods (7.3%), especially the Hyperiidae (4.4%), the rock crab, Cancer irroratus (4.2%), the Crangonidae (4.1%) such as Crangon (3.9%) and Pontophilus (0.1%), the pandalid shrimp, Dichelopandalus (3.7%), and lastly, isopods (2.0%) which are included in the category, "Other Crustacea." Fish constituted over one third of the spotted hake's diet, 34.2%. Gadids such as silver hake (2.2%) and red hake (2.1%) were important prey, along with the Atlantic mackerel, Scomber scombrus (3.3%). The bothid prey included the Gulf Stream flounder, Citharichthys arctifrons (1.8%), whereas the only member of the

Pleuronectidae identified was the yellowtail, Limanda ferruginea (0.5%). Fish, considered under the category "Other Pisces," that could be identified were cusk-eel (family Ophidiidae) (4.4%), lanternfish (family Myctophidae) (3.0%), primarily of the genus Myctophum (1.5%), and the snake eel, Omochelys cruentifer (0.1%). The only other taxon that was of significance as prey is the Mollusca. Within this phylum, Cephalopoda (11.2%) was the most important class. Two genera of squid were identified in the stomachs, Loligo (4.2%) and Rossia (0.4%). Most of the remaining cephalopods (6.6%) could not be identified.

Haddock, Melanogrammus aeglefinus

Haddock fed on a variety of benthic invertebrates with echinoderms (29.9%) of the family Ophiuridea (21.6%) being of major importance. The brittle stars Ophiura (6.2%) and Ophiopholis (5.5%) were the two most important prey items. Polychaetes, crustaceans, and fish, all contributed about equally to the diet, 17.6%, 16.2%, and 14.6%, respectively. A number of different polychaetes were identified in the stomach contents. For example, Aphrodita (0.5%), Cistenidae (0.2%), Chone infundibulinformis (0.1%), Sabella (0.1%), and Nephtys (0.1%). The single most important species was Ammotrypane aulogaster (3.8%) which accounted for more than one-quarter of the category "Other Polychaeta" (12.7%). Amphipods (6.4%), particularly gammaridean amphipods (4.2%), were the largest component of the crustacean prey. Other crustaceans of importance were euphausiids (2.6%), such as Meganyctiphanes norvegica (1.8%), and the pandalid shrimp (1.4%), Pandalus (0.7%) and Dichelopandalus leptocerus (0.5%). The

importance of fish may be slightly overemphasized from the present results. The Clupeidae appear to be a major food source, however, the entire weight (12.9%) was due to the consumption of herring eggs rather than adult or juvenile fish. Finally, sand and rocks made up 8.7% of the stomach contents by weight, thus reflecting the haddock's benthic habits.

Longfin hake, Phycis chesteri

The longfin hake preyed primarily on Crustacea, as this prey group made up 97.6% of the diet. However, the total quantity of prey examined was relatively small (35.28 g) although it represented 126 fish. Possibly a more extensive study of the food habits of this fish would broaden the spectrum of prey consumed. Nevertheless, in this study the single most important prey item was the euphausiid, Meganyctiphanes norvegica, which constituted more than half (55.9%) of the diet. The only other crustacean identified to the genus level was the shrimp, Pandalus (8.6%).

Fourbeard rockling, Enchelyopus cimbrius

A large proportion of the diet of the fourbeard rockling was Crustacea (57.4%). The primary prey species was Crangon septemspinosa (40.7%). The pandalid shrimp, Dichelopandalus leptocerus (9.6%), was of secondary importance, while euphausiids (1.0%) and amphipods (1.0%) contributed little to the diet. Polychaetes (12.5%) were also preyed upon but the only identifiable genus was Ammotrypane (3.3%). Unidentified animal remains made up 30.1% of the diet. This is due to the state of digestion of the prey and also, possibly, because of the small total weight in the stomachs (14.4 g). Consequently, a small increase in unidentified material would greatly influence the percentage of animal remains.

Marlin spike, Nezumia bairdi

This summary of the food habits of the marlin spike is based on a total of only 23 fish and an extremely small weight (3.22 g) for all the prey. The breakdown in Table 2, as percent weight, may serve more as a qualitative guide to the food habits, since the percent composition might vary quite strikingly if more fish had been available for analysis. In any case, it is likely that the same type of prey would be eaten. The two most important prey groups were the crustaceans (47.3%) and polychaetes (27.5%). The polychaete remains could not be identified below the phylum level. Some of the crustaceans were identifiable, such as hippolytid shrimp, Eualus pusiolus (26.0%) which accounts for most of the animals included in "Other Decapoda." Mysids, Neomysis americana (4.0%), the isopod, Cirolina (0.6%), and euphausiids (<0.1%) were the other crustaceans that could be identified.

Longnose grenadier, Coelorhynchus carminatus

As has been described for the marlin spike, the summary of food habits for the longnose grenadier is based on a small sample both in the number of fish analyzed and the total weight of prey. It is possible that the percent composition of the diet would differ markedly if more fish were available for analysis. From the available data, polychaetes and decapod shrimp were the only identifiable prey.

Fawn cusk-eel, Lepophidium cervinum

The stomach contents of 109 cusk-eel were examined, but the total weight of the prey amounted to only 3.27 g. For this reason the percent weights list

in the table should be used more as a qualitative guide to the food habits, since a small change in weight could markedly influence the percent composition of the diet. Bearing this precaution in mind, the prey items are discussed below.

The most significant prey group was the crustaceans (28.8%). Within this group the "Other Crustacea" were the largest contributors, primarily the isopod Cirolina (12.6%). A variety of different families of amphipods were found in the stomachs, the most important being the Gammaridae (4.6%). Other crustaceans that could be identified were two members of the Crangonidae (6.4%), (Crangon (2.3%) and Sabinea (2.6%)), the munid crab, Munidopsis (0.7%), and the mud shrimp, Calocaris (0.3%). Polychaetes (9.9%) were moderately important, with a few identified to the genus level, such as Nephtys (1.8%), Scalibregma (1.0%) and Nothria (0.6%). "Other phyla" (29.8%) was the single most important group contributing to the stomach contents, and this was composed of a large number of parasitic nematodes (29.4%).

Ocean pout, Macrozoarces americanus

Ocean pout preyed most heavily on echinoderms (70.7%), the single most important species being the sand dollar, Echinarachnius parma (56.3%). Ophiuroids (5.3%), such as Ophiopholis (1.1%) and Ophiura (0.1%), were also identified in the stomach contents. Crustaceans (11.1%), most notably the rock crabs of the family Cancridae (2.9%), both Cancer irroratus (1.0%) and C. borealis (0.7%), and a number of different amphipods (5.6%) were also prey items. Polychaetes of the genus Aphrodita (3.0%) and the tunicate, Cnemidocarpa mollis (1.7%), which falls into the category "Other Phyla," were other components of the diet.

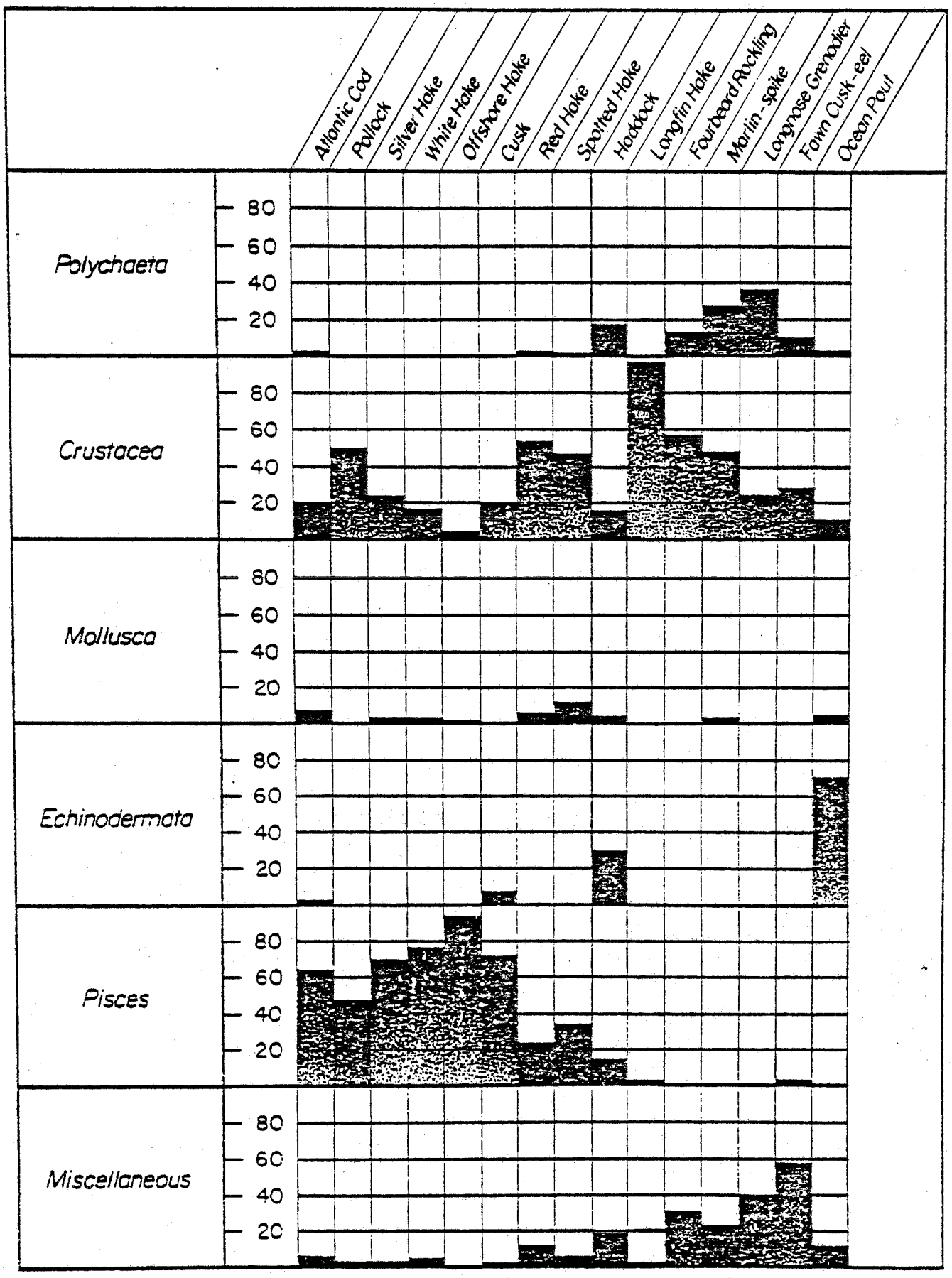


Figure 2. A diagrammatic representation of the prey for each of the 15 gadiform fishes from all five geographic areas in the Northwest Atlantic. The data are expressed as percent weight.

Table 2. Stomach contents of some gadiform fishes, expressed as percent weight, collected during the spring and autumn groundfish survey cruises, 1969-1972. (+ indicates <0.1%).

PREY/PREDATORS	Atlantic cod		Pollock		Silver hake		White hake	
POLYCHAETA	1.3		0.1		0.2		0.2	
Terebelliformia		+		-		-		-
Sabelliformia		-		-		-		-
Nereidiformia		1.2		+		0.2		0.1
Other Polychaeta		0.1		+		+		0.1
CRUSTACEA	20.7		50.8		25.0		17.3	
Axiidae		0.5		-		+		0.1
Cancridae		4.7		-		0.1		0.3
Crangonidae		0.3		+		1.4		0.3
Majidae		2.1		-		-		-
Paguridae		1.7		-		-		+
Pandalidae		2.9		2.5		5.3		9.1
Other Decapoda		4.4		10.4		2.6		2.3
Euphausiacea		2.1		35.3		12.6		4.3
Mysidacea		0.1		+		0.2		+
Amphipoda		0.5		0.1		0.4		0.1
Other Crustacea		1.4		2.4		2.4		0.8
MOLLUSCA	7.6		0.4		2.2		2.1	
Pelecypoda		4.3		+		+		+
Gastropoda		2.4		0.4		+		+
Cephalopoda		0.1		+		2.2		2.1
Other Mollusca		0.8		+		+		+
ECHINODERMATA	1.2		-		+		+	
Echinoidea		0.1		-		-		-
Ophiuroidea		0.6		-		+		+
Other Echinodermata		0.5		-		+		-
PISCES	64.0		47.0		70.9		78.2	
Clupeidae		27.4		19.2		14.6		12.5
Gadidae		3.7		1.4		7.1		10.7
Scrombridae		3.1		-		18.9		7.3
Scorpaenidae		3.2		1.5		-		1.7
Bothidae		0.3		-		-		-
Pleuronectidae		2.5		-		0.1		-
Other Pisces		23.8		24.9		30.1		46.0
OTHER PHYLA	0.4		0.5		0.1		0.1	
ANIMAL REMAINS	3.2		1.2		1.6		2.1	
SAND AND ROCK	1.6		0.1		+		+	
Number of stomachs	1541		644		2136		907	
Percent empty	7.6		11.8		32.8		23.9	
Mean wt. per stomach(g)	27.9		18.2		2.5		18.0	
Mean predator length(cm)	54.7		46.8		27.5		46.4	

Table 2. Stomach contents of some gadiform fishes, expressed as percent weight, collected during the spring and autumn groundfish survey cruises, 1969-1972. (+ indicates <0.1%).

PREY/PREDATORS	Offshore hake		Cusk		Red hake		Spotted hake	
POLYCHAETA	-		-		2.9		0.5	
Terebelliformia		-		-		+		-
Sabelliformia		-		-		0.1		-
Nereidiformia		-		-		1.3		0.1
Other Polychaeta		-		-		1.5		0.4
CRUSTACEA	5.5		20.4		54.1		47.5	
Axiidae		-		-		2.0		+
Cancridae		-		-		5.3		6.8
Crangonidae		-		-		3.0		4.1
Majidae		-		1.7		0.1		+
Paguridae		-		-		2.8		0.1
Pandalidae		2.5		4.1		12.1		3.9
Other Decapoda		1.9		11.6		13.4		20.8
Euphausiacea		1.1		0.3		3.0		+
Mysidacea		-		-		0.1		+
Amphipoda		-		+		7.4		7.3
Other Crustacea		-		2.7		4.9		4.5
MOLLUSCA	0.9		-		6.3		11.5	
Pelecypoda		-		-		+		0.2
Gastropoda		-		-		3.1		0.1
Cephalopoda		0.9		-		1.3		11.2
Other Mollusca		-		-		1.9		+
ECHINODERMATA	-		6.8		0.6		+	
Echinoidea		-		-		0.1		-
Ophiuroidea		-		6.8		-		-
Other Echinodermata		-		-		0.5		+
PISCES	93.4		71.5		25.3		34.2	
Clupeidae		-		-		0.5		-
Gadidae		59.9		-		0.4		4.3
Scrombridae		-		-		0.4		3.3
Scorpaenidae		-		-		-		-
Bothidae		-		-		0.5		1.8
Pleuronectidae		-		-		+		0.8
Other Pisces		33.5		71.5		23.5		24.0
OTHER PHYLA	+		0.2		0.8		+	
ANIMAL REMAINS	0.2		0.9		9.6		5.9	
SAND AND ROCK	-		0.2		0.4		0.3	
Number of stomachs	73		72		1110		876	
Percent empty	57.5		73.6		15.9		14.3	
Mean wt. per stomach(g)	2.4		3.2		2.3		1.1	
Mean predator length(cm)	32.2		63.0		30.3		18.4	

Table 2. Stomach contents of some gadiform fishes, expressed as percent weight, collected during the spring and autumn groundfish survey cruises, 1969-1972. (+ indicates <0.1%).

PREY/PREDATORS	Haddock	Longfin hake	Fourbeard rockling	Marlin spike
POLYCHAETA	17.6	-	12.5	27.5
Terebelliformia	1.6	-	-	-
Sabelliformia	1.3	-	-	-
Nereidiformia	2.0	-	-	-
Other Polychaeta	12.7	-	12.5	27.5
CRUSTACEA	16.2	97.6	57.4	47.3
Axiidae	0.9	-	-	-
Cancridae	0.1	-	-	-
Crangonidae	0.1	-	40.7	-
Majidae	0.3	-	-	-
Paguridae	0.4	-	-	-
Pandalidae	1.4	8.7	9.6	-
Other Decapoda	1.8	15.4	4.7	27.5
Euphausiacea	2.6	60.3	1.0	+
Mysidacea	0.1	-	+	4.0
Amphipoda	6.4	+	1.0	7.8
Other Crustacea	2.1	13.2	0.4	8.0
MOLLUSCA	3.1	-	-	2.5
Pelecypoda	2.3	-	-	2.5
Gastropoda	0.3	-	-	-
Cephalopoda	0.2	-	-	-
Other Mollusca	0.3	-	-	-
ECHINODERMATA	29.9	0.3	-	-
Echinoidea	5.7	0.3	-	-
Ophiuroidea	21.6	-	-	-
Other Echinodermata	2.6	-	-	-
PISCES	14.6	1.1	+	-
Clupeidae	12.9	-	-	-
Gadidae	0.3	-	-	-
Scrombridae	-	-	-	-
Scorpaenidae	-	-	-	-
Bothidae	-	-	-	-
Pleuronectidae	+	-	-	-
Other Pisces	1.4	1.1	+	-
OTHER PHYLA	1.0	+	+	-
ANIMAL REMAINS	8.9	1.0	30.1	22.4
SAND AND ROCK	8.7	-	-	0.3
Number of stomachs	1131	126	48	23
Percent empty	7.3	62.7	12.5	8.7
Mean weight per stomach(g)	6.8	0.28	0.30	0.14
Mean predator length (cm)	45.6	23.6	24.2	24.2

Table 2. Stomach contents of some gadiform fishes, expressed as percent weight, collected during the spring and autumn groundfish survey cruises, 1969-1972. (+ indicates <0.1%).

PREY/PREDATORS	Long-nose grenadier		Fawn cusk-eel		Ocean pout	
POLYCHAETA	35.8		9.9		3.3	
Terebelliformia		-		-		+
Sabelliformia		-		-		-
Nereidiformia		-		2.4		3.0
Other Polychaeta		35.8		7.5		0.3
CRUSTACEA	24.8		28.8		11.1	
Axiidae		-		0.3		-
Cancridae		-		-		2.9
Crangonidae		-		6.4		+
Majidae		-		-		0.3
Paguridae		-		+		0.5
Pandalidae		-		-		+
Other Decapoda		23.6		0.7		0.8
Euphausiacea		-		-		-
Mysidacea		-		-		-
Amphipoda		-		4.9		5.6
Other Crustacea		1.2		16.5		1.0
MOLLUSCA	-		0.2		4.0	
Pelecypoda		-		-		3.3
Gastropoda		-		-		0.6
Cephalopoda		-		-		-
Other Mollusca		-		0.2		0.1
ECHINODERMATA	-		0.5		70.7	
Echinoidea		-		-		64.9
Ophiuroidea		-		0.2		5.3
Other Echinodermata		-		0.3		0.5
PISCES	+		2.3		0.1	
Clupeidae		-		-		-
Gadidae		-		-		-
Scrombridae		-		-		-
Scorpaenidae		-		-		-
Bothidae		-		-		-
Pleuronectidae		-		-		-
Other Pisces		+		2.3		0.1
OTHER PHYLA	2.8		29.8		2.7	
ANIMAL REMAINS	36.6		28.5		4.0	
SAND AND ROCK	-		+		4.1	
Number of stomachs	11		109		351	
Percent empty	36.4		22.9		25.9	
Mean wt. per stomach(g)	0.09		0.03		6.9	
Mean predator length(cm)	19.3		22.3		46.0	

Areal Food Habits

Food habits data for the 15 species of Gadiformes for each of the five geographic areas (see Figure 1) in the Northwest Atlantic are presented in Tables 3-17. In this section the data is compared and contrasted for each species and each of the five areas to emphasize similarities and differences in food habits over these broad geographic regions.

Atlantic Cod, *Gadus morhua*

In all of the geographic areas fish was the major prey of Atlantic cod with the Clupeidae generally being the most important. In the Middle Atlantic, however, only seven Atlantic cod stomachs were examined and yellowtail (33.7%) was the most important prey. In Southern New England and on Georges Bank most of the clupeids could be identified as the Atlantic herring *Clupea harengus* (27.1% and 31.4%, respectively). The only other clupeid identified to species level was an alewife, *Alosa pseudoharengus* (0.9%) from Georges Bank. A variety of other fish were eaten throughout the Northwest Atlantic and have been listed by area as follows:

Middle Atlantic - Red hake (12.9%); winter flounder, *Pseudopleuronectes americanus* (10.0%); beard fishes, Polymixiidae (9.0%); cusk-eels, Ophidiidae (6.4%); sand lance, *Ammodytes* (2.7%); and the longhorn sculpin, *Myoxocephalus octodecemspinosus* (1.5%).

Southern New England - Atlantic mackerel, *Scomber scombrus* (6.4%); windowpane, *Scophthalmus aquosus* (1.9%); a seahorse, *Hippocampus* (0.2%); Cryptacanthodidae (2.8%); and the Cottidae (1.1%).

Georges Bank - Yellowtail, *Limanda ferruginea* (3.4%); American plaice, *Hippoglossoides platessoides* (0.9%); summer flounder, *Paralichthys dentatus* (0.1%); windowpane (0.2%); the rock gunnel, *Pholis gunnellus* (0.1%); sculpins such as the grubby, *Myoxocephalus aeneus* (<0.1%), the longhorn

sculpin (0.5%), and the mailed sculpin, Triglops nybelini (0.1%).

Gulf of Maine - The scorpaenids, Helicolenus dactylopterus (1.9%) and Sebastes marinus (9.6%); Atlantic mackerel (8.7%); wolffish, Anarhichadidae (3.3%); Argentina sp. (3.2%); silver hake (1.6%); and the wrymouth, Cryptacanthodes maculatus (0.4%).

Western Nova Scotia - sand lance (11.3%); gadids, including silver hake (1.7%), haddock (0.7%), and Atlantic cod (0.1%); Atlantic mackerel (1.7%); redfish, Sebastes marinus (0.9%); wolffish (0.2%); and the rock gunnel (0.1%).

Crustacea were generally the second most important group of prey and, like fish, a variety of different crustaceans were consumed, but only the major groups will be discussed here. In the Middle Atlantic the only crustacean prey of any significance was hermit crabs, Paguridae (3.8%) and rock crabs (2.5%). Crustaceans comprised 20.9% of the cod's diet in Southern New England; and the rock crabs (12.8%), Cancer borealis (2.8%) and C. irroratus (1.8%), accounted for more than half of this group. On Georges Bank rock crabs (4.4%) were again the most important crustacean prey but pandalid shrimp (3.1%) (i.e., Dichelopandalus (2.3%), and hermit crabs, Pagurus (2.5%) also contributed to the diet. In the Gulf of Maine rock crabs (5.9%) and pandalid shrimp (2.8%) were again preyed upon but the red crab, Geryon (10.1%) was the most important decapod prey. Spider crabs (family Majidae) of the genus Hyas (7.4%) and euphausiids (8.8%) such as Meganyctiphanes (2.6%) were the primary crustacean prey in Western Nova Scotia. Of secondary importance were the Paguridae (2.2%) and the pandalid shrimp (3.9%), Dichelopandalus leptocerus (0.8%) and Pandalus montagui (0.3%).

Two other taxa were of some significance in two of the geographic areas. In Southern New England polychaetes of the order Nereidiformia made up 6.4% of the diet, and this was entirely due to the sea mouse, Aphrodita. The Mollusca accounted for 15.6% of the prey on Georges Bank. The pelecypods contributed most of the weight (9.4%), with the scallops, Placopecten (6.3%) and Pecten (2.6%), accounting for the majority of theprey in this group but these scallops may be scallop remains discarded by fishermen since only scallop viscera and no adductor muscles were found in the stomachs.

Pollock, Pollachius virens

Because only six fish were collected for stomach content analysis in Southern New England and the Middle Atlantic, the following discussion is limited to the other three areas.

The major prey of pollock on Georges Bank and in Western Nova Scotia were crustaceans (71.6% and 61.2%, respectively). In both of these areas euphausiids comprised more than one half the diet. Of the euphausiids identified, Meganyctiphanes norvegica was the most important, contributing 46.6% of the diet on Georges Bank and 46.2% in Western Nova Scotia. Other euphausiids, such as Thysanoessa longicaudata, were preyed upon in both areas (3.6% on Georges Bank and <0.1% in Western Nova Scotia), but Euphausia krohnii (0.1%) was only found in stomachs collected from Georges Bank. Apart from euphausiids, pandalid shrimp, primarily Pandalus sp. (2.7% on Georges Bank and 2.9% in Western Nova Scotia), and "Other Decapoda" such as Pasiphaea (4.0% in Western Nova Scotia) were the only other important Crustacea. Fish accounted for the remaining bulk of the diet and a number of different species were identified in the stomach contents as follows: Georges Bank - lanternfish (8.8%), the pearlside, Maurolicus pennanti (1.2%); silver hake (0.4%); and

pollock (0.1%). Western Nova Scotia - the snake eel, Omochelys cruentifer (5.5%); redfish, Sebastes marinus (1.3%); haddock (0.7%): silver hake (0.6%); blueback herring, Alosa aestivalis (0.5%); and the sand lance, Ammodytes (0.4%).

In the Gulf of Maine the emphasis shifted from Crustacea (33.8%) to Pisces (64.9%) as the major prey category. This differenee was almost entirely caused by heavy predation on the Atlantic herring, Clupea harengus (29.4%). Few other fish, except for redfish (2.3%) and silver hake (1.9%) could be identified from the partially digested remains. Crustaceans remained an important prey group but the groups comprising the category differed from those of Georges Bank and Western Nova Scotia. "Other Decapoda" were the most important, with Pasiphaea being the largest single prey item (5.5%). Euphausiids also contributed to the diet and, again, Meganyctiphanes (6.7%) was the most important, although Thysanoessa inermis (0.1%) was also present in the stomach contents. Finally, three species of pandalid shrimp were identified, Dichelopandalus leptocerus (0.9%), Pandalus borealis (0.6%), and P. montagui (<0.1%)..

Silver hake, Merluccius bilinearis

Silver hake are fairly ubiquitous with the result that stomachs were collected in reasonably large numbers from all geographic areas. In all five areas fish was the major prey but the species of fish eaten differed. Gadids (13.5%) were of primary importance in the Middle Atlantic where silver hake were heavily cannibalistic (12.6%). Yellowtail, Limanda ferruginea (0.7%), was the only pleuronectid eaten and some of the fish

in the "Other Pisces" category were the butterfish, Peprilus triacanthus (0.9%), horned lanternfish, Ceratoscopelus maderensis (0.6%), and the longhorn sculpin, Myoxocephalus octodecemspinosus (0.1%). In Southern New England the Gadidae (12.6%) were also important and silver hake were again cannibalistic (7.4%). The Atlantic mackerel Scomber scombrus (31.7%), however, was the primary prey. "Other Pisces" included butterfish (4.8%), the sand lance, Ammodytes (<0.1%), and an unidentified member of the Cottidae (0.1%). Silver hake (<0.1%) were again identified as prey on Georges Bank but their contribution to the diet was insignificant. The only other fish identified were lanternfish, Myctophidae, (3.2%) and the snakeblenny, Lumpenus lumpretaeformis (0.1%). Atlantic mackerel (28.0%), Atlantic herring, Clupea harengus (23.1%), alewife, Alosa pseudoharengus (9.4%), silver hake (1.4%), and butterfish (1.1%) were all preyed upon in the Gulf of Maine. In Western Nova Scotia the Gadidae (51.2%) were preyed on extensively but silver hake only comprised 1.1% of the diet. None of the other fish were identified to species.

Crustacea formed the remaining bulk of the diet in all five geographic areas, and within this category the Euphausiacea and Pandalidae were the most important. In the Middle Atlantic, Dichelopandalus (8.2%) was the only pandalid shrimp identified. The majority of euphausiids (7.0%) were identified to the family level, however, those identified to the species level were found to be Meganyctiphanes norvegica (0.1%). The only other shrimp of any signficance was Crangon septemspinosa (7.4%). Dichelopandalus leptocerus was also

important in Southern New England and Georges Bank (8.6% and 1.8%, respectively), as were the euphausiids, Meganyctiphanes (5.4% and 9.6%, respectively). In the Gulf of Maine, Meganyctiphanes was again the major crustacean prey (8.0%). The shrimp Pasiphaea (4.4%) replaced the pandalids, but Dichelopandalus (0.5%) and Pandalus borealis (0.3%) were still eaten in small quantities. In Western Nova Scotia euphausiids (28.4%), especially Meganyctiphanes (13.4%), were the only crustaceans of any significance

The Mollusca were the only other taxonomic grouping to warrant discussion and here only in the Middle Atlantic. Cephalopods accounted for 13.6% of the diet with Loligo (8.3%) and Rossia (1.2%) being the two general identified.

White hake, Urophycis tenuis

White hake fed most heavily on fish in the four areas where they were collected for stomach content analysis. In Southern New England, silver hake, (18.1%), and Atlantic mackerel, Scomber scombrus (16.6%), were the most important prey, but "Other Pisces" such as the butterfish, Peprilus triacanthus (2.8%), and wrymouth, Cryptacanthodes maculatus (1.7%), were also identified in the stomach contents. White hake taken from Georges Bank were also found to prey on silver hake (6.0%), but other gadids such as red hake (7.7%), haddock (3.8%), and to a lesser degree, longfin hake (0.3%), were important. Clupeids represented almost half the fish eaten (27.7%), and of these almost half (12.1%) were identified as Atlantic herring, Clupea harengus.
The Clupeidae also contributed heavily to the diet of

white hake in the Gulf of Maine (17.5%) and at least part of the remains were identified as Atlantic herring (6.6%). Atlantic mackerel (9.6%) also accounted for some of the prey as did a number of fish in the "Other Pisces" category (47.2%). Some of these other fish were Argentina silus (16.6%), the wrymouth (1.1%), pearlsides, Maurolicus (0.1%), and the sand lance, Ammodytes (0.1%). In Western Nova Scotia, Atlantic cod (2.2%), longfin hake (1.3%), and white hake (0.4%) contributed to the gadid prey. The redfish (4.7%), sand lance (2.9%), and longhorn sculpin, Myoxocephalus octodecemspinosus (0.2%), are most of the other fish that were identified.

Crustacea was generally the second most important taxonomic grouping except in Southern New England where Cephalopods (11.6%) such as Loligo (6.5%) were preyed on. In the Gulf of Maine and on Georges Bank three species of pandalid shrimp were eaten, Dichelopandalus leptocerus (0.1% in the Gulf of Maine and 3.5% on Georges Bank), Pandalus borealis (3.9% in the Gulf of Maine and 0.4% on Georges Bank) and P. montagui (0.5% in the Gulf of Maine and 0.2% on Georges Bank). In Western Nova Scotia P. propinquus (0.2%) was also present but P. borealis was not. The only other crustaceans of note were the euphausiids, and these preimarily in the Gulf of Maine, wehre Meganyctiphanes (3.5%) was the most important species.

Offshore hake, Merluccius albidus

Stomachs were collected from offshore hake in three of the five geographic areas. In the Middle Atlantic, data were collected from only four fish, and therefore a discussion of the food habits in this area is of little value. Suffice it to say that the two species of Crustacea eaten, Meganyctiphanes norvegica and Pasiphaea sp., were also preyed upon

in the other geographic areas. In Southern New England and on Georges Bank, the composition of the diet was very similar. In both areas fish was the major prey group (96.7% in Southern New England and 80.4% on Georges Bank); however, the particular species of fish could not be identified. Crustaceans were of secondary importance, with Dichelopandalus leptocerus (1.5% in Southern New England and 6.4% on Georges Bank) being the main prey item within this group.

Cusk, Brosme brosme

The areal breakdown of food habits for cusk differs significantly from the summary (Table 2) which combines all areas into a single group. This is primarily due to the heavy predation on fish in Western Nova Scotia (98.2% of the diet). In the three other areas where cusk were collected the major prey was either crustaceans or echinoderms. On Georges Bank only four fish were examined and, of the two which had food in their stomachs, the prey was either the brittle star, Ophiopholis aculeata (80.0%) or the toad crab, Hyas coarctatus (20.0%). In Southern New England very few fish were examined. The total quantity of prey was extremely small and consisted exclusively of amphipods, Aoridae (57.1%) and Gammaridae (42.9%). The largest sample of cusk came from the Gulf of Maine, and here the primary prey was Crustacea (90.6%). Of the decapods that could be identified the three pandalids, Pandalus borealis (17.0%), Dichelopandalus leptocerus (3.5%), and P. propinquus (0.5%), together with some penaeid shrimp (6.9%), were the most important. However, small quantities of Meganyctiphanes norvegica (1.7%) were also found in the stomach contents. The remainder of the diet consisted of fish (4.2%), "Other Phyla" such as brachiopods (1.2%), and sand or animal remains (3.9%).

Red hake, Urophycis chuss

In all five geographic areas, at least half the red hake's diet was composed of crustaceans. In the Middle Atlantic, munid crabs of the genera Munida (16.9%) and Munidopsis (3.3%) accounted for a large percentage of the crustaceans classified under "Other Decapoda." Pandalid shrimp (15.7%) were the next most important prey group with the majority of these identified as Dichelopandalus (9.1%). Of secondary importance were the unidentified amphipods (5.1%), the rock crab, Cancer irroratus (2.6%), the sand shrimp, Crangon (2.2%), and the isopod, Cirolina (1.8%). In Southern New England the munid crab, Munida (12.9%), was again of primary importance, as was Dichelopandalus (5.6%). Cancer irroratus (1.6%) and Crangon (1.5%) were also preyed upon. On Georges Bank the hermit carb, Pagurus (10.6%), and the sand shrimp, Crangon (20.6%) were major prey items. Cancer crabs (8.7%) and pandalid shrimp, Dichelopandalus (6.1%), also contributed significantly to the diet. Euphausiids (18.7%), some of which could be identified as Meganyctiphanes (5.6%), the pandaled shrimp, Dichelopandalus (11.6%), and the crab, Cancer (11.2%), were of major importance in the Gulf of Maine, while the pandalids, Dichelopandalus leptocerus (30.9%) and Pandalus montagui (40.3%) were the primary prey in Western Nova Scotia.

In three of the geographic areas, Pisces followed the Crustacea as a major prey category. Many of the fish eaten in the Middle Atlantic could not be

identified. However, of those identified one of the "Other Pisces" was the snake eel, Omochelys cruentifer (5.9%), and the pleuronectid was the winter flounder, Pseudopleuronectes americanus (0.1%). Red hake were cannibalistic in Southern New England (0.3%) but also ate other gadids such as the silver hake (0.3%). The wrymouth, Cryptacanthodes maculatus (1.8%), Gulf Stream flounder, Citharichthys arctifrons (0.9%), and the Atlantic Mackerel Scomber scombrus (0.6%), made up a small percentage of the other fish eaten. On Georges Bank clupeids (3.5%) and "Other Pisces" (1.8%) accounted for all the fish prey. Fish remains (23.9%) from the stomachs of red hake caught in the Gulf of Maine could not be identified.

The only other taxon that was of any significance, and then only on Georges Bank, was the Mollusca of the class Gastropoda (17.4%).

Spotted hake, Urophycis regius

The areal breakdown of food habits for the spotted hake is limited to the Middle Atlantic and Southern New England, since no stomachs were collected in the Gulf of Maine and Western Nova Scotia, and only four fish were analyzed from Georges Bank. A comparison between the two areas showed that the food habits were reasonably similar, the major difference being due to the importance of cephalopods (16.1%), especially Loligo (6.8%), in the Middle Atlantic.

Crustaceans were a major prey category. In both the Middle Atlantic and Southern New England the "Other Decapoda" was the largest grouping consisting mostly of the munid crabs. In the Middle Atlantic, Munida (9.4%), both M. iris (7.4%) and M. valida (1.7%), together with Munidopsis (2.8%), were present in the stomach contents, but in Southern New England the species were restricted to M. iris (11.3%) and M. valida (9.2%). Interestingly, hyperid amphipods were important, making up 3.4% of the diet

in the Middle Atlantic and 6.1% in Southern New England. The rock crab, Cancer irroratus (6.7%) comprised a significant part of the prey in the Middle Atlantic. Other crustaceans of secondary importance were Crangon (4.8% in the Middle Atlantic and 2.6% in Southern New England), Dichelopandalus (3.6% in the Middle Atlantic and 4.0% in Southern New England), and the isopods (3.1% in the Middle Atlantic only) such as Cirolina polita (0.7%) which are included under "Other Crustacea."

Pisces were the last major grouping. In the Middle Atlantic red hake (3.4%) and silver hake (3.3%), the bothid, Citharichthys arctifrons (1.7%), the pleuronectid, Limanda ferruginea (0.8%), and "Other Pisces" (19.2%) such as the snake eel, Omochelys cruentifer (0.2%), and lanternfish (family Myctophidae) (3.9%), constituted the pisces prey. In Southern New England the fawn cusk-eel, Lepophidium cervinum (1.1%), and some unidentified cusk eels (10.8%), together with Atlantic mackerel (9.1%), the Gulf Stream flounder (1.9%), and silver hake (1.1%) represented a large part of the fish consumed.

Haddock, Melangrammus aeglefinus

Few haddocks were collected in the Middle Atlantic and Southern New England and therefore the following discussion is limited primarily to the three other geographic areas.

The food habits of haddock from Georges Bank may be considered slightly atypical. It would appear that fish accounted for more than one quarter (28.4%) of the diet whereas fish were reasonably insignificant in all the other areas. This shift in food habits was not actually due to predation on adult or juvenile fish but rather entirely due to the consumption of herring eggs, implying that

haddock prey heavily on herring spawn when it is available. Polychaetes were also more important prey on Georges Bank (23.5%) than in the other areas. The "Other Polychaeta" category contributed the largest percentage (18.3%) with Ammotrypane aulogaster (8.3%) being the most important animal. Laonice (0.1%), Ophelia (<0.1%), Scalibregma (<0.1%), and Sternaspis (0.1%) were other polychaetes identified in the stomach contents. Noné of the Terebelliformia (2.1%) could be identified below the order level and Chone infundibuliformis (0.3%) was the only Sabelliformia (2.1%) identified to species. The third prey group that was of any significance was the crustaceans (16.0%). Amphipods (7.1%) made up the largest portion but the individual species of amphipods usually accounted for <0.1%. As a group the gammarid amphipods were the most important, with species such as Unciola irrorata (<0.1%), Casco bigelowi (<0.1%), Anonyx sp. (0.1%), Leptocerus pinguis (0.1%), and Pleustes sp. (<0.1%) having been found in the haddock stomachs. Echinoderms (7.8%) and molluscs (3.8%) were the least important prey groups for Georges Bank haddock. Brittle stars such as Ophiopholis aculeata (2.4%) were the most important echinoderm, while pelecypods like Astarte (0.2%) and Pecten (0.1%) were the more important molluscs that could be identified. Sand and rocks (15.3%) were more prevalent in the haddock stomachs collected on Georges Bank than elsewhere, possibly because polychaetes and pelecypods accounted for a larger percentage of the diet here than in the other areas.

The haddock's food habits in the Gulf of Maine and Western Nova Scotia were quite different from the other three geographic areas, but within these two areas the food habits were very similar. For example, in both areas half

the diet consisted of echinoderms. Similarly, crustaceans and polychaetes contributed between 10 to 15% of the diet and molluscs between 1 to 3%. Brittle stars were the main food item, with Ophiura (16.2%) being of primary importance in the Gulf of Maine. However, Amphiura (0.8%), Ophiopholis (0.4%), and Ophiacantha bidentata (<0.1%), together with unidentified ophiuroid remains (20.5%), are also included in this prey group. In Western Nova Scotia three ophiuroids were eaten, Ophiopholis (13.0%), Ophiura (8.2%), and Amphiopolis (0.2%), together with some unidentifiable ophiuroid remains (13.0%). In the Gulf of Maine 15.2% of the diet was crustaceans. The "Other Decapoda" were the largest group (5.9%) primarily because of the shrimp Pasiphaea (4.9%). The shrimp, Pandalus (2.0%), was of secondary importance as were euphausiids (1.9%) and gammarid amphipods (1.8%). Gammarid amphipods (3.4%) as well as the caprellid Aeginina longicornis (0.3%), were the main curstacean prey in Western Nova Scotia, while the Axiidae, both Axius (1.8%) and Calocaris (0.5%) were of secondary importance. Polychaetes were the only other group accounting for much of the diet. The majority were not identified below the order level, but in the Gulf of Maine some of the more common were Sabella (0.4%), Eunice pennata (0.2%), Nephtys (0.2%), Goniada (0.1%), and lumbrineris (0.1%). In Western Nova Scotia a variety of polychaetes were identified in the stomach contents but the only genera contributing >0.1% to the diet were Cistenides (0.5%), Aphrodita (0.8%), and Eunice (0.4%).

Longfin hake, Phycis chesteri

Although longfin hake were collected in all five geographic areas, a discussion of the areal breakdown of the food habits is of little value. Few fish were collected, and on Georges Bank, where the largest sample was

taken, over half the stomachs were empty, effectively leaving a maximum of 26 fish to evaluate food habits in any one region. Nevertheless, in all areas, crustaceans were the major prey, with the euphausiid, Meganyctiphanes norvegica, being the most important.

Fourbeard Rockling, Enchelyopus cimbrius

Fourbeard rockling were collected for stomach contents analysis in three of the five ecological areas. Only on Georges Bank, however, was the total weight of the prey and sample size sufficiently large to warrant discussion. On Georges Bank crustaceans were the major prey, accounting for 59.3% of the diet. The two most important crustaceans were Crangon septemspinosa (46.3%) and Dichelopandalus leptocerus (11.2%). The other taxonomic grouping of importance was the Polychaeta (13.6%), and here the only identification to the genus level was Ammotrypane (3.9%).

Marlin-spike, Nezumia bairdi

Marlin-spike were collected in three of the geographic areas; Southern New England, Gulf of Maine, and Western Nova Scotia, but in very small numbers. Due to the small sample size, both in the number of fish examined and the total weight of prey, a meaningful discussion of areal differences in food habits is unwarranted. Table 2 adequately summarizes the available information on food habits.

Longnose grenadier, Coelorhynchus carminatus

As has been described for the marlin-spike, a meaningful discussion of the areal differences in food habits is not justifiable because of the small number of fish examined and the small quantity of prey in the stomachs.

Fawn cusk-eel, Lepophidium cervinum

Fawn cusk-eel were collected in significant numbers in the Middle Atlantic and Southern New England but the total quantity of prey in the stomachs amounted to only 3.27 g. An areal breakdown of food habits is therefore of little value, especially since almost one gram of the total weight was due to a heavy infestation of parasitic nematodes (37.1%) in the fish collected in the Middle Atlantic. For a summary of the food habits see Table 2.

Ocean pout, Macrozoarces americanus

Ocean pout were collected in all areas but were most abundant in Southern New England and on Georges Bank. In these two areas the major prey was echinoderms, with the sand dollar, Echinarachnius parma, being the single most important species (54.4% in Southern New England and 61.6% on Georges Bank). In Southern New England crustaceans (22.0%) and polychaetes (7.8%) made up most of the remainder of the prey. Amphipods (13.1%) such as Unciola sp. (1.0%) and Leptocerus pinguis (1.2%) were important, as were the rock crabs (5.4%), particularly Cancer irroratus (2.0%). The majority of the polychaete prey was identified as Aphrodita (7.4%). On Georges Bank, crustaceans (4.3%) were of little signficance and ophiuroids (9.6%) such as Ophiopholis (1.1%) and the pelecypod, Pecten (4.5%) formed the remaining bulk of the diet. In the Middle Atlantic few ocean-pout were collected, but as on Georges Bank and in Southern New England, the single major prey species was the sand dollar, Echinarachnius parma (86.3%). In the Gulf of Maine echinoderms were apparently less important

although E. parma still accounted for 24.8% of the prey. "Other Phyla" were also important and the single contributor to this category was the tunicate, Cnemidocarpa mollis (18.5%). Sand and rock (33.4%) made up a large part of the weight of the stomach contents.

Table 3. Areal summary of the stomach contents of the Atlantic cod, *Gadus morhua*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	0.1	6.4	1.1	0.3	0.8
Terebelliformia	-	-	+	+	+
Sabelliformia	-	-	-	-	-
Nereidiformia	0.1	6.4	1.0	0.2	0.6
Other Polychaeta	-	+	0.1	0.1	0.2
CRUSTACEA	10.2	20.9	15.2	26.1	27.6
Axiidae	-	2.4	0.1	+	1.3
Cancridae	2.8	12.8	4.4	5.9	-
Crangonidae	1.4	0.3	0.4	0.1	0.1
Majidae	-	+	1.5	0.2	7.4
Paguridae	3.8	0.9	2.5	0.2	2.2
Pandalidae	0.1	0.7	3.1	2.8	3.9
Other Decapoda	-	1.6	0.7	14.1	1.7
Euphausiacea	-	-	0.4	1.2	8.8
Mysidacea	-	+	0.2	+	+
Amphipoda	+	1.6	0.7	0.1	0.1
Other Crustacea	2.1	0.6	1.2	1.5	2.1
MOLLUSCA	0.6	1.9	15.6	0.7	0.6
Pelecypoda	-	0.4	9.4	0.1	+
Gastropoda	-	1.4	4.7	0.3	0.3
Cephalopoda	-	+	+	0.3	+
Other Mollusca	0.6	0.1	1.5	+	0.3
ECHINODERMATA	-	0.8	0.6	0.4	3.6
Echinoidea	-	+	+	+	0.2
Ophiuroidea	-	0.3	0.3	0.2	1.9
Other Echinodermata	-	0.5	0.3	0.2	1.5
PISCES	86.5	64.1	61.6	69.5	60.6
Clupeidae	-	32.8	37.3	23.3	12.1
Gadidae	12.9	-	2.6	4.5	6.5
Scrombridae	-	6.4	-	8.7	1.7
Scorpaenidae	-	-	-	11.6	0.9
Bothidae	-	1.9	0.3	-	-
Pleuronectidae	43.7	-	4.3	-	-
Other Pisces	29.9	23.0	17.1	21.4	39.4
OTHER PHYLA	+	0.1	0.6	0.3	0.3
ANIMAL REMAINS	2.6	4.8	2.7	2.2	5.4
SAND AND ROCK	+	1.0	2.6	0.5	1.1
Number of stomachs	7	79	666	348	441
Percent empty	0.0	6.3	6.9	8.6	8.1
Mean wt. per stomach(g)	69.7	46.6	29.6	31.9	18.2
Mean predator length(cm)	82.0	65.8	50.3	57.7	57.9

Table 4. Areal summary of the stomach contents of the pollock, *Pollachius virens*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	-	-	0.1	+	0.1
Terebelliformia	-	-	-	-	-
Sabelliformia	-	-	-	-	-
Nereidiformia	-	-	-	+	+
Other Polychaeta	-	-	0.1	+	0.1
CRUSTACEA	92.7	-	71.6	33.8	61.2
Axiidae	-	-	-	-	-
Cancridae	-	-	-	-	-
Crangonidae	-	-	0.1	-	+
Majidae	-	-	-	-	-
Paguridae	-	-	-	-	-
Pandalidae	-	-	2.9	2.1	3.1
Other Decapoda	-	-	0.4	16.0	4.2
Euphausiacea	-	-	66.4	11.4	53.7
Mysidacea	-	-	0.1	+	-
Amphipoda	-	-	0.5	+	+
Other Crustacea	92.7	-	1.2	4.3	0.2
MOLLUSCA	-	-	1.6	0.1	+
Pelecypoda	-	-	-	-	+
Gastropoda	-	-	1.6	-	-
Cephalopoda	-	-	-	0.1	+
Other Mollusca	-	-	-	-	-
ECHINODERMATA	-	-	-	-	-
Echinoidea	-	-	-	-	-
Ophiuroidea	-	-	-	-	-
Other Echinodermata	-	-	-	-	-
PISCES	7.3	100.0	22.8	64.9	37.1
Clupeidae	7.0	-	0.8	36.9	4.0
Gadidae	-	-	0.5	1.9	1.3
Scrombridae	-	-	-	-	-
Scorpaenidae	-	-	-	2.3	1.3
Bothidae	-	-	-	-	-
Pleuronectidae	-	-	-	-	-
Other Pisces	0.3	100.0	21.5	23.8	30.5
OTHER PHYLA	-	-	1.3	0.3	0.3
ANIMAL REMAINS	-	-	2.6	0.8	1.3
SAND AND ROCK	-	-	+	0.1	+
Number of stomachs	5	1	206	203	229
Percent empty	20.0	0.0	2.9	12.8	18.8
Mean wt. per stomach(g)	36.3	13.1	12.7	27.7	14.2
Mean predator length(cm)	51.0	82.0	38.2	66.4	44.6

Table 5. Areal summary of the stomach contents of the silver hake, *Merluccius bilinearis*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	+	1.1	+	+	+
Terebelliformia	-	-	-	-	-
Sabelliformia	-	-	-	-	-
Nereidiformia	-	1.0	-	+	-
Other Polychaeta	+	0.1	+	+	+
CRUSTACEA	27.7	33.6	20.4	21.5	33.8
Axiidae	+	-	-	-	-
Cancridae	0.1	-	+	0.1	-
Crangonidae	7.5	1.1	2.0	0.1	-
Majidae	-	-	-	-	-
Paguridae	-	-	-	-	-
Pandalidae	8.5	15.7	2.6	1.7	0.4
Other Decapoda	0.7	1.3	0.7	4.8	0.2
Euphausiacea	7.0	10.8	13.1	12.5	28.4
Mysidacea	0.2	0.7	-	0.2	0.1
Amphipoda	1.0	1.3	0.1	+	+
Other Crustacea	2.7	2.7	1.9	2.1	4.7
MOLLUSCA	13.6	0.8	0.6	1.3	-
Pelecypoda	+	-	-	+	-
Gastropoda	+	-	-	-	-
Cephalopoda	13.6	0.8	0.6	1.3	-
Other Mollusca	+	-	-	-	-
ECHINODERMATA	-	-	+	-	-
Echinoidea	-	-	-	-	-
Ophiuroidea	-	-	+	-	-
Other Echinodermata	-	-	+	-	-
PISCES	53.7	61.7	78.2	76.1	65.1
Clupeidae	-	-	-	32.5	-
Gadidae	13.5	12.6	+	1.4	51.2
Scrombridae	-	31.7	-	28.0	-
Scorpaenidae	-	-	-	-	-
Bothidae	-	-	-	-	-
Pleuronectidae	0.7	-	-	-	-
Other Pisces	39.5	17.4	78.2	14.2	13.9
OTHER PHYLA	0.1	0.2	+	-	+
ANIMAL REMAINS	4.9	2.6	0.8	1.1	1.1
SAND AND ROCK	+	+	+	+	+
Number of stomachs	465	688	248	453	282
Percent empty	34.6	35.8	24.6	30.7	33.3
Mean wt. per stomach(g)	1.1	1.5	4.3	5.2	1.0
Mean predator length(cm)	26.7	27.5	29.9	27.1	27.7

Table 6. Areal summary of the stomach contents of the white hake, *Urophycis tenuis*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	NONE	0.1	0.1	0.1	0.3
Terebelliformia		-	-	-	-
Sabelliformia		-	-	-	-
Nereidiformia		+	+	0.1	0.1
Other Polychaeta		0.1	0.1	+	0.2
CRUSTACEA		3.7	29.4	21.1	10.4
Axiidae		0.2	0.1	+	0.1
Cancridae		1.8	0.4	-	-
Crangonidae		0.3	1.1	0.1	0.4
Majidae		-	-	-	-
Paguridae		-	0.4	-	+
Pandalidae		0.5	21.7	10.7	4.3
Other Decapoda		0.6	1.9	3.0	1.9
Euphausiacea		-	2.3	6.4	2.9
Mysidacea		-	-	+	+
Amphipoda		0.3	0.1	+	0.1
Other Crustacea		+	1.4	0.9	0.7
MOLLUSCA		11.6	3.8	0.2	0.4
Pelecypoda		-	+	+	-
Gastropoda		+	+	+	-
Cephalopoda		11.6	3.5	0.2	0.4
Other Mollusca		-	0.3	-	+
ECHINODERMATA		-	-	+	-
Echinoidea		-	-	-	-
Ophiuroidea		-	-	+	-
Other Echinodermata		-	-	-	-
PISCES		83.3	62.5	76.5	86.5
Clupeidae		-	27.6	17.5	0.8
Gadidae		18.1	17.8	1.1	25.7
Scrombridae		16.6	-	9.6	-
Scorpaenidae		-	-	1.1	4.7
Bothidae		-	-	-	-
Pleuronectidae		-	-	-	-
Other Pisces		48.6	17.1	47.2	55.3
OTHER PHYLA		0.1	+	0.1	+
ANIMAL REMAINS		1.2	4.0	2.0	2.3
SAND AND ROCK		-	0.2	+	0.1
Number of stomachs		95	173	475	164
Percent empty		26.3	23.1	27.4	13.4
Mean wt. per stomach(g)		22.5	10.0	18.5	22.6
Mean predator length(cm)		48.3	45.3	46.5	43.7

Table 7. Areal summary of the stomach contents of the offshore hake, *Merluccius albidus*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	-	-	-	NONE	NONE
Terebelliformia	-	-	-		
Sabelliformia	-	-	-		
Nereidiformia	-	-	-		
Other Polychaeta	-	-	-		
CRUSTACEA	100.0	3.2	14.0		
Axiidae	-	-	-		
Cancridae	-	-	-		
Crangonidae	-	-	-		
Majidae	-	-	-		
Paguridae	-	-	-		
Pandalidae	-	1.6	6.4		
Other Decapoda	37.5	0.8	6.1		
Euphausiacea	62.5	0.8	1.5		
Mysidacea	-	-	-		
Amphipoda	-	-	-		
Other Crustacea	-	-	-		
MOLLUSCA	-	-	5.1		
Pelecypoda	-	-	-		
Gastropoda	-	-	-		
Cephalopoda	-	-	5.1		
Other Mollusca					
ECHINODERMATA	-	-	-		
Echinoidea	-	-	-		
Ophiuroidea	-	-	-		
Other Echinodermata	-	-	-		
PISCES	-	96.7	80.4		
Clupeidae	-	-	-		
Gadidae	-	73.8	-		
Scrombridae	-	-	-		
Scorpaenidae	-	-	-		
Bothidae	-	-	-		
Pleuronectidae	-	-	-		
Other Pisces	-	22.9	80.4		
OTHER PHYLA	-	+	-		
ANIMAL REMAINS	-	0.1	0.5		
SAND AND ROCK	-	-	-		
Number of stomachs	4	46	23		
Percent empty	25.0	58.7	60.9		
Mean wt. per stomach(g)	0.1	3.1	1.4		
Mean predator length(cm)	31.3	30.9	37.1		

Table 8. Areal summary of the stomach contents of the cusk, Brosme brosme, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	NONE	-	-	-	-
Terebelliformia		-	-	-	-
Sabelliformia		-	-	-	-
Nereidiformia		-	-	-	-
Other Polychaeta		-	-	-	-
CRUSTACEA		100.0	20.0	90.6	1.4
Axiidae		-	-	-	-
Cancridae		-	-	-	-
Crangonidae		-	-	-	-
Majidae		-	20.0	-	-
Paguridae		-	-	-	-
Pandalidae		-	-	21.0	-
Other Decapoda		-	-	55.5	1.1
Euphausiacea		-	-	1.7	-
Mysidacea		-	-	-	-
Amphipoda		100.0	-	-	-
Other Crustacea		-	-	12.4	0.3
MOLLUSCA		-	-	-	-
Pelecypoda		-	-	-	-
Gastropoda		-	-	-	-
Cephalopoda		-	-	-	-
Other Mollusca		-	-	-	-
ECHINODERMATA		-	80.0	-	-
Echinoidea		-	-	-	-
Ophiuroidea		-	80.0	-	-
Other Echinodermata		-	-	-	-
PISCES		-	-	4.2	98.2
Clupeidae		-	-	-	-
Gadidae		-	-	-	-
Scrombridae		-	-	-	-
Scorpaenidae		-	-	-	-
Bothidae		-	-	-	-
Pleuronectidae		-	-	-	-
Other Pisces		-	-	4.2	98.2
OTHER PHYLA		-	-	1.3	-
ANIMAL REMAINS		-	-	3.1	0.4
SAND AND ROCK		-	-	0.8	-
Number of stomachs		6	4	51	11
Percent empty		33.3	50.0	78.4	81.8
Mean wt. per stomach(g)		0.01	4.89	0.88	15.03
Mean predator length(cm)		25.5	57.3	64.8	60.5

Table 9. Areal summary of the stomach contents of the red hake, *Urophycis chuss*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	1.4	3.3	3.0	2.9	2.4
Terebelliformia	-	-	0.2	-	-
Sabelliformia	-	0.2	+	-	-
Nereidiformia	0.1	1.7	1.1	0.6	0.4
Other Polychaeta	1.3	1.4	1.7	2.3	2.0
CRUSTACEA	52.2	50.8	57.2	64.7	88.5
Axiidae	-	2.9	1.9	-	-
Cancridae	2.7	4.4	8.7	11.2	-
Crangonidae	2.2	1.5	10.6	0.6	1.9
Majidae	+	0.1	-	-	-
Paguridae	0.5	1.3	10.6	2.3	3.2
Pandalidae	15.7	9.4	7.7	19.7	71.2
Other Decapoda	21.7	15.5	3.0	4.4	7.6
Euphausiacea	+	1.8	2.0	18.7	2.3
Mysidacea	0.1	+	+	0.6	0.2
Amphipoda	5.5	9.6	4.3	1.8	1.9
Other Crustacea	3.8	4.3	8.4	5.4	0.2
MOLLUSCA	0.3	5.4	17.7	3.8	-
Pelecypoda	0.1	+	-	-	-
Gastropoda	0.2	0.1	17.4	3.8	-
Cephalopoda	-	2.2	-	-	-
Other Mollusca	+	3.1	0.3	-	-
ECHINODERMATA	0.1	0.6	0.2	2.0	-
Echinoidea	-	0.1	0.2	-	-
Ophiuroidea	-	-	-	-	-
Other Echinodermata	0.1	0.5	+	2.0	-
PISCES	38.5	28.2	5.3	23.9	0.6
Clupeidae	-	-	3.5	-	-
Gadidae	-	0.7	-	-	-
Scrombridae	-	0.6	-	-	-
Scorpaenidae	-	-	-	-	-
Bothidae	-	0.9	-	-	-
Pleuronectidae	0.1	-	-	-	-
Other Pisces	38.4	26.0	1.8	23.9	0.6
OTHER PHYLA	+	1.2	0.2	0.1	5.4
ANIMAL REMAINS	7.2	10.3	16.2	2.5	2.9
SAND AND ROCK	0.3	0.2	0.2	0.1	0.2
Number of stomachs	213	600	208	72	17
Percent empty	16.4	13.3	21.6	19.4	11.8
Mean wt. per stomach(g)	1.8	2.4	1.9	2.9	2.6
Mean predator length(cm)	29.3	29.6	33.1	34.3	32.6

Table 10. Areal summary of the stomach contents of the spotted hake, *Urophycis regius*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	0.4	0.6	-	NONE	NONE
Terebelliformia	-	-	-		
Sabelliformia	-	-	-		
Nereidiformia	0.1	0.1	-		
Other Polychaeta	0.3	0.5	-		
CRUSTACEA	48.6	46.8	6.8		
Axiidae	-	0.1	-		
Cancridae	10.3	1.1	-		
Crangonidae	5.0	2.6	1.2		
Majidae	+	-	-		
Paguridae	0.1	0.1	-		
Pandalidae	3.8	4.3	-		
Other Decapoda	14.5	31.9	0.3		
Euphausiacea	+	0.1	-		
Mysidacea	+	-	-		
Amphipoda	8.0	6.2	2.9		
Other Crustacea	6.9	0.4	2.4		
MOLLUSCA	16.6	1.1	71.6		
Pelecypoda	0.4	-	-		
Gastropoda	0.1	-	-		
Cephalopoda	16.1	1.0	71.6		
Other Mollusca	+	0.1	-		
ECHINODERMATA	-	+	-		
Echinoidea	-	-	-		
Ophiuroidea	-	-	-		
Other Echinodermata	-	+	-		
PISCES	28.5	45.1	0.3		
Clupeidae	-	-	-		
Gadidae	6.8	0.3	-		
Scrombridae	-	9.1	-		
Scorpaenidae	-	-	-		
Bothidae	1.7	1.9	-		
Pleuronectidae	0.8	0.8	-		
Other Pisces	19.2	33.0	0.3		
OTHER PHYLA	+	0.1	+		
ANIMAL REMAINS	5.7	5.8	21.3		
SAND AND ROCK	0.2	0.5	+		
Number of stomachs	689	183	4		
Percent empty	10.5	31.0	25.0		
Mean wt. per stomach(g)	0.8	1.9	2.8		
Mean predator length(cm)	18.2	26.2	24.1		

Table 11. Areal summary of the stomach contents of the haddock, *Melanogrammus aeglefinus*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic		Southern New England		Georges Bank		Gulf of Maine		Western Nova Scotia	
POLYCHAETA	14.3		4.5		23.5		14.7		11.8	
Terebelliformia		-		-		2.1		+		1.9
Sabelliformia		-		-		2.1		0.5		0.8
Nereidiformia		13.4		2.5		1.0		3.0		2.7
Other Polychaeta		0.9		2.0		18.3		11.2		6.4
CRUSTACEA	2.2		82.0		16.0		15.2		14.4	
Axiidae		-		-		0.2		0.2		2.3
Cancridae		-		0.2		0.2		-		-
Crangonidae		0.3		0.5		0.2		-		0.1
Majidae		-		0.6		0.1		0.5		0.4
Paguridae		-		0.9		0.2		0.1		0.8
Pandalidae		-		0.7		1.1		2.9		1.0
Other Decapoda		-		1.0		0.2		5.9		1.7
Euphausiacea		-		-		3.7		2.0		1.7
Mysidacea		-		-		0.1		-		+
Amphipoda		0.6		75.3		7.1		2.2		5.0
Other Crustacea		1.3		2.8		2.9		1.4		1.4
MOLLUSCA	0.4		0.7		3.8		1.6		3.0	
Pelecypoda		-		0.7		3.2		0.9		1.9
Gastropoda		0.4		+		0.2		0.5		0.3
Cephalopoda		-		+		0.1		-		0.5
Other Mollusca		-		-		0.3		0.2		0.3
ECHINODERMATA	-		1.4		7.8		51.9		49.0	
Echinoidea		-		1.2		1.5		10.6		9.0
Ophiuroidea		-		+		6.0		38.0		34.5
Other Echinodermata		-		0.2		0.3		3.3		5.5
PISCES	-		+		28.4		2.2		3.8	
Clupeidae		-		-		28.3		-		-
Gadidae		-		-		-		-		0.8
Scrombridae		-		-		-		-		-
Scorpaenidae		-		-		-		-		-
Bothidae		-		-		-		-		-
Pleuronectidae		-		-		+		-		-
Other Pisces		-		+		0.1		2.2		3.0
OTHER PHYLA	1.1		0.1		0.3		0.6		2.0	
ANIMAL REMAINS	-		8.3		4.9		11.2		13.0	
SAND AND ROCK	82.0		3.0		15.3		2.6		3.0	
Number of stomachs	10		27		352		232		510	
Percent empty	0.0		11.1		4.3		5.6		10.0	
Mean wt. per stomach(g)	3.2		4.1		10.0		6.6		4.9	
Mean predator length(cm)	20.1		54.8		46.7		56.3		43.4	

Table 12. Areal summary of the stomach contents of the longfin hake, *Phycis chesteri*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	-	-	-	-	-
Terebelliformia	-	-	-	-	-
Sabelliformia	-	-	-	-	-
Nereidiformia	-	-	-	-	-
Other Polychaeta	-	-	-	-	-
CRUSTACEA	100.0	70.3	95.9	75.0	99.6
Axiidae	-	-	-	-	-
Cancridae	-	-	-	-	-
Crangonidae	-	-	-	-	-
Majidae	-	-	-	-	-
Paguridae	-	-	-	-	-
Pandalidae	-	-	18.0	-	-
Other Decapoda	100.0	-	4.3	-	25.4
Euphausiacea	-	70.3	52.2	-	68.5
Mysidacea	-	-	-	-	-
Amphipoda	-	-	-	25.0	-
Other Crustacea	-	-	21.4	50.0	5.7
MOLLUSCA	-	-	-	-	-
Pelecypoda	-	-	-	-	-
Gastropoda	-	-	-	-	-
Cephalopoda	-	-	-	-	-
Other Mollusca	-	-	-	-	-
ECHINODERMATA	-	-	0.7	-	-
Echinoidea	-	-	0.7	-	-
Ophiuroidea	-	-	-	-	-
Other Echinodermata	-	-	-	-	-
PISCES	-	-	2.4	-	-
Clupeidae	-	-	-	-	-
Gadidae	-	-	-	-	-
Scrombridae	-	-	-	-	-
Scorpaenidae	-	-	-	-	-
Bothidae	-	-	-	-	-
Pleuronectidae	-	-	-	-	-
Other Pisces	-	-	2.4	-	-
OTHER PHYLA	-	-	-	-	+
ANIMAL REMAINS	-	29.7	1.0	-	0.4
SAND AND ROCK	-	-	-	25.0	-
Number of stomachs	6	12	64	16	28
Percent empty	83.3	58.3	59.4	93.8	50.0
Mean wt. per stomach(g)	0.03	0.03	0.26	+	0.63
Mean predator length(cm)	27.9	21.8	24.0	20.5	25.4

Table 13. Areal summary of the stomach contents of the fourbeard rockling, *Enchelyopus cimbrius*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	NONE	-	13.6	5.8	NONE
Terebelliformia		-	-	-	
Sabelliformia		-	-	-	
Nereidiformia		-	-	-	
Other Polychaeta		-	13.6	5.8	
CRUSTACEA		60.0	59.3	44.8	
Axiidae		-	-	-	
Cancridae		-	-	-	
Crangonidae		-	46.3	5.3	
Majidae		-	-	-	
Paguridae		-	-	-	
Pandalidae		-	11.2	-	
Other Decapoda		-	-	35.8	
Euphausiacea		-	1.1	-	
Mysidacea		-	+	-	
Amphipoda		60.0	0.7	0.5	
Other Crustacea		+	-	3.2	
MOLLUSCA		-	-	-	
Pelecypoda		-	-	-	
Gastropoda		-	-	-	
Cephalopoda		-	-	-	
Other Mollusca		-	-	-	
ECHINODERMATA		-	-	-	
Echinoidea		-	-	-	
Ophiuroidea		-	-	-	
Other Echinodermata		-	-	-	
PISCES		-	+	-	
Clupeidae		-	-	-	
Gadidae		-	-	-	
Scrombridae		-	-	-	
Scorpaenidae		-	-	-	
Bothidae		-	-	-	
Pleuronectidae		-	-	-	
Other Pisces		-	+	-	
OTHER PHYLA		-	+	-	
ANIMAL REMAINS		40.0	27.1	49.4	
SAND AND ROCK		-	-	-	
Number of stomachs		3	27	18	
Percent empty		66.67	0.04	16.67	
Mean wt. per stomach(g)		0.03	0.46	0.11	
Mean predator length(cm)		24.9	27.3	22.7	

Table 14. Areal summary of the stomach contents of the marlin-spike, *Nezumia bairdi*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	NONE	28.6	NONE	-	27.8
Terebelliformia		-		-	-
Sabelliformia		-		-	-
Nereidiformia		-		-	-
Other Polychaeta		28.6		-	27.8
CRUSTACEA		10.7		+	51.5
Axiidae		-		-	-
Cancridae		-		-	-
Crangonidae		-		-	-
Majidae		-		-	-
Paguridae		-		-	-
Pandalidae		-		-	-
Other Decapoda		3.6		-	30.2
Euphausiacea		-		+	-
Mysidacea		-		-	4.5
Amphipoda		7.1		-	7.9
Other Crustacea		+		-	8.9
MOLLUSCA		-		-	2.7
Pelecypoda		-		-	2.7
Gastropoda		-		-	-
Cephalopoda		-		-	-
Other Mollusca		-		-	-
ECHINODERMATA		-		-	-
Echinoidea		-		-	-
Ophiuroidea		-		-	-
Other Echinodermata		-		-	-
PISCES		-		-	-
Clupeidae		-		-	-
Gadidae		-		-	-
Scrombridae		-		-	-
Scorpaenidae		-		-	-
Bothidae		-		-	-
Pleuronectidae		-		-	-
Other Pisces		-		-	-
OTHER PHYLA		-		-	-
ANIMAL REMAINS		60.7		100.0	17.7
SAND AND ROCK		+		-	0.3
Number of stomachs		6		2	15
Percent empty		0.0		0.0	13.3
Mean wt. per stomach(g)		0.05		0.02	0.19
Mean predator length(cm)		21.9		25.7	23.2

Table 15. Areal summary of the stomach contents of the longnose grenadier, *Coelorhynchus carminatus*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	97.0	8.0	-	NONE	NONE
Terebelliformia	-	-	-		
Sabelliformia	-	-	-		
Nereidiformia	-	-	-		
Other Polychaeta	97.0	8.0			
CRUSTACEA	3.0	34.6	-		
Axiidae	-	-	-		
Cancridae	-	-	-		
Crangonidae	-	-	-		
Majidae	-	-	-		
Paguridae	-	-	-		
Pandalidae	-	-	-		
Other Decapoda	-	34.3	-		
Euphausiacea	-	-	-		
Mysidacea	-	-	-		
Amphipoda	-	-	-		
Other Crustacea	3.0	0.3	-		
MOLLUSCA	-	-	-		
Pelecypoda	-	-	-		
Gastropoda	-	-	-		
Cephalopoda	-	-	-		
Other Mollusca	-	-	-		
ECHINODERMATA	-	-	-		
Echinoidea	-	-	-		
Ophiuroidea	-	-	-		
Other Echinodermata	-	-	-		
PISCES	-	+	-		
Clupeidae	-	-	-		
Gadidae	-	-	-		
Scrombridae	-	-	-		
Scorpaenidae	-	-	-		
Bothidae	-	-	-		
Pleuronectidae	-	-	-		
Other Pisces	-	+	-		
OTHER PHYLA	+	4.1	-		
ANIMAL REMAINS	-	53.3	-		
SAND AND ROCK	-	+	-		
Number of stomachs	4	5	2		
Percent empty	25.0	40.0	100.0		
Mean wt. per stomach(g)	0.07	0.13	0.0		
Mean predator length(cm)	18.6	19.2	21.2		

Table 16. Areal summary of the stomach contents of the fawn cusk-eel, *Lepophidium cervinum*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	7.0	21.9	-	-	NONE
Terebelliformia	-	-	-	-	
Sabelliformia	-	-	-	-	
Nereidiformia	3.0	-	-	-	
Other Polychaeta	4.0	21.9	-	-	
CRUSTACEA	19.6	62.9	100.0	-	
Axiidae	-	1.5	-	-	
Cancridae	-	-	-	-	
Crangonidae	2.7	21.9	-	-	
Majidae	-	-	-	-	
Paguridae	-	-	-	-	
Pandalidae	-	-	-	-	
Other Decapoda	0.8	0.8	-	-	
Euphausiacea	-	-	-	-	
Mysidacea	-	-	-	-	
Amphipoda	0.2	23.4	14.3	-	
Other Crustacea	15.9	15.3	85.7	-	
MOLLUSCA	+	0.8	-	-	
Pelecypoda	+	-	-	-	
Gastropoda	-	-	-	-	
Cephalopoda	-	-	-	-	
Other Mollusca	-	0.8	-	-	
ECHINODERMATA	0.6	+	-	-	
Echinoidea	-	-	-	-	
Ophiuroidea	0.2	+	-	-	
Other Echinodermata	0.4	-	-	-	
PISCES	2.8	-	-	-	
Clupeidae	-	-	-	-	
Gadidae	-	-	-	-	
Scrombridae	-	-	-	-	
Scorpaenidae	-	-	-	-	
Bothidae	-	-	-	-	
Pleuronectidae	-	-	-	-	
Other Pisces	2.8	-	-	-	
OTHER PHYLA	37.1	2.1	-	-	
ANIMAL REMAINS	32.9	12.3	-	-	
SAND AND ROCK	-	+	-	-	
Number of stomachs	68	37	2	2	
Percent empty	14.7	35.1	0.0	100.0	
Mean wt. per stomach(g)	0.04	0.02	0.02	0.00	
Mean predator length(cm)	21.4	23.0	26.0	23.2	

Table 17. Areal summary of the stomach contents of the ocean pout, *Macrozoarces americanus*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises 1969-1972. (+ indicates <0.1%).

PREY	Middle Atlantic	Southern New England	Georges Bank	Gulf of Maine	Western Nova Scotia
POLYCHAETA	-	7.8	0.5	0.3	-
Terebelliformia	-	-	+	+	-
Sabelliformia	-	-	-	-	-
Nereidiformia	-	7.7	+	-	-
Other Polychaeta	-	0.1	0.5	0.3	-
CRUSTACEA	9.4	22.0	4.3	3.5	+
Axiidae	-	-	-	-	-
Cancridae	5.7	5.4	1.3	0.1	-
Crangonidae	-	+	+	0.2	-
Majidae	-	-	0.7	-	-
Paguridae	0.3	0.1	0.8	0.3	-
Pandalidae	-	+	+	-	-
Other Decapoda	-	1.3	0.7	-	-
Euphausiacea	-	-	-	-	-
Mysidacea	-	-	-	-	-
Amphipoda	0.2	13.1	0.7	2.0	-
Other Crustacea	3.2	2.1	0.1	0.9	+
MOLLUSCA	-	1.6	6.1	4.1	-
Pelecypoda	-	0.6	5.9	2.1	-
Gastropoda	-	0.9	0.1	2.0	-
Cephalopoda	-	-	-	-	-
Other Mollusca	-	0.1	0.1	-	-
ECHINODERMATA	86.3	63.9	81.1	37.2	99.3
Echinoidea	86.3	63.9	71.5	25.3	-
Ophiuroidea	-	+	9.6	6.2	99.3
Other Echinodermata	-	-	-	5.7	-
PISCES	0.5	0.1	+	0.5	+
Clupeidae	-	-	-	-	-
Gadidae	-	-	-	-	-
Scrombridae	-	-	-	-	-
Scorpaenidae	-	-	-	-	-
Bothidae	-	-	-	-	-
Pleuronectidae	-	-	-	-	-
Other Pisces	0.5	0.1	+	0.5	+
OTHER PHYLA	0.2	0.3	1.9	18.5	-
ANIMAL REMAINS	1.8	2.5	5.4	2.5	-
SAND AND ROCK	1.8	1.8	0.7	33.4	0.7
Number of stomachs	14	187	110	34	6
Percent empty	0.0	22.5	32.7	26.5	66.7
Mean wt. per stomach(g)	6.6	5.0	10.6	6.4	0.5
Mean predator length(cm)	44.7	45.2	56.5	36.6	32.4

Sexual Differences in Food Habits

The overall and areal summary of food habits have already been described in some detail. The following description of the sexually related changes in food habits, as shown in Tables 18-32, will be limited to those species where there is some indication that sexual differences in diet composition or the quantity of prey consumed existed.

Differences in the composition of the diet were observed for male and female fish in six of the 15 species examined. In three of the species the sexual differences in food habits was characterized by a shift from crustaceans being the major prey of the males to fish being the major prey of the females. In silver hake, for example, 69.0% of the diet of males was made up of crustaceans while only 16.9% of the females' diet was composed of crustaceans. Conversely, fish accounted for 78.3% of the diet of the females examined while only 23.2% of the males' diet was fish (Table 20). A similar pattern was noted for pollock (Table 19) and cusk (Table 23). The food habits of spotted hake also varied between males and females in the manner similar to that described above (Table 25). Unfortunately, more than 25% of the males' diet was animal remains, and it is not known to what taxonomic group this prey belongs, so that no real conclusion can be drawn regarding sexual differences in food habits for spotted hake. Marlin-spike also showed some sexual dimorphism in their food habits (Table 29). The major prey of females was polychaetes (41.7%) while males primarily fed on crustaceans (60.0%). It is difficult to know if these observed differences are due to the small sample of fish examined or due to a true variation in feeding habits between male and female fish.

The last fish showing any sexually related changes in diet was the haddock (Table 26). Although the major prey group, echinoderms, was the same for both males and females, there were some differences in the consumption of secondary prey. For example, 29.3% of the males' diet was composed of polychaetes whereas they accounted for only 8.9% of the females' diet and, conversely, females consumed more mollusks (8.4%) than males (0.8%).

Apart from sexually related changes in the composition of the diet, the most noticeable difference between males and females was the actual quantity of food consumed, as reflected by the mean weight per stomach (Table 33). In 13 of the 15 species examined the females consumed a greater quantity of prey than the males. The actual difference in the mean weight per stomach varied from as little as 0.02 g, or an 18% increase for females, for the fourbeard rockling, to 4.63 g, or a 712% increase, for female silver hake. In only two fish, the ocean pout and marlin-spike, was the mean weight per stomach greater for males than females.

Table 18. Diet composition, expressed as percent weight, of male and female Atlantic cod, *Gadus morhua*, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	1.1		1.0	
Terebelliformia		+		+
Sabelliformia		-		-
Nereidiformia		1.0		0.8
Other Polychaeta		0.1		0.2
CRUSTACEA	21.0		20.3	
Axiidae		0.7		0.5
Cancridae		4.0		4.8
Crangonidae		0.3		0.2
Majidae		1.6		3.1
Paguridae		1.6		1.4
Pandalidae		2.2		2.1
Other Decapoda		5.3		4.6
Euphausiacea		3.5		2.0
Mysidacea		+		+
Amphipoda		0.4		0.1
Other Crustacea		1.4		1.5
MOLLUSCA	9.7		6.4	
Pelecypoda		5.4		4.0
Gastropoda		3.6		1.1
Cephalopoda		0.2		+
Other Mollusca		0.5		1.3
ECHINODERMATA	2.0		1.1	
Echinoidea		0.1		+
Ophiuroidea		0.9		0.6
Other Echinodermata		1.0		0.5
PISCES	61.0		66.8	
Clupeidae		40.8		35.1
Gadidae		0.6		3.2
Scrombridae		-		1.4
Scorpaenidae		1.1		0.1
Bothidae		0.1		0.1
Pleuronectidae		-		4.8
Other Pisces		18.7		22.1
OTHER PHYLA	0.5		0.1	
ANIMAL REMAINS	3.4		3.3	
SAND AND ROCK	1.0		1.0	
Number of Stomachs	471		567	
Mean wt. per Stomach	24.51		33.01	

Table 19. Diet composition, expressed as percent weight, of male and female pollock, *Pollachius virens*, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%)

	Percent Weight			
	Male		Female	
POLYCHAETA	0.1		+	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		-		+
Other Polychaeta		0.1		+
CRUSTACEA	53.6		36.9	
Axiidae		-		-
Cancridae		-		-
Crangonidae		+		+
Majidae		-		-
Paguridae		-		-
Pandalidae		5.0		1.4
Other Decapoda		12.2		2.2
Euphausiacea		35.4		28.7
Mysidacea		+		+
Amphipoda		+		+
Other Crustacea		1.0		4.6
MOLLUSCA	-		0.2	
Pelecypoda		-		+
Gastropoda		-		0.1
Cephalopoda		-		0.1
Other Mollusca		-		+
ECHINODERMATA	-		-	
Echinoidea		-		-
Ophiuroidea		-		-
Other Echinodermata		-		-
PISCES	43.8		61.2	
Clupeidae		21.8		29.7
Gadidae		3.3		1.2
Scrombridae		-		-
Scorpaenidae		1.5		2.4
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		17.2		27.9
OTHER PHYLA	0.5		0.3	
ANIMAL REMAINS	1.9		1.4	
SAND AND ROCK	0.1		+	
Number of Stomachs	229		268	
Mean wt. per Stomach (g)	12.71		20.19	

Table 20. Diet composition, expressed as percent weight, of male and female silver hake, Merluccius bilinearis, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	0.5		+	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		0.4		+
Other Polychaeta		0.1		+
CRUSTACEA	69.0		16.9	
Axiidae		-		+
Cancridae		0.1		-
Crangonidae		4.4		0.4
Majidae		-		-
Paguridae		-		-
Pandalidae		12.3		2.0
Other Decapoda		6.8		2.7
Euphausiacea		33.8		10.5
Mysidacea		1.1		+
Amphipoda		1.4		0.2
Other Crustacea		9.1		1.1
MOLLUSCA	4.6		2.9	
Pelecypoda		-		-
Gastropoda		-		-
Cephalopoda		4.6		2.9
Other Mollusca		-		-
ECHINODERMATA	+		+	
Echinoidea		-		-
Ophiuroidea		-		+
Other Echinodermata		+		-
PISCES	23.2		78.3	
Clupeidae		-		23.2
Gadidae		11.9		7.5
Scrombridae		-		30.1
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		0.1
Other Pisces		11.3		17.4
OTHER PHYLA	+		0.1	
ANIMAL REMAINS	2.7		1.8	
SAND AND ROCK	+		-	
Number of Stomachs	474		629	
Mean wt. per Stomach (g)	0.65		5.28	

Table 21. Diet composition, expressed as percent weight, of male and female white hake, *Urophycis tenuis*, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	0.5		0.1	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		0.3		+
Other Polychaeta		0.2		+
CRUSTACEA	9.6		8.4	
Axiidae		0.1		-
Cancridae		-		0.4
Crangonidae		0.6		0.1
Majidae		-		-
Paguridae		+		0.1
Pandalidae		2.7		3.0
Other Decapoda		1.4		1.2
Euphausiacea		4.0		3.3
Mysidacea		0.1		-
Amphipoda		0.1		+
Other Crustacea		0.6		0.3
MOLLUSCA	3.0		1.8	
Pelecypoda		-		-
Gastropoda		+		+
Cephalopoda		3.0		1.8
Other Mollusca		-		+
ECHINODERMATA	+		+	
Echinoidea		-		-
Ophiuroidea		+		-
Other Echinodermata		-		-
PISCES	83.4		88.4	
Clupeidae		17.1		13.1
Gadidae		6.4		13.5
Scrombridae		31.5		3.5
Scorpaenidae		-		2.7
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		28.4		55.6
OTHER PHYLA	+		+	
ANIMAL REMAINS	3.5		1.3	
SAND AND ROCK	+		+	
Number of Stomachs	212		295	
Mean wt. per Stomach (g)	12.64		34.06	

Table 22. Diet composition, expressed as percent weight, of male and female offshore hake, Merluccius albidus, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	-		-	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		-		-
Other Polychaeta		-		-
CRUSTACEA	12.0		2.5	
Axiidae		-		-
Cancridae		-		-
Crangonidae		-		-
Majidae		-		-
Paguridae		-		-
Pandalidae		3.1		1.5
Other Decapoda		7.9		0.2
Euphausiacea		1.0		0.8
Mysidacea		-		-
Amphipoda		-		-
Other Crustacea		-		-
MOLLUSCA	4.3		-	
Pelecypoda		-		-
Gastropoda		-		-
Cephalopoda		4.3		-
Other Mollusca		-		-
ECHINODERMATA	-		-	
Echinoidea		-		-
Ophiuroidea		-		-
Other Echinodermata		-		-
PISCES	82.8		97.5	
Clupeidae		-		-
Gadidae		-		77.7
Scrombridae		-		-
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		82.8		19.8
OTHER PHYLA	-		+	
ANIMAL REMAINS	0.9		-	
SAND AND ROCK	-		-	
Number of Stomachs	41		30	
Mean wt. per Stomach (g)	0.96		4.58	

Table 23. Diet composition, expressed as percent weight, of male and female cusk, Brosme brosme, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	-		-	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		-		-
Other Polychaeta		-		-
CRUSTACEA	90.0		11.1	
Axiidae		-		-
Cancridae		-		-
Crangonidae		-		-
Majidae		9.4		1.2
Paguridae		-		-
Pandalidae		10.5		2.3
Other Decapoda		65.5		4.8
Euphausiacea		-		0.4
Mysidacea		-		-
Amphipoda		0.1		+
Other Crustacea		4.5		2.4
MOLLUSCA	-		-	
Pelecypoda		-		-
Gastropoda		-		-
Cephalopoda		-		-
Other Mollusca		-		-
ECHINODERMATA	-		7.8	
Echinoidea		-		-
Ophiuroidea		-		7.8
Other Echinodermata		-		-
PISCES	4.4		80.4	
Clupeidae		-		-
Gadidae		-		-
Scrombridae		-		-
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		4.4		80.4
OTHER PHYLA	3.4		+	
ANIMAL REMAINS	1.8		0.6	
SAND AND ROCK	0.4		0.1	
Number of Stomachs	17		37	
Mean wt. per Stomach (g)	0.89		5.42	

Table 24. Diet composition, expressed as percent weight, of male and female red hake, *Urophycis chuss*, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	5.3		3.0	
Terebelliformia		0.1		+
Sabelliformia		0.8		-
Nereidiformia		1.8		1.7
Other Polychaeta		2.6		1.2
CRUSTACEA	58.9		53.4	
Axiidae		2.3		2.0
Cancridae		1.5		8.3
Crangonidae		5.8		2.3
Majidae		0.1		+
Paguridae		0.8		1.0
Pandalidae		19.6		7.2
Other Decapoda		9.2		21.5
Euphausiacea		9.8		2.0
Mysidacea		0.3		+
Amphipoda		5.7		4.3
Other Crustacea		3.8		4.8
MOLLUSCA	1.4		4.6	
Pelecypoda		+		+
Gastropoda		1.4		1.3
Cephalopoda		-		2.5
Other Mollusca		+		0.8
ECHINODERMATA	0.6		0.5	
Echinoidea		-		-
Ophiuroidea		-		-
Other Echinodermata		0.6		0.5
PISCES	18.9		27.0	
Clupeidae		3.3		-
Gadidae		1.2		0.4
Scrombridae		-		0.7
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		14.4		25.9
OTHER PHYLA	2.2		0.8	
ANIMAL REMAINS	12.3		10.5	
SAND AND ROCK	0.4		0.2	
Number of Stomachs	240		391	
Mean wt. per Stomach (g)	1.72		3.37	

Table 25. Diet composition, expressed as percent weight, of male and female spotted hake, *Urophycis regius*, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	0.1		+	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		-		+
Other Polychaeta		0.1		-
CRUSTACEA	38.2		41.1	
Axiidae		-		0.1
Cancridae		1.8		5.3
Crangonidae		4.8		3.8
Majidae		-		0.1
Paguridae		-		+
Pandalidae		-		3.8
Other Decapoda		18.6		25.2
Euphausiacea		+		-
Mysidacea		-		-
Amphipoda		4.9		1.1
Other Crustacea		8.1		1.7
MOLLUSCA	22.7		19.9	
Pelecypoda		-		0.5
Gastropoda		-		-
Cephalopoda		22.7		19.4
Other Mollusca		-		-
ECHINODERMATA	0.2		-	
Echinoidea		-		-
Ophiuroidea		-		-
Other Echinodermata		0.2		-
PISCES	9.4		33.4	
Clupeidae		-		-
Gadidae		1.9		0.1
Scrombridae		-		-
Scorpaenidae		-		-
Bothidae		-		+
Pleuronectidae		-		1.0
Other Pisces		7.5		32.3
OTHER PHYLA	-		0.1	
ANIMAL REMAINS	27.8		5.3	
SAND AND ROCK	1.6		0.2	
Number of Stomachs	65		116	
Mean wt. per Stomach (g)	0.76		2.31	

Table 26. Diet composition, expressed as percent weight, of male and female haddock, *Melanogrammus aeglefinus*, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	29.3		8.9	
Terebelliformia		2.4		2.1
Sabelliformia		0.7		0.5
Nereidiformia		1.9		1.5
Other Polychaeta		24.3		4.8
CRUSTACEA	11.4		14.1	
Axiidae		1.0		1.6
Cancridae		+		0.2
Crangonidae		0.2		0.1
Majidae		0.2		0.1
Paguridae		0.4		0.7
Pandalidae		0.9		0.6
Other Decapoda		1.5		1.1
Euphausiacea		0.7		4.9
Mysidacea		0.3		+
Amphipoda		4.8		3.2
Other Crustacea		1.4		1.6
MOLLUSCA	0.8		8.4	
Pelecypoda		0.6		6.6
Gastropoda		0.1		0.7
Cephalopoda		-		0.7
Other Mollusca		0.1		0.4
ECHINODERMATA	37.5		43.2	
Echinoidea		3.8		6.7
Ophiuroidea		31.9		32.0
Other Echinodermata		1.8		4.5
PISCES	1.1		2.1	
Clupeidae		-		-
Gadidae		-		0.9
Scrombridae		-		-
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		1.1		1.2
OTHER PHYLA	0.8		2.0	
ANIMAL REMAINS	13.4		11.1	
SAND AND ROCK	5.7		10.2	
Number of Stomachs	303		419	
Mean wt. per Stomach (g)	4.24		5.42	

Table 27. Diet composition, expressed as percent weight, of male and female longfin hake, *Phycis chesteri*, collected during the spring and autumn survey cruises, 1969-1972.

	Percent Weight	
	Male	Female
POLYCHAETA	-	-
Terebelliformia	-	-
Sabelliformia	-	-
Nereidiformia	-	-
Other Polychaeta	-	-
CRUSTACEA	99.4	98.5
Axiidae	-	-
Cancridae	-	-
Crangonidae	-	-
Majidae	-	-
Paguridae	-	-
Pandalidae	-	13.7
Other Decapoda	8.8	22.6
Euphausiacea	90.6	57.6
Mysidacea	-	-
Amphipoda	-	-
Other Crustacea	-	4.6
MOLLUSCA	-	-
Pelecypoda	-	-
Gastropoda	-	-
Cephalopoda	-	-
Other Mollusca	-	-
ECHINODERMATA	-	0.5
Echinoidea	-	0.5
Ophiuroidea	-	-
Other Echinodermata	-	-
PISCES	-	-
Clupeidae	-	-
Gadidae	-	-
Scrombridae	-	-
Scorpaenidae	-	-
Bothidae	-	-
Pleuronectidae	-	-
Other Pisces	-	-
OTHER PHYLA	-	-
ANIMAL REMAINS	0.6	1.0
SAND AND ROCK	-	-
Number of Stomachs	39	61
Mean wt. per Stomach (g)	0.12	0.36

Table 28. Diet composition, expressed as percent weight, of male and female fourbeard rockling, Enchelyopus cimbrius, collected during the spring and autumn survey cruises, 1969-1972.

	Percent Weight			
	Male		Female	
POLYCHAETA	41.3		36.0	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		-		-
Other Polychaeta		41.3		36.0
CRUSTACEA	18.7		39.8	
Axiidae		-		-
Cancridae		-		-
Crangonidae		6.3		-
Majidae		-		-
Paguridae		-		-
Pandalidae		-		-
Other Decapoda		-		36.6
Euphausiacea		8.9		-
Mysidacea		-		-
Amphipoda		3.5		-
Other Crustacea		-		3.2
MOLLUSCA	-		-	
Pelecypoda		-		-
Gastropoda		-		-
Cephalopoda		-		-
Other Mollusca		-		-
ECHINODERMATA	-		-	
Echinoidea		-		-
Ophiuroidea		-		-
Other Echinodermata		-		-
PISCES	-		-	
Clupeidae		-		-
Gadidae		-		-
Scrombridae		-		-
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		-		-
OTHER PHYLA	-		-	
ANIMAL REMAINS	40.0		24.2	
SAND AND ROCK	-		-	
Number of Stomachs	15		14	
Mean wt. per Stomach (g)	0.11		0.13	

Table 29. Diet composition, expressed as percent weight, of male and female marlin-spike, *Nezumia bairdi*, collected during the spring and autumn survey cruises, 1969-1972.

	Percent Weight			
	Male		Female	
POLYCHAETA	18.3		41.7	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		-		-
Other Polychaeta		18.3		41.7
CRUSTACEA	60.0		27.6	
Axiidae		-		-
Cancridae		-		-
Crangonidae		-		-
Majidae		-		-
Paguridae		-		-
Pandalidae		-		-
Other Decapoda		43.2		3.2
Euphausiacea		-		-
Mysidacea		6.6		-
Amphipoda		3.6		14.2
Other Crustacea		6.6		10.2
MOLLUSCA	2.0		3.1	
Pelecypoda		2.0		3.1
Gastropoda		-		-
Cephalopoda		-		-
Other Mollusca		-		-
ECHINODERMATA	-		-	
Echinoidea		-		-
Ophiuroidea		-		-
Other Echinodermata		-		-
PISCES	-		-	
Clupeidae		-		-
Gadidae		-		-
Scrombridae		-		-
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		-		-
OTHER PHYLA	-		-	
ANIMAL REMAINS	19.7		26.8	
SAND AND ROCK	-		0.8	
Number of Stomachs	13		10	
Mean wt. per Stomach (g)	0.15		0.13	

Table 30. Diet composition, expressed as percent weight, of male and female longnose grenadier, *Coelorhynchus carminatus*, collected during the spring and autumn survey cruises, 1969-1972.

	Percent Weight	
	Male	Female
POLYCHAETA	11.3	None
Terebelliformia	-	
Sabelliformia	-	
Nereidiformia	-	
Other Polychaeta	11.3	
CRUSTACEA	20.5	
Axiidae	-	
Cancridae	-	
Crangonidae	-	
Majidae	-	
Paguridae	-	
Pandalidae	-	
Other Decapoda	19.9	
Euphausiacea	-	
Mysidacea	-	
Amphipoda	-	
Other Crustacea	0.6	
MOLLUSCA	-	
Pelecypoda	-	
Gastropoda	-	
Cephalopoda	-	
Other Mollusca	-	
ECHINODERMATA	-	
Echinoidea	-	
Ophiuroidea	-	
Other Echinodermata	-	
PISCES	-	
Clupeidae	-	
Gadidae	-	
Scrombridae	-	
Scorpaenidae	-	
Bothidae	-	
Pleuronectidae	-	
Other Pisces	-	
OTHER PHYLA	-	
ANIMAL REMAINS	68.2	
SAND AND ROCK	-	
Number of Stomachs	2	
Mean wt. per Stomach (g)	0.15	

Table 31. Diet composition, expressed as percent weight, of male and female fawn cusk-eel, *Lepophidium cervinum*, collected during the spring and autumn survey cruises, 1969-1972.

	Percent Weight			
	Male		Female	
POLYCHAETA	2.6		12.9	
Terebelliformia		-		-
Sabelliformia		-		-
Nereidiformia		-		1.1
Other Polychaeta		2.6		11.8
CRUSTACEA	61.5		49.6	
Axiidae		-		2.1
Cancridae		-		-
Crangonidae		-		16.1
Majidae		-		-
Paguridae		-		-
Pandalidae		-		-
Other Decapoda		3.8		1.1
Euphausiacea		-		-
Mysidacea		-		-
Amphipoda		2.6		5.6
Other Crustacea		55.1		24.7
MOLLUSCA	-		1.1	
Pelecypoda		-		-
Gastropoda		-		-
Cephalopoda		-		-
Other Mollusca		-		1.1
ECHINODERMATA	-		-	
Echinoidea		-		-
Ophiuroidea		-		-
Other Echinodermata		-		-
PISCES	-		-	
Clupeidae		-		-
Gadidae		-		-
Scrombridae		-		-
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		-		-
OTHER PHYLA	23.1		30.0	
ANIMAL REMAINS	12.8		6.4	
SAND AND ROCK	-		-	
Number of Stomachs	27		28	
Mean wt. per Stomach (g)	0.014		0.017	

Table 32. Diet composition, expressed as percent weight, of male and female ocean pout, *Macrozoarces americanus*, collected during the spring and autumn survey cruises, 1969-1972. (+ indicates <0.1%).

	Percent Weight			
	Male		Female	
POLYCHAETA	2.8		4.6	
Terebelliformia		+		+
Sabelliformia		-		-
Nereidiformia		2.6		4.1
Other Polychaeta		0.2		0.5
CRUSTACEA	8.6		7.5	
Axiidae		-		-
Cancridae		3.5		3.0
Crangonidae		+		0.1
Majidae		-		0.8
Paguridae		0.8		0.1
Pandalidae		+		+
Other Decapoda		0.6		1.4
Euphausiacea		-		-
Mysidacea		-		-
Amphipoda		2.5		1.5
Other Crustacea		1.2		0.6
MOLLUSCA	7.0		0.7	
Pelecypoda		6.5		0.6
Gastropoda		0.4		+
Cephalopoda		-		-
Other Mollusca		0.1		0.1
ECHINODERMATA	70.8		74.1	
Echinoidea		62.2		69.8
Ophiuroidea		8.6		3.1
Other Echinodermata		-		1.2
PISCES	0.1		0.1	
Clupeidae		-		-
Gadidae		-		-
Scrombridae		-		-
Scorpaenidae		-		-
Bothidae		-		-
Pleuronectidae		-		-
Other Pisces		0.1		0.1
OTHER PHYLA	1.6		4.7	
ANIMAL REMAINS	5.7		3.3	
SAND AND ROCK	3.4		5.0	
Number of Stomachs	115		116	
Mean wt. per Stomach (g)	9.69		8.47	

Table 33. The mean weight of the stomach contents for male and female fish. The number of fish of each sex examined is in parentheses following the weight.

Species	Mean Weight of Stomach Contents (g)	
	Male n	Female n
Atlantic cod	24.51 (471)	33.01 (567)
Pollock	12.71 (229)	20.19 (268)
Silver hake	0.65 (474)	5.28 (629)
White hake	12.64 (212)	34.06 (295)
Offshore hake	0.96 (41)	4.58 (30)
Cusk	0.89 (17)	5.42 (37)
Red hake	1.72 (240)	3.37 (391)
Spotted hake	0.76 (65)	2.31 (116)
Haddock	4.24 (303)	5.42 (419)
Longfin hake	0.12 (39)	0.36 (61)
Fourbeard rockling	0.11 (15)	0.13 (14)
Marlin-spike	0.15 (13)	0.13 (10)
Longnose grenadier	0.15 (2)	-
Fawn cusk-eel	0.014(27)	0.017(28)
Ocean pout	9.69 (115)	8.47 (116)

Seasonal Variation in Food Habits

A consideration of seasonal differences in food habits is limited to a comparison between the spring and autumn cruises for the years 1971 and 1972. Because fish were collected over a broad geographic region and only during two seasons of the year a thorough discussion of seasonal changes in the diet is not possible. Furthermore, a more detailed listing of the seasonal variation in food habits, including a breakdown by ecological area, for eight of the fish considered in this report may be found in Bowman (1977). The data is presented here as a further breakdown of the overall summary of the food habits for the Gadiformes. In a few instances the data may suggest seasonal trends in the diet composition or quantity of food consumed for certain species of fish but these would need to be confirmed by a more detailed study, sampling fish on a year round basis over a more restricted geographical area.

Examination of the food habits data in Tables 34-48 revealed only two species of fish that demonstrated an apparent seasonal change in the composition of their diet. Pollock, for example (Table 35), were found to consume more crustaceans in the spring of both 1971 and 1972 than in the autumn of those same years, while fish constituted the major prey in the autumn. The haddock also showed some differences in food habits between the spring and autumn (Table 42) although the changes were not as readily apparent as for the pollock. In the spring of both 1971 and 1972 crustaceans and either polychaetes or echinoderms were important prey while in the autumn haddock preyed very heavily on echinoderms with ophiuroids accounting for almost one half the diet.

Of equal interest to compositional variations in diet is a change in the quantity of prey consumed. In order to facilitate a comparison between seasons for different sized fish the data was standardized by dividing the mean weight of prey per stomach by the mean predator weight. The mean weight of prey per stomach is given in Tables 34-48 and the mean predator length (also Tables 34-48) was converted to weight using the regression equation presented in Table 50. The data in Table 49 indicate that the relative amount of prey in the stomachs of the different species of fish is quite variable, ranging from as little as 0.87 g prey/kg predator in the fawn cusk-eel to a maximum of 30.90 g prey/kg predator for the white hake. An examination of the data for seasonal trends in the quantity of prey consumed reveals no overall pattern in the 15 fish. For several individual species, however, there was an apparent trend in the quantity of prey consumed between the spring and autumn. For example, Atlantic cod, silver hake, and haddock had relatively more prey in their stomachs in the autumn whereas white hake had relatively more in their stomachs in the spring.

Table 34. Stomach contents of the Atlantic cod, Gadus morhua, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971		Autumn 1971		Spring 1972		Autumn 1972	
POLYCHAETA	3.3		0.1		2.1		0.4	
Terebelliformia		-		-		+		+
Sabelliformia		-		-		-		-
Nereidiformia		3.2		0.1		1.7		0.3
Other Polychaeta		0.1		+		0.4		0.1
CRUSTACEA	21.9		32.0		28.4		12.4	
Axiidae		1.0		-		1.5		-
Cancridae		5.4		7.0		5.9		3.3
Crangonidae		0.5		+		0.3		0.4
Majidae		2.9		2.6		5.4		0.5
Paguridae		3.0		1.4		0.7		0.8
Pandalidae		4.6		1.9		2.2		2.0
Other Decapoda		1.5		8.0		8.0		3.9
Euphausiacea		0.6		9.9		0.4		0.5
Mysidacea		+		+		0.7		+
Amphipoda		1.1		0.1		0.1		0.1
Other Crustacea		1.3		1.1		3.2		0.9
MOLLUSCA	23.0		1.1		0.5		0.9	
Pelecypoda		14.1		0.1		+		0.1
Gastropoda		6.1		0.5		0.4		0.8
Cephalopoda		+		0.4		-		-
Other Mollusca		2.8		0.1		0.1		+
ECHINODERMATA	1.3		1.0		2.8		1.1	
Echinoidea		0.1		+		0.2		+
Ophiuroidea		0.6		0.7		0.8		0.7
Other Echinodermata		0.6		0.3		1.8		0.4
PISCES	46.1		62.9		59.1		80.2	
Clupeidae		0.5		35.8		12.7		67.9
Gadidae		5.7		3.0		11.7		0.1
Scrombridae		-		-		4.6		1.1
Scorpaenidae		0.1		1.9		-		-
Bothidae		0.7		-		-		0.1
Pleuronectidae		10.0		-		-		+
Other Pisces		29.1		22.2		30.1		11.0
OTHER PHYLA	0.8		+		0.2		0.2	
ANIMAL REMAINS	2.5		1.2		6.7		3.8	
SAND AND ROCK	1.1		1.7		0.2		1.0	
Number of stomachs	310		216		242		449	
Percent empty	9.4		10.2		2.1		8.9	
Mean wt. per stomach(g)	34.49		30.05		21.37		27.24	
Mean predator length(cm)	67.2		59.5		55.9		44.6	

Table 35. Stomach contents of the pollock, *Pollachius virens*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	0.1	-	0.2	0.1
Terebelliformia	-	-	-	-
Sabelliformia	-	-	-	-
Nereidiformia	-	-	0.2	-
Other Polychaeta	0.1	-	+	0.1
CRUSTACEA	67.7	35.7	65.7	18.6
Axiidae	-	-	-	-
Cancridae	-	-	-	-
Crangonidae	+	-	+	-
Majidae	-	-	-	-
Paguridae	-	-	-	-
Pandalidae	3.9	2.0	0.4	1.6
Other Decapoda	9.1	0.6	44.4	4.3
Euphausiacea	49.4	33.0	18.8	10.5
Mysidacea	-	-	-	0.1
Amphipoda	0.3	+	0.1	+
Other Crustacea	5.0	0.1	2.0	2.1
MOLLUSCA	0.9	+	0.5	+
Pelecypoda	+	-	-	-
Gastropoda	0.9	-	0.2	-
Cephalopoda	+	-	0.3	+
Other Mollusca	-	+	+	-
ECHINODERMATA	-	-	-	-
Echinoidea	-	-	-	-
Ophiuroidea	-	-	-	-
Other Echinodermata	-	-	-	-
PISCES	30.2	63.6	28.9	76.0
Clupeidae	-	51.5	3.8	10.5
Gadidae	0.1	0.5	8.0	1.9
Scrombridae	-	-	-	-
Scorpaenidae	-	4.1	-	0.5
Bothidae	-	-	-	-
Pleuronectidae	-	-	-	-
Other Pisces	30.1	7.5	17.1	63.1
OTHER PHYLA	0.7	0.5	0.2	0.6
ANIMAL REMAINS	0.4	0.1	4.5	4.5
SAND AND ROCK	-	0.1	+	0.2
Number of stomachs	189	91	178	141
Percent empty	10.6	8.8	15.2	12.1
Mean wt. per stomach(g)	23.06	44.12	8.14	8.32
Mean predator length(cm)	54.8	50.0	39.0	48.3

Table 36. Stomach contents of the silver hake, Merluccius bilinearis, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	0.2	+	-	+
Terebelliformia	-	-	-	-
Sabelliformia	-	-	-	-
Nereidiformia	0.2	+	-	-
Other Polychaeta	+	-	-	+
CRUSTACEA	35.8	25.9	21.8	12.4
Axiidae	-	-	+	-
Cancridae	0.5	-	-	-
Crangonidae	1.9	0.2	0.7	2.2
Majidae	-	-	-	-
Paguridae	-	-	-	-
Pandalidae	5.1	5.8	0.5	6.3
Other Decapoda	0.9	1.0	13.6	0.9
Euphausiacea	25.1	16.0	3.9	1.3
Mysidacea	+	0.4	0.2	-
Amphipoda	0.4	0.3	0.2	0.7
Other Crustacea	1.9	2.2	2.7	1.0
MOLLUSCA	13.3	0.1	2.3	1.9
Pelecypoda	-	-	-	-
Gastropoda	-	+	-	-
Cephalopoda	13.3	+	2.3	1.9
Other Mollusca	-	+	-	-
ECHINODERMATA	-	-	-	+
Echinoidea	-	-	-	-
Ophiuroidea	-	-	-	+
Other Echinodermata	-	-	-	+
PISCES	47.4	72.4	73.7	83.5
Clupeidae	-	33.7	-	-
Gadidae	18.8	6.8	14.5	-
Scrombridae	-	10.5	53.7	81.7
Scorpaenidae	-	-	-	-
Bothidae	-	-	-	-
Pleuronectidae	0.5	-	-	-
Other Pisces	28.1	21.4	5.5	1.8
OTHER PHYLA	0.3	+	+	+
ANIMAL REMAINS	3.0	1.6	2.2	2.2
SAND AND ROCK	+	-	-	-
Number of stomachs	464	563	276	148
Percent empty	36.6	27.7	35.1	23.0
Mean wt. per stomach(g)	1.46	4.07	2.27	3.51
Mean predator length(cm)	26.8	28.7	29.3	26.4

Table 37. Stomach contents of the white hake, *Urophycis tenuis*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	+	0.1	0.4	0.1
Terebelliformia	-	-	-	-
Sabelliformia	-	-	-	-
Nereidiformia	-	+	0.4	+
Other Polychaeta	+	0.1	-	0.1
CRUSTACEA	5.5	15.4	9.9	1.7
Axiidae	-	-	0.2	-
Cancridae	0.3	0.1	-	0.1
Crangonidae	-	0.3	0.6	0.1
Majidae	-	-	-	-
Paguridae	-	+	+	0.2
Pandalidae	1.9	5.2	2.4	1.0
Other Decapoda	2.2	2.5	0.5	0.1
Euphausiacea	1.0	6.8	5.0	0.1
Mysidacea	+	+	0.1	-
Amphipoda	+	0.1	0.1	+
Other Crustacea	0.1	0.4	1.0	0.1
MOLLUSCA	0.5	2.7	6.1	0.5
Pelecypoda	-	-	-	-
Gastropoda	+	-	+	-
Cephalopoda	0.5	2.7	6.0	0.5
Other Mollusca	-	-	+	+
ECHINODERMATA	-	-	+	-
Echinoidea	-	-	-	-
Ophiuroidea	-	-	+	-
Other Echinodermata	-	-	-	-
PISCES	93.7	79.4	79.0	96.6
Clupeidae	-	30.6	-	-
Gadidae	11.0	19.5	9.3	2.2
Scrombridae	12.5	-	-	26.7
Scorpaenidae	-	5.3	-	-
Bothidae	-	-	-	-
Pleuronectidae	-	-	-	-
Other Pisces	70.2	24.0	69.7	67.7
OTHER PHYLA	0.1	0.1	+	+
ANIMAL REMAINS	0.2	2.3	4.6	1.1
SAND AND ROCK	+	+	-	+
Number of stomachs	61	186	196	73
Percent empty	34.4	8.1	37.8	31.5
Mean wt. per stomach(g)	46.74	27.49	7.98	43.35
Mean predator length(cm)	52.6	41.2	47.2	45.7

Table 38. Stomach contents of the offshore hake, *Merluccius albidus*, expressed in percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	NONE	NONE	-	-
Terebelliformia			-	-
Sabelliformia			-	-
Nereidiformia			-	-
Other Polychaeta			-	-
CRUSTACEA			3.6	6.0
Axiidae			-	-
Cancridae			-	-
Crangonidae			-	-
Majidae			-	-
Paguridae			-	-
Pandalidae			-	3.1
Other Decapoda			0.9	2.2
Euphausiacea			2.7	0.7
Mysidacea			-	-
Amphipoda			-	-
Other Crustacea			-	-
MOLLUSCA			-	1.2
Pelecypoda			-	-
Gastropoda			-	-
Cephalopoda			-	1.2
Other Mollusca			-	-
ECHINODERMATA			-	-
Echinoidea			-	-
Ophiuroidea			-	-
Other Echinodermata			-	-
PISCES			96.4	92.5
Clupeidae			-	-
Gadidae			-	76.6
Scrombridae			-	-
Scorpaenidae			-	-
Bothidae			-	-
Pleuronectidae			-	-
Other Pisces			96.4	15.9
OTHER PHYLA			+	-
ANIMAL REMAINS			-	0.3
SAND AND ROCK			-	-
Number of stomachs			22	51
Percent empty			44.5	62.7
Mean wt. per stomach(g)			1.77	2.73
Mean predator length(cm)			37.3	30.3

Table 39. Stomach contents of the cusk, Brosme brosme, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	-	-	-	-
Terebelliformia	-	-	-	-
Sabelliformia	-	-	-	-
Nereidiformia	-	-	-	-
Other Polychaeta	-	-	-	-
CRUSTACEA	100.0	93.8	4.0	88.4
Axiidae	-	-	-	-
Cancridae	-	-	-	-
Crangonidae	-	-	-	-
Majidae	-	-	2.1	-
Paguridae	-	-	-	-
Pandalidae	-	-	0.1	43.5
Other Decapoda	-	93.8	1.7	-
Euphausiacea	-	-	-	5.4
Mysidacea	-	-	-	-
Amphipoda	100.0	-	-	-
Other Crustacea	-	-	0.1	39.5
MOLLUSCA	-	-	-	-
Pelecypoda	-	-	-	-
Gastropoda	-	-	-	-
Cephalopoda	-	-	-	-
Other Mollusca	-	-	-	-
ECHINODERMATA	-	-	8.5	-
Echinoidea	-	-	-	-
Ophiuroidea	-	-	8.5	-
Other Echinodermata	-	-	-	-
PISCES	-	3.2	86.9	6.8
Clupeidae	-	-	-	-
Gadidae	-	-	-	-
Scrombridae	-	-	-	-
Scorpaenidae	-	-	-	-
Bothidae	-	-	-	-
Pleuronectidae	-	-	-	-
Other Pisces	-	3.2	86.9	6.8
OTHER PHYLA	-	3.0	-	0.3
ANIMAL REMAINS	-	-	0.6	2.0
SAND AND ROCK	-	-	-	2.5
Number of stomachs	7	8	16	28
Percent empty	42.9	62.5	75.0	82.1
Mean wt. per stomach(g)	0.005	2.17	15.38	0.49
Mean predator length(cm)	57.5	67.2	71.5	61.0

Table 40. Stomach contents of the red hake, *Urophycis chuss*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971		Autumn 1971		Spring 1972		Autumn 1972	
POLYCHAETA	1.0		2.5		1.2		5.0	
Terebelliformia		-		0.2		-		+
Sabelliformia		+		+		-		0.3
Nereidiformia		0.1		0.5		0.2		3.1
Other Polychaeta		0.9		1.8		1.0		1.6
CRUSTACEA	65.3		61.8		49.7		42.9	
Axiidae		1.7		0.1		-		3.2
Cancridae		7.8		0.2		0.5		7.6
Crangonidae		1.0		1.8		1.7		4.7
Majidae		0.1		-		-		-
Paguridae		0.6		7.4		0.6		0.7
Pandalidae		2.1		24.9		13.3		14.0
Other Decapoda		42.5		4.7		11.5		3.4
Euphausiacea		4.1		15.1		0.5		0.1
Mysidacea		+		0.5		+		+
Amphipoda		3.2		1.8		17.1		3.1
Other Crustacea		2.2		5.3		4.5		6.1
MOLLUSCA	1.4		26.9		0.1		5.7	
Pelecypoda		0.1		+		+		-
Gastropoda		0.1		17.7		+		2.5
Cephalopoda		1.0		-		-		3.0
Other Mollusca		0.2		9.2		0.1		0.2
ECHINODERMATA	0.1		1.9		-		0.3	
Echinoidea		-		-		-		-
Ophiuroidea		-		-		-		-
Other Echinodermata		0.1		1.9		-		0.3
PISCES	27.5		3.6		36.8		27.9	
Clupeidae		-		-		-		1.5
Gadidae		-		-		1.9		0.7
Scrombridae		-		-		4.0		-
Scorpaenidae		-		-		-		-
Bothidae		-		-		-		-
Pleuronectidae		-		-		-		-
Other Pisces		27.5		3.6		30.9		25.7
OTHER PHYLA	+		0.1		2.5		1.5	
ANIMAL REMAINS	4.7		3.1		8.9		16.4	
SAND AND ROCK	-		0.1		0.8		0.3	
Number of stomachs	143		142		143		302	
Percent empty	17.5		4.9		18.9		11.9	
Mean wt. per stomach(g)	4.32		2.15		1.57		2.95	
Mean predator length(cm)	29.4		30.4		31.3		30.1	

Table 41. Stomach contents of the spotted hake, *Urophycis regius*, expressed in percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	0.7	-	-	0.1
Terebelliformia	-	-	-	-
Sabelliformia	-	-	-	-
Nereidiformia	-	-	-	0.1
Other Polychaeta	0.7	-	-	-
CRUSTACEA	23.0	46.6	83.3	60.4
Axiidae	-	-	-	0.4
Cancridae	5.2	7.5	11.2	0.1
Crangonidae	3.1	0.7	3.9	10.2
Majidae	-	-	0.9	-
Paguridae	0.2	0.3	0.4	-
Pandalidae	+	2.0	-	11.0
Other Decapoda	4.7	29.4	58.2	37.0
Euphausiacea	-	-	-	+
Mysidacea	+	-	-	-
Amphipoda	7.1	4.1	-	0.5
Other Crustacea	2.7	2.6	8.7	1.2
MOLLUSCA	38.6	1.5	-	15.7
Pelecypoda	-	1.3	-	-
Gastropoda	-	-	-	-
Cephalopoda	38.6	-	-	15.7
Other Mollusca	-	0.2	-	-
ECHINODERMATA	-	-	-	0.2
Echinoidea	-	-	-	-
Ophiuroidea	-	-	-	-
Other Echinodermata	-	-	-	0.2
PISCES	21.1	50.6	16.5	14.5
Clupeidae	-	-	-	-
Gadidae	-	-	-	1.5
Scrombridae	-	-	-	-
Scorpaenidae	-	-	-	-
Bothidae	-	5.5	-	0.2
Pleuronectidae	-	-	-	3.8
Other Pisces	21.1	45.1	16.5	9.0
OTHER PHYLA	+	+	-	0.2
ANIMAL REMAINS	15.9	1.3	0.1	8.5
SAND AND ROCK	0.7	+	0.1	0.4
Number of stomachs	97	62	42	50
Percent empty	20.6	9.7	28.6	20.0
Mean wt. per stomach(g)	1.39	1.90	0.51	1.43
Mean predator length(cm)	16.4	19.2	23.0	20.8

Table 42. Stomach contents of the haddock, *Melanogrammus aeglefinus*, expressed as percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971		Autumn 1971		Spring 1972		Autumn 1972	
POLYCHAETA	27.1		11.8		9.4		9.4	
Terebelliformia		5.1		0.6		-		1.4
Sabelliformia		0.7		0.6		-		1.0
Nereidiformia		2.4		1.4		1.3		1.1
Other Polychaeta		18.9		9.2		8.1		5.9
CRUSTACEA	29.0		8.0		28.3		11.7	
Axiidae		1.7		0.5		4.1		0.5
Cancridae		+		0.2		-		+
Crangonidae		0.2		+		0.1		0.5
Majidae		0.1		0.2		2.1		0.1
Paguridae		0.1		0.3		1.9		1.0
Pandalidae		1.0		0.7		1.5		0.3
Other Decapoda		0.7		0.7		2.3		2.5
Euphausiacea		10.6		2.0		0.3		0.8
Mysidacea		-		+		1.1		-
Amphipoda		11.1		1.9		10.5		4.8
Other Crustacea		3.5		1.5		4.4		1.2
MOLLUSCA	9.2		1.5		3.0		4.9	
Pelecypoda		8.6		0.6		2.3		2.3
Gastropoda		0.4		0.4		0.6		0.2
Cephalopoda		-		0.1		-		1.8
Other Mollusca		0.2		0.4		0.1		0.6
ECHINODERMATA	6.5		59.5		29.7		53.0	
Echinoidea		3.2		7.8		4.6		6.1
Ophiuroidea		1.2		48.8		16.6		44.5
Other Echinodermata		2.1		2.9		8.5		2.4
PISCES	0.6		0.8		5.2		4.2	
Clupeidae		-		-		-		-
Gadidae		-		-		5.2		-
Scrombridae		-		-		-		-
Scorpaenidae		-		-		-		-
Bothidae		-		-		-		-
Pleuronectidae		-		-		-		-
Other Pisces		0.6		0.8		+		4.2
OTHER PHYLA	2.3		0.9		0.4		0.8	
ANIMAL REMAINS	5.2		11.5		21.1		15.0	
SAND AND ROCK	20.1		6.0		2.9		1.0	
Number of stomachs		262		191		153		244
Percent empty		11.8		5.2		6.5		6.2
Mean wt. per stomach(g)		5.53		8.61		2.58		2.98
Mean predator length(cm)		51.1		48.8		43.7		38.2

Table 43. Stomach contents of the longfin hake, *Phycis chesteri*, expressed in percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	NONE	NONE	-	-
Terebelliformia			-	-
Sabelliformia			-	-
Nereidiformia			-	-
Other Polychaeta			-	-
CRUSTACEA			98.0	94.7
Axiidae			-	-
Cancridae			-	-
Crangonidae			-	-
Majidae			-	-
Paguridae			-	-
Pandalidae			-	53.0
Other Decapoda			15.9	12.8
Euphausiacea			66.4	28.9
Mysidacea			-	-
Amphipoda			-	-
Other Crustacea			15.7	-
MOLLUSCA			-	-
Pelecypoda			-	-
Gastropoda			-	-
Cephalopoda			-	-
Other Mollusca			-	-
ECHINODERMATA			-	2.1
Echinoidea			-	2.1
Ophiuroidea			-	-
Other Echinodermata			-	-
PISCES			1.4	-
Clupeidae			-	-
Gadidae			-	-
Scrombridae			-	-
Scorpaenidae			-	-
Bothidae			-	-
Pleuronectidae			-	-
Other Pisces			1.4	-
OTHER PHYLA			-	-
ANIMAL REMAINS			0.6	3.2
SAND AND ROCK			-	-
Number of stomachs			68	58
Percent empty			52.9	74.1
Mean wt. per stomach(g)			0.43	0.10
Mean predator length(cm)			25.8	21.6

Table 44. Stomach contents of the fourbeard rockling, Enchelyopus cimbrius, expressed in percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	NONE	-	64.4	13.2
Terebelliformia		-	-	-
Sabelliformia		-	-	-
Nereidiformia		-	-	-
Other Polychaeta		-	64.4	13.2
CRUSTACEA		94.4	10.6	18.6
Axiidae		-	-	-
Cancridae		-	-	-
Crangonidae		-	-	12.0
Majidae		-	-	-
Paguridae		-	-	-
Pandalidae		-	-	-
Other Decapoda		94.4	-	-
Euphausiacea		-	7.4	-
Mysidacea		-	-	-
Amphipoda		-	-	6.6
Other Crustacea		-	3.2	-
MOLLUSCA		-	-	-
Pelecypoda		-	-	-
Gastropoda		-	-	-
Cephalopoda		-	-	-
Other Mollusca		-	-	-
ECHINODERMATA		-	-	-
Echinoidea		-	-	-
Ophiuroidea		-	-	-
Other Echinodermata		-	-	-
PISCES		-	-	-
Clupeidae		-	-	-
Gadidae		-	-	-
Scrombridae		-	-	-
Scorpaenidae		-	-	-
Bothidae		-	-	-
Pleuronectidae		-	-	-
Other Pisces		-	-	-
OTHER PHYLA		-	-	-
ANIMAL REMAINS		5.6	25.0	68.2
SAND AND ROCK		-	-	-
Number of stomachs		2	19	10
Percent empty		0	10.5	30.0
Mean wt. per stomach(g)		0.36	0.10	0.084
Mean predator length(cm)		26.1	21.2	23.5

Table 45. Stomach contents of the marlin spike, Neuzmia bairdi, expressed in percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972		Autumn 1972	
POLYCHAETA	NONE	NONE	46.9		13.0	
Terebelliformia				-		-
Sabelliformia				-		-
Nereidiformia				-		-
Other Polychaeta				46.9		13.0
CRUSTACEA			10.1		75.1	
Axiidae				-		-
Cancridae				-		-
Crangonidae				-		-
Majidae				-		-
Paguridae				-		-
Pandalidae				-		-
Other Decapoda				2.2		46.4
Euphausiacea				-		-
Mysidacea				-		7.0
Amphipoda				7.9		7.6
Other Crustacea				-		14.1
MOLLUSCA			5.8		-	
Pelecypoda				5.8		-
Gastropoda				-		-
Cephalopoda				-		-
Other Mollusca				-		-
ECHINODERMATA			-		-	
Echinoidea				-		-
Ophiuroidea				-		-
Other Echinodermata				-		-
PISCES			-		-	
Clupeidae				-		-
Gadidae				-		-
Scrombridae				-		-
Scorpaenidae				-		-
Bothidae				-		-
Pleuronectidae				-		-
Other Pisces				-		-
OTHER PHYLA			-		-	
ANIMAL REMAINS			37.2		11.4	
SAND AND ROCK			-		0.5	
Number of stomachs				8		15
Percent empty				25.0		0
Mean wt. per stomach(g)				0.18		0.12
Mean predator length(cm)				24.1		24.2

Table 46. Stomach contents of the longnose grenadier, *Coelorhynchus carminatus*, expressed in percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	NONE	NONE	35.8	NONE
Terebelliformia			-	
Sabelliformia			-	
Nereidiformia			-	
Other Polychaeta			35.8	
CRUSTACEA			24.8	
Axiidae			-	
Cancridae			-	
Crangonidae			-	
Majidae			-	
Paguridae			-	
Pandalidae			-	
Other Decapoda			23.6	
Euphausiacea			-	
Mysidacea			-	
Amphipoda			-	
Other Crustacea			1.2	
MOLLUSCA			-	
Pelecypoda			-	
Gastropoda			-	
Cephalopoda			-	
Other Mollusca			-	
ECHINODERMATA			-	
Echinoidea			-	
Ophiuroidea			-	
Other Echinodermata			-	
PISCES			+	
Clupeidae			-	
Gadidae			-	
Scrombridae			-	
Scorpaenidae			-	
Bothidae			-	
Pleuronectidae			-	
Other Pisces			+	
OTHER PHYLA			2.8	
ANIMAL REMAINS			36.6	
SAND AND ROCK			-	
Number of stomachs			11	
Percent empty			36.4	
Mean wt. per stomach(g)			0.09	
Mean predator length(cm)			19.3	

Table 47. Stomach contents of the fawn cusk-eel, Lepophidium cervinum, expressed in percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971		Autumn 1971		Spring 1972		Autumn 1972	
POLYCHAETA	66.7		36.4		22.0		-	
Terebelliformia		-		-		-		-
Sabelliformia		-		-		-		-
Nereidiformia		8.3		-		-		-
Other Polychaeta		58.4		36.4		22.0		-
CRUSTACEA	33.3		9.1		71.9		49.0	
Axiidae		-		-		-		1.9
Cancridae		-		-		-		-
Crangonidae		33.3		-		25.6		-
Majidae		-		-		-		-
Paguridae		-		-		-		-
Pandalidae		-		-		-		-
Other Decapoda		-		-		0.9		2.9
Euphausiacea		-		-		-		-
Mysidacea		-		-		-		-
Amphipoda		-		9.1		22.5		-
Other Crustacea		-		-		17.9		44.2
MOLLUSCA	-		-		-		1.0	
Pelecypoda		-		-		-		-
Gastropoda		-		-		-		-
Cephalopoda		-		-		-		-
Other Mollusca		-		-		-		1.0
ECHINODERMATA	-		-		-		-	
Echinoidea		-		-		-		-
Ophiuroidea		-		-		-		-
Other Echinodermata		-		-		-		-
PISCES	-		-		-		-	
Clupeidae		-		-		-		-
Gadidae		-		-		-		-
Scrombridae		-		-		-		-
Scorpaenidae		-		-		-		-
Bothidae		-		-		-		-
Pleuronectidae		-		-		-		-
Other Pisces		-		-		-		-
OTHER PHYLA	-		-		2.5		44.2	
ANIMAL REMAINS	-		54.5		3.6		5.8	
SAND AND ROCK	-		-		-		-	
Number of stomachs	7		12		19		22	
Percent empty	71.4		58.3		26.3		22.7	
Mean wt. per stomach(g)	0.009		0.005		0.029		0.024	
Mean predator length(cm)	23.5		23.2		22.7		22.9	

Table 48. Stomach contents of the ocean pout, *Macrozoarces americanus*, expressed in percent weight, for fish collected during the spring and autumn groundfish cruises, 1971-1972. (+ indicates <0.1%).

PREY	Spring 1971	Autumn 1971	Spring 1972	Autumn 1972
POLYCHAETA	1.2	NONE	3.5	1.0
Terebelliformia	-		+	-
Sabelliformia	-		-	-
Nereidiformia	1.1		3.2	-
Other Polychaeta	0.1		0.3	1.0
CRUSTACEA	11.1		10.9	34.2
Axiidae	-		-	-
Cancridae	0.1		3.3	-
Crangonidae	-		+	-
Majidae	-		0.4	-
Paguridae	-		0.4	5.6
Pandalidae	-		+	0.4
Other Decapoda	-		0.9	+
Euphausiacea	-		-	-
Mysidacea	-		-	-
Amphipoda	8.3		5.3	4.1
Other Crustacea	2.7		0.6	24.1
MOLLUSCA	4.5		3.9	0.1
Pelecypoda	1.2		3.6	0.1
Gastropoda	3.3		0.2	-
Cephalopoda	-		-	-
Other Mollusca	-		0.1	-
ECHINODERMATA	77.2		70.5	-
Echinoidea	77.2		63.9	-
Ophiuroidea	-		6.0	-
Other Echinodermata	-		0.6	-
PISCES	-		0.1	0.1
Clupeidae	-		-	-
Gadidae	-		-	-
Scrombridae	-		-	-
Scorpaenidae	-		-	-
Bothidae	-		-	-
Pleuronectidae	-		-	-
Other Pisces	-		0.1	0.1
OTHER PHYLA	14.1		2.9	2.4
ANIMAL REMAINS	-		4.3	38.0
SAND AND ROCK	22.6		3.9	24.2
Number of stomachs	30		229	47
Percent empty	3.3		22.7	29.8
Mean wt. per stomach(g)	8.49		9.35	0.18
Mean predator length(cm)	47.8		52.5	33.2

Table 49. A relative measure of the quantity of food in the stomach, expressed as grams prey/kilogram predator, for 15 species of gadiform fishes.

Species	Overall mean	Spring 1971	Fall 1971	Spring 1972	Fall 1972
Atlantic cod	17.21	11.26	14.23	12.24	31.10
Pollock	17.40	13.81	34.85	13.66	7.30
Silver hake	18.89	10.85	24.55	12.85	27.32
White hake	30.90	27.38	14.15	42.63	39.42
Offshore hake	9.34	-	-	4.72	13.96
Cusk	1.32	0.003	0.73	4.33	0.21
Red hake	16.51	27.78	12.41	8.25	17.59
Spotted hake	25.12	38.19	32.20	4.98	18.97
Haddock	4.75	3.90	7.00	2.94	5.14
Longfin hake	3.14	-	-	4.45	1.83
Fourbeard rockling	2.12	-	3.41	1.85	1.11
Marlin-spike	4.01	-	-	4.83	3.18
Longnose grenadier	1.97	-	-	1.97	-
Fawn cusk-eel	0.87	0.55	0.32	1.99	0.63
Ocean pout	10.16	16.21	-	13.14	1.13

Table 50. Constants for the length-weight regression equations of the form ln W = ln a + b ln L, where W is weight in kilograms and L is length in centimeters. All the values are from groundfish survey cruise data except for the marlin-spike which was computed from length-weight values collected on cruise ALB IV 74-04.

Species	ln a	b
Atlantic cod	-11.7231	3.0521
Pollock	-11.6113	3.0283
Silver hake	-12.0351	3.0499
White hake	-12.5300	3.2196
Offshore hake	-12.3335	3.1372
Cusk	-10.6773	2.7978
Red hake	-12.7539	3.2217
Spotted hake	-11.8871	3.0648
Haddock	-11.7200	3.0678
Longfin hake	-12.7705	3.2101
Fourbeard rockling	-12.7506	3.2200
Marlin-spike	-11.9134	2.7105
Longnose grenadier	- 8.2540	1.7466
Fawn cusk-eel	-13.5906	3.000
Ocean pout	-13.2839	3.2680

Yearly Food Habits

A breakdown of the food habits, by predator, for each of the four years of the study is given in Tables 51-65 and the yearly changes in predation on the major prey categories are presented diagrammatically in Figures 3 and 4. Details of the composition of each predator's food habits have been given in the overall and areal summaries so that the discussion here is limited to a consideration of major changes in the year to year composition of the diet and in the total quantity of prey consumed.

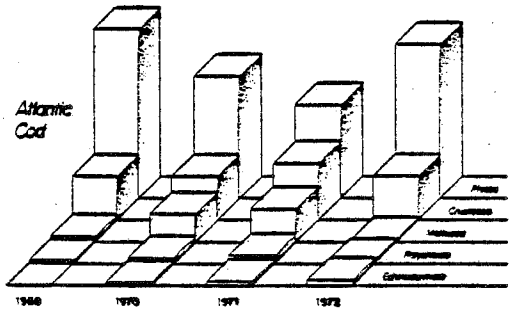
A number of fish showed a change in their major prey from one year to the next (Figures 3 and 4). The pollock, for example, preyed primarily on crustaceans and fish and the percentage contributed to the diet by each of these prey groups usually ranged between 45 to 53% (Table 52). In 1970, however, the quantity of euphausiids consumed increased markedly with the result that crustaceans accounted for 82% of the total prey. It is difficult to explain this shift in the diet except to suggest that euphausiids were particularly abundant in the region where the fish were being sampled for food habits analysis. The haddock (Table 59) also showed a change in its dietary habits in 1970 but this is more easily explained. Haddock were preying on herring eggs which were available as a food source at the time the fish were caught. Other fish also showed some changes in diet which may simply reflect the availability of various prey immediately before they were caught. Thus, the silver hake (Table 53) fed more heavily on crustaceans in 1970 than in other years. The white hake (Table 54) consumed more fish in 1971 and the cusk (Table 56) ate more fish in 1972. The spotted hake

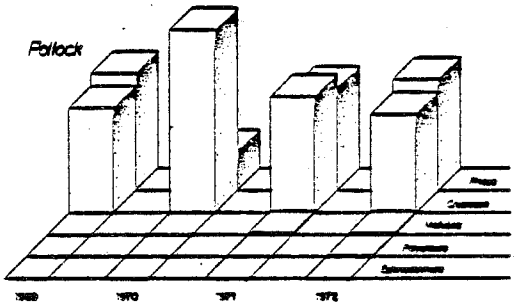
(Table 58) preyed heavily on squid in 1971 but to a lesser extent in the other three years. The fawn cusk-eel (Table 64) and fourbeard rockling (Table 61) also showed yearly changes in diet but in some years the percentage of unidentifiable animal remains makes it impossible to determine if the changes were real.

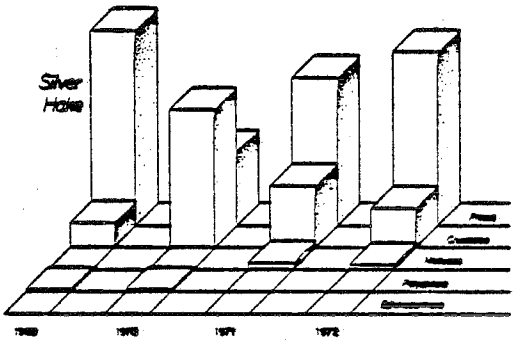
None of the differences noted above are obviously related to size dependent changes in food habits since the mean predator length was reasonably constant, except for the pollock, whose length varied greatly but did not correlate with any major dietary changes. Only the ocean pout (Table 65) showed a yearly change in its food habits which might be size related, although the suggestion is tenuous at best. The ocean pout caught in 1969 and 1970 averaged 37 cm in length and preyed primarily on crustaceans. In 1971 and 1972 the average length of ocean pout was 47 cm and in both of these years over two-thirds of the diet was made up of sand dollars.

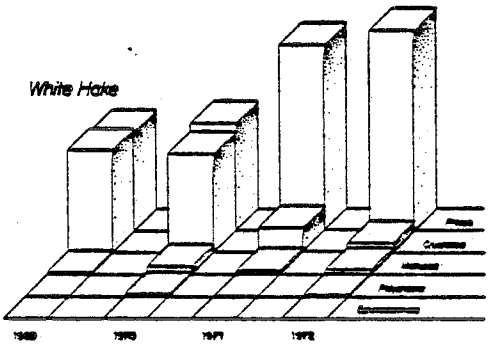
To facilitate the comparison of the quantity of prey consumed by any one species of fish the data was standardized as grams of prey per kilogram of predator and presented in Table 66. The variation in the quantity of prey per unit weight of predator for any one species of fish is quite large ranging, for example, in the ocean pout from 0.69 g/kg in 1970 to 15.62 g/kg in 1971. The reasons behind this variability are obscure especially in instances where the number of fish actually analyzed was large thus reducing the variation between the estimates of the mean predator length and mean weight per stomach actually obtained.

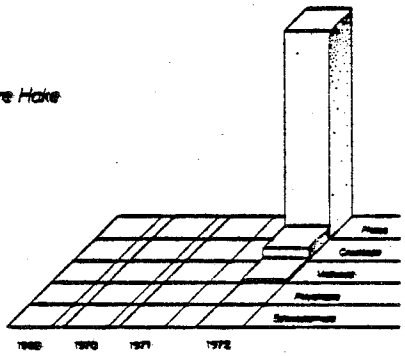
Figures 3 and 4. The yearly change in predation on the major prey categories, 1969-1972, for some Northwest Atlantic fishes. The data is expressed as percent weight.

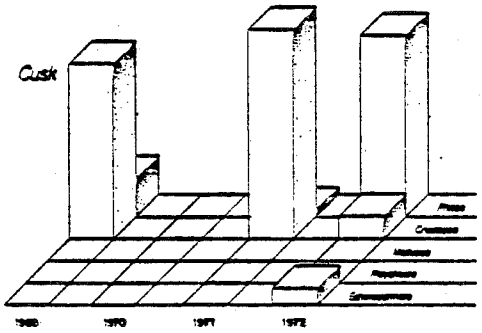

Atlantic Cod
1969
1970
1971
1972

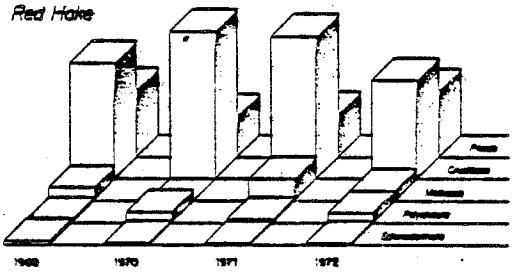

Pollock
1969
1970
1971
1972

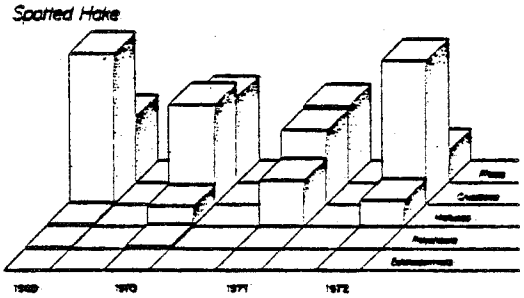

Silver Hake
1969
1970
1971
1972

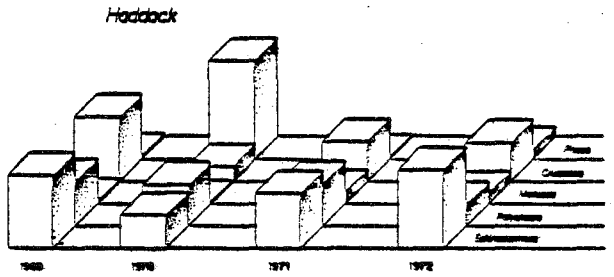

White Hake
1969
1970
1971
1972

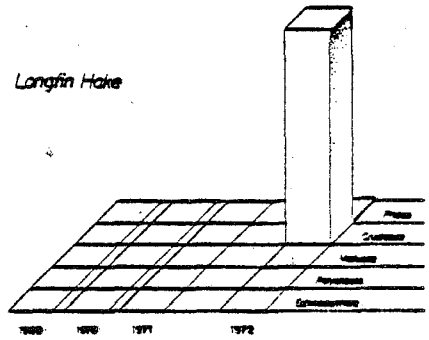

Offshore Hake
1969
1970
1971
1972

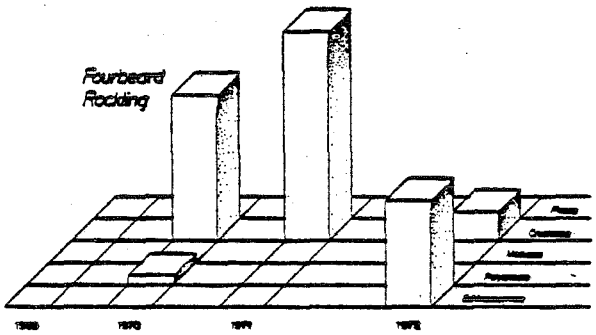

Cusk
1969
1970
1971
1972

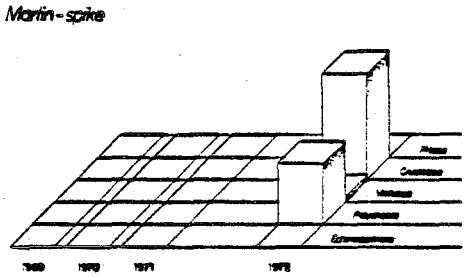

Red Hake
1969
1970
1971
1972

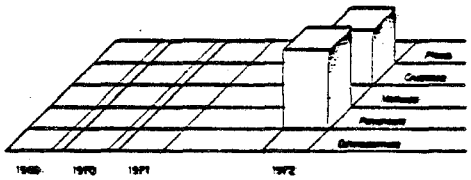

Spotted Hake
1969
1970
1971
1972

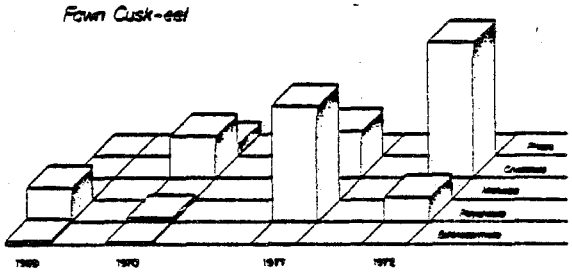

Haddock


Longfin Hake


Fourbeard
Rocking


Marlin-spike


Longnose Grenadier


Fawn Cusk-eel

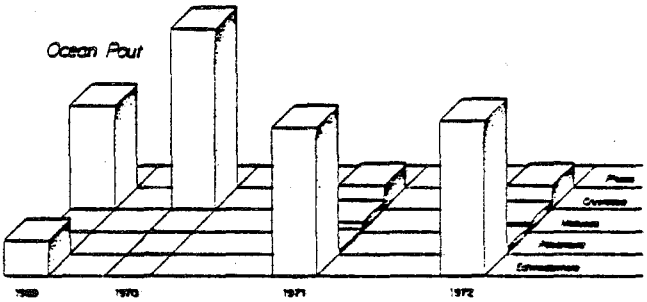

Ocean Pout

Table 51. Yearly summary of the stomach contents of the Atlantic cod, Gadus morhua, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969		1970		1971		1972	
POLYCHAETA	0.3		0.6		2.1		0.9	
Terebelliformia		-		-		-		+
Sabelliformia		-		-		-		-
Nereidiformia		0.2		0.4		2.0		0.7
Other Polychaeta		0.1		0.2		0.1		0.2
CRUSTACEA	15.7		19.9		25.7		17.0	
Axiidae		0.3		0.3		0.6		0.4
Cancridae		2.8		3.4		6.0		4.1
Crangonidae		0.2		0.2		0.3		0.3
Majidae		0.7		1.4		2.8		2.0
Paguridae		1.7		2.7		2.4		0.7
Pandalidae		4.2		2.7		3.6		2.0
Other Decapoda		2.1		6.3		3.9		5.1
Euphausiacea		0.9		1.8		4.1		0.5
Mysidacea		+		+		+		0.2
Amphipoda		1.1		0.3		0.7		0.1
Other Crustacea		1.7		0.8		1.3		1.6
MOLLUSCA	2.0		12.8		14.8		0.8	
Pelecypoda		1.2		7.2		8.8		0.1
Gastropoda		0.7		4.9		4.0		0.7
Cephalopoda		+		0.1		0.2		-
Other Mollusca		0.1		0.6		1.8		+
ECHINODERMATA	0.1		0.5		1.2		1.6	
Echinoidea		+		0.3		+		0.1
Ophiuroidea		+		0.2		0.7		0.7
Other Echinodermata		+		-		0.5		0.8
PISCES	77.4		55.7		52.4		74.0	
Clupeidae		6.0		4.0		13.8		51.5
Gadidae		-		4.4		4.7		3.5
Scrombridae		22.3		-		-		2.2
Scorpaenidae		17.3		11.7		0.8		-
Bothidae		0.9		-		0.4		0.1
Pleuronectidae		-		-		6.2		+
Other Pisces		30.9		35.6		26.5		16.7
OTHER PHYLA	1.0		0.4		0.5		0.2	
ANIMAL REMAINS	2.4		2.4		2.0		4.7	
SAND AND ROCK	1.1		7.7		1.3		0.8	
Number of stomachs	159		164		526		691	
Percent empty	5.7		7.3		9.7		6.5	
Mean wt. per stomach(g)	27.4		24.6		32.7		25.2	
Mean predator length(cm)	65.7		56.0		63.7		48.0	

Table 52. Yearly summary of the stomach contents of the pollock, *Pollachius virens*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969		1970		1971		1972	
POLYCHAETA	-		-		+		0.2	
Terebelliformia		-		-		-		-
Sabelliformia		-		-		-		-
Nereidiformia		-		-		-		0.1
Other Polychaeta		-		-		+		0.1
CRUSTACEA	47.3		82.3		52.4		44.6	
Axiidae		-		-		-		-
Cancridae		-		-		-		-
Crangonidae		-		0.9		+		+
Majidae		-		-		-		-
Paguridae		-		-		-		-
Pandalidae		2.4		4.7		3.0		0.9
Other Decapoda		17.1		9.9		5.0		26.5
Euphausiacea		27.7		65.1		41.6		15.1
Mysidacea		0.1		1.5		-		+
Amphipoda		-		0.2		0.1		0.1
Other Crustacea		-		-		2.7		2.1
MOLLUSCA	-		-		0.5		0.3	
Pelecypoda		-		-		+		-
Gastropoda		-		-		0.5		0.1
Cephalopoda		-		-		+		0.2
Other Mollusca		-		-		-		+
ECHINODERMATA	-		-		-		-	
Echinoidea		-		-		-		-
Ophiuroidea		-		-		-		-
Other Echinodermata		-		-		-		-
PISCES	52.7		17.6		46.2		50.0	
Clupeidae		-		-		24.7		6.8
Gadidae		-		-		0.3		5.3
Scrombridae		-		-		-		-
Scorpaenidae		-		-		2.0		0.2
Bothidae		-		-		-		-
Pleuronectidae		-		-		-		-
Other Pisces		52.7		17.6		19.2		37.7
OTHER PHYLA	-		0.1		0.6		0.4	
ANIMAL REMAINS	-		-		0.3		4.5	
SAND AND ROCK	-		-		+		0.1	
Number of stomachs	23		22		280		319	
Percent empty	0		18.2		10.0		13.8	
Mean wt. per stomach(g)	22.85		7.66		29.90		8.22	
Mean predator length(cm)	70.1		56.8		52.5		41.7	

Table 53. Yearly summary of the stomach contents of the silver hake, *Merluccius bilinearis*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969	1970	1971	1972
POLYCHAETA	0.9	0.9	0.1	+
Terebelliformia	-	-	-	-
Sabelliformia	-	0.6	-	-
Nereidiformia	0.8	-	0.1	-
Other Polychaeta	0.1	0.3	+	+
CRUSTACEA	11.3	62.0	28.1	17.6
Axiidae	-	-	-	+
Cancridae	+	-	0.1	-
Crangonidae	1.6	8.6	0.6	1.4
Majidae	-	-	-	-
Paguridae	-	-	-	-
Pandalidae	3.8	14.4	5.7	3.1
Other Decapoda	1.5	2.6	0.9	7.9
Euphausiacea	2.8	25.1	18.1	2.7
Mysidacea	+	0.5	0.3	0.1
Amphipoda	0.4	0.7	0.3	0.5
Other Crustacea	1.1	10.1	2.1	1.9
MOLLUSCA	-	+	3.1	2.1
Pelecypoda	-	-	-	-
Gastropoda	-	-	+	-
Cephalopoda	-	+	3.0	2.1
Other Mollusca	-	-	+	-
ECHINODERMATA	-	-	-	+
Echinoidea	-	-	-	-
Ophiuroidea	-	-	-	+
Other Echinodermata	-	-	-	+
PISCES	87.8	33.4	66.7	78.1
Clupeidae	-	-	26.0	-
Gadidae	0.2	0.3	9.5	7.9
Scrombridae	-	-	8.1	66.4
Scorpaenidae	-	-	-	-
Bothidae	-	-	-	-
Pleuronectidae	-	-	0.1	-
Other Pisces	87.6	33.1	23.0	3.8
OTHER PHYLA	-	0.1	0.1	+
ANIMAL REMAINS	-	3.6	1.9	2.2
SAND AND ROCK	-	+	+	-
Number of stomachs	210	475	1027	424
Percent empty	27.1	39.4	31.7	30.9
Mean wt. per stomach(g)	4.21	0.62	2.89	2.70
Mean predator length(cm)	29.0	26.8	27.5	27.4

Table 54. Yearly summary of the stomach contents of the white hake, *Urophycis tenuis*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969	1970	1971	1972
POLYCHAETA	+	0.2	0.1	0.3
Terebelliformia	-	-	-	-
Sabelliformia	-	-	-	-
Nereidiformia	-	-	+	0.2
Other Polychaeta	+	0.2	0.1	0.1
CRUSTACEA	47.3	45.1	11.8	4.4
Axiidae	-	0.5	-	0.1
Cancridae	1.8	-	0.2	0.1
Crangonidae	0.7	0.3	0.2	0.3
Majidae	-	-	-	-
Paguridae	-	+	+	0.1
Pandalidae	25.3	33.8	4.0	1.5
Other Decapoda	10.9	-	2.4	0.2
Euphausiacea	4.1	9.1	4.8	1.7
Mysidacea	+	-	+	+
Amphipoda	+	0.3	0.1	0.1
Other Crustacea	4.5	1.1	0.3	0.4
MOLLUSCA	0.4	3.8	1.9	2.3
Pelecypoda	+	0.1	-	-
Gastropoda	+	+	+	+
Cephalopoda	+	3.7	1.9	2.3
Other Mollusca	0.4	-	-	+
ECHINODERMATA	-	-	-	+
Echinoidea	-	-	-	-
Ophiuroidea	-	-	-	+
Other Echinodermata	-	-	-	-
PISCES	46.6	49.0	84.6	90.8
Clupeidae	29.1	-	19.6	-
Gadidae	13.0	+	16.5	4.6
Scrombridae	-	-	4.5	17.9
Scorpaenidae	-	-	3.4	-
Bothidae	-	-	-	-
Pleuronectidae	-	-	-	-
Other Pisces	4.5	49.0	40.6	68.4
OTHER PHYLA	0.6	+	0.1	+
ANIMAL REMAINS	4.9	1.9	1.5	2.2
SAND AND ROCK	0.2	+	+	+
Number of stomachs	141	250	247	269
Percent empty	13.5	26.0	14.6	36.1
Mean wt. per stomach(g)	11.65	8.03	32.25	17.58
Mean predator length(cm)	45.2	50.2	44.4	46.4

Table 55. Yearly summary of the stomach contents of the offshore hake, *Merluccius albidus*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969	1970	1971	1972
POLYCHAETA	NONE	NONE	NONE	-
Terebelliformia				-
Sabelliformia				-
Nereidiformia				-
Other Polychaeta				-
CRUSTACEA				5.5
Axiidae				-
Cancridae				-
Crangonidae				-
Majidae				-
Paguridae				-
Pandalidae				2.5
Other Decapoda				1.9
Euphausiacea				1.1
Mysidacea				-
Amphipoda				-
Other Crustacea				-
MOLLUSCA				0.9
Pelecypoda				-
Gastropoda				-
Cephalopoda				0.9
Other Mollusca				-
ECHINODERMATA				-
Echinoidea				-
Ophiuroidea				-
Other Echinodermata				-
PISCES				93.4
Clupeidae				-
Gadidae				59.9
Scrombridae				-
Scorpaenidae				-
Bothidae				-
Pleuronectidae				-
Other Pisces				33.5
OTHER PHYLA				+
ANIMAL REMAINS				0.2
SAND AND ROCK				-
Number of stomachs				73
Percent empty				57.5
Mean wt. per stomach(g)				2.44
Mean predator length(cm)				32.2

Table 56. Yearly summary of the stomach contents of the cusk, Brosme brosme, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969	1970	1971	1972
POLYCHAETA	-	NONE	-	-
Terebelliformia	-		-	-
Sabelliformia	-		-	-
Nereidiformia	-		-	-
Other Polychaeta	-		-	-
CRUSTACEA	78.8		93.8	9.8
Axiidae	-		-	-
Cancridae	-		-	-
Crangonidae	-		-	-
Majidae	-		-	2.0
Paguridae	-		-	-
Pandalidae	23.0		-	3.1
Other Decapoda	52.1		93.6	1.5
Euphausiacea	-		-	0.4
Mysidacea	-		-	-
Amphipoda	-		0.2	-
Other Crustacea	3.7		-	2.8
MOLLUSCA	-		-	-
Pelecypoda	-		-	-
Gastropoda	-		-	-
Cephalopoda	-		-	-
Other Mollusca	-		-	-
ECHINODERMATA	-		-	7.9
Echinoidea	-		-	-
Ophiuroidea	-		-	7.9
Other Echinodermata	-		-	-
PISCES	17.3		3.2	81.4
Clupeidae	-		-	-
Gadidae	-		-	-
Scrombridae	-		-	-
Scorpaenidae	-		-	-
Bothidae	-		-	-
Pleuronectidae	-		-	-
Other Pisces	17.3		3.2	81.4
OTHER PHYLA	-		3.0	+
ANIMAL REMAINS	3.9		-	0.7
SAND AND ROCK	-		-	0.2
Number of stomachs	10		15	44
Percent empty	70.0		33.3	79.6
Mean wt. per stomach(g)	1.40		1.16	4.51
Mean predator length(cm)	55.1		62.0	65.2

Table 57. Yearly summary of the stomach contents of the red hake, *Urophycis chuss*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969		1970		1971		1972	
POLYCHAETA	1.2		4.6		1.5		4.3	
Terebelliformia		-		-		0.1		+
Sabelliformia		-		-		+		0.3
Nereidiformia		0.1		0.7		0.2		2.5
Other Polychaeta		1.1		3.9		1.2		1.5
CRUSTACEA	52.0		66.2		64.2		44.3	
Axiidae		2.8		1.4		1.1		2.5
Cancridae		4.7		1.2		5.3		6.1
Crangonidae		5.0		0.9		1.3		4.1
Majidae		0.2		-		0.1		-
Paguridae		5.8		10.9		2.8		0.8
Pandalidae		13.0		12.2		9.7		13.9
Other Decapoda		0.7		0.7		30.0		5.0
Euphausiacea		+		0.3		7.8		0.2
Mysidacea		+		0.1		0.2		+
Amphipoda		12.0		36.3		2.7		5.9
Other Crustacea		7.8		2.2		3.2		5.8
MOLLUSCA	5.6		0.1		9.9		4.5	
Pelecypoda		+		+		0.1		+
Gastropoda		0.3		0.1		5.9		2.0
Cephalopoda		-		-		0.7		2.4
Other Mollusca		5.3		-		3.2		0.1
ECHINODERMATA	1.6		0.4		0.7		0.2	
Echinoidea		0.4		0.4		-		-
Ophiuroidea		-		-		-		-
Other Echinodermata		1.2		-		0.7		0.2
PISCES	30.6		18.3		19.6		29.7	
Clupeidae		-		-		-		1.2
Gadidae		0.2		-		-		0.9
Scrombridae		-		-		-		0.8
Scorpaenidae		-		-		-		-
Bothidae		4.0		-		-		-
Pleuronectidae		-		0.1		-		-
Other Pisces		26.4		18.2		19.6		26.8
OTHER PHYLA	0.1		0.9		0.1		1.7	
ANIMAL REMAINS	7.1		9.5		4.0		14.9	
SAND AND ROCK	1.8		-		+		0.4	
Number of stomachs	203		177		285		445	
Percent empty	16.3		27.1		11.2		14.2	
Mean wt. per stomach(g)	1.53		0.87		3.24		2.50	
Mean predator length(cm)	31.9		29.0		29.8		30.6	

Table 58. Yearly summary of the stomach contents of the spotted hake, *Urophycis regius*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969		1970		1971		1972	
POLYCHAETA	0.3		0.7		0.4		0.1	
Terebelliformia		-		-		-		-
Sabelliformia		-		-		-		-
Nereidiformia		0.2		0.1		-		0.1
Other Polychaeta		0.1		0.6		0.4		-
CRUSTACEA	68.8		45.5		34.0		65.8	
Axiidae		-		-		-		0.3
Cancridae		7.4		7.7		6.2		2.7
Crangonidae		3.9		4.3		2.0		8.7
Majidae		-		-		-		0.2
Paguridae		-		0.1		0.2		0.1
Pandalidae		14.3		1.9		1.0		8.5
Other Decapoda		9.0		22.1		16.3		41.9
Euphausiacea		0.3		-		-		+
Mysidacea		-		0.1		+		-
Amphipoda		32.8		2.7		5.7		0.4
Other Crustacea		1.1		6.6		2.6		3.0
MOLLUSCA	0.6		9.1		21.3		12.1	
Pelecypoda		0.6		-		0.6		-
Gastropoda		-		0.1		-		-
Cephalopoda		-		9.0		20.6		12.1
Other Mollusca		-		-		0.1		-
ECHINODERMATA	-		-		-		0.1	
Echinoidea		-		-		-		-
Ophiuroidea		-		-		-		-
Other Echinodermata		-		-		-		0.1
PISCES	30.3		38.8		34.9		15.0	
Clupeidae		-		-		-		-
Gadidae		-		8.4		-		1.2
Scrombridae		-		6.7		-		-
Scorpaenidae		-		-		-		-
Bothidae		-		2.2		2.6		0.1
Pleuronectidae		0.2		1.0		-		2.9
Other Pisces		30.1		20.5		32.3		10.8
OTHER PHYLA	-		+		+		0.1	
ANIMAL REMAINS	-		5.6		9.0		6.5	
SAND AND ROCK	-		0.3		0.4		0.3	
Number of stomachs	164		461		159		92	
Percent empty	-		11.7		16.4		23.9	
Mean wt. per stomach(g)	0.76		1.01		1.59		1.01	
Mean predator length(cm)	18.8		17.5		18.6		21.2	

Table 59. Yearly summary of the stomach contents of the haddock, *Melanogrammus aeglefinus*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969		1970		1971		1972	
POLYCHAETA	20.0		18.5		19.0		9.5	
Terebelliformia		2.5		-		2.7		0.9
Sabelliformia		2.3		2.0		0.7		0.7
Nereidiformia		5.0		1.1		1.9		1.2
Other Polychaeta		10.2		15.4		13.7		6.7
CRUSTACEA	29.6		6.8		17.8		17.5	
Axiidae		0.6		0.4		1.0		1.7
Cancridae		+		+		0.1		+
Crangonidae		0.1		0.1		0.1		0.4
Majidae		0.8		-		0.1		0.8
Paguridae		0.3		0.1		0.2		1.4
Pandalidae		2.2		2.1		0.9		0.7
Other Decapoda		1.3		3.3		0.7		2.4
Euphausiacea		0.5		0.2		6.0		0.6
Mysidacea		-		-		+		0.4
Amphipoda		18.7		0.4		6.2		6.8
Other Crustacea		5.1		0.2		2.5		2.3
MOLLUSCA	1.2		0.7		5.1		4.2	
Pelecypoda		0.6		0.4		4.3		2.3
Gastropoda		0.3		0.1		0.4		0.3
Cephalopoda		-		-		0.1		1.2
Other Mollusca		0.3		0.2		0.3		0.4
ECHINODERMATA	32.9		15.0		34.7		44.9	
Echinoidea		11.8		3.0		5.7		5.6
Ophiuroidea		15.2		11.9		26.5		34.7
Other Echinodermata		5.9		0.1		2.5		4.6
PISCES	1.6		44.1		0.7		4.5	
Clupeidae		-		42.2		-		-
Gadidae		-		-		-		1.8
Scrombridae		-		-		-		-
Scorpaenidae		-		-		-		-
Bothidae		-		-		-		-
Pleuronectidae		+		-		-		-
Other Pisces		1.5		1.9		0.7		2.7
OTHER PHYLA	0.3		0.5		1.6		0.6	
ANIMAL REMAINS	10.1		4.8		8.5		17.1	
SAND AND ROCK	4.3		9.6		12.6		1.7	
Number of stomachs	166		115		453		397	
Percent empty	8.4		1.7		9.1		6.3	
Mean wt. per stomach(g)	6.91		20.52		6.83		2.82	
Mean predator length(cm)	46.7		45.4		50.4		40.8	

Table 60. Yearly summary of the stomach contents of the longfin hake, *Phycis chesteri*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969	1970	1971	1972
POLYCHAETA	NONE	NONE	NONE	-
Terebelliformia				-
Sabelliformia				-
Nereidiformia				-
Other Polychaeta				-
CRUSTACEA				97.6
Axiidae				-
Cancridae				-
Crangonidae				-
Majidae				-
Paguridae				-
Pandalidae				8.7
Other Decapoda				15.4
Euphausiacea				60.3
Mysidacea				-
Amphipoda				+
Other Crustacea				13.2
MOLLUSCA				-
Pelecypoda				-
Gastropoda				-
Cephalopoda				-
Other Mollusca				-
ECHINODERMATA				0.3
Echinoidea				0.3
Ophiuroidea				-
Other Echinodermata				-
PISCES				1.1
Clupeidae				-
Gadidae				-
Scrombridae				-
Scorpaenidae				-
Bothidae				-
Pleuronectidae				-
Other Pisces				1.1
OTHER PHYLA				+
ANIMAL REMAINS				1.0
SAND AND ROCK				-
Number of stomachs				126
Percent empty				62.7
Mean wt. per stomach(g)				0.28
Mean predator length(cm)				23.6

Table 61. Yearly summary of the stomach contents of the fourbeard rockling, Enchelyopus cimbrius, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969	1970	1971	1972
POLYCHAETA	NONE	4.4	-	48.6
Terebelliformia		-	-	-
Sabelliformia		-	-	-
Nereidiformia		-	-	-
Other Polychaeta		4.4	-	48.6
CRUSTACEA		65.9	94.4	13.1
Axiidae		-	-	-
Cancridae		-	-	-
Crangonidae		52.5	-	3.7
Majidae		-	-	-
Paguridae		-	-	-
Pandalidae		12.6	-	-
Other Decapoda		-	94.4	-
Euphausiacea		-	-	5.2
Mysidacea		-	-	-
Amphipoda		0.8	-	2.0
Other Crustacea		-	-	2.2
MOLLUSCA		-	-	-
Pelecypoda		-	-	-
Gastropoda		-	-	-
Cephalopoda		-	-	-
Other Mollusca		-	-	-
ECHINODERMATA		-	-	-
Echinoidea		-	-	-
Ophiuroidea		-	-	-
Other Echinodermata		-	-	-
PISCES		-	-	-
Clupeidae		-	-	-
Gadidae		-	-	-
Scrombridae		-	-	-
Scorpaenidae		-	-	-
Bothidae		-	-	-
Pleuronectidae		-	-	-
Other Pisces		-	-	-
OTHER PHYLA		+	+	+
ANIMAL REMAINS		29.7	5.6	38.3
SAND AND ROCK		-	-	-
Number of stomachs		17	2	29
Percent empty		5.9	0	17.2
Mean wt. per stomach(g)		0.65	0.36	0.09
Mean predator length(cm)		28.1	26.1	23.0

Table 62. Yearly summary of the stomach contents of the marlin spike, *Nezumia bairdi*, expressed as percent weight, for fish collected during the spring and autumn survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969	1970	1971	1972
POLYCHAETA	NONE	NONE	NONE	27.5
Terebelliformia				-
Sabelliformia				-
Nereidiformia				-
Other Polychaeta				27.5
CRUSTACEA				47.3
Axiidae				-
Cancridae				-
Crangonidae				-
Majidae				-
Paguridae				-
Pandalidae				-
Other Decapoda				27.5
Euphausiacea				-
Mysidacea				4.0
Amphipoda				7.7
Other Crustacea				8.0
MOLLUSCA				2.5
Pelecypoda				2.5
Gastropoda				-
Cephalopoda				-
Other Mollusca				-
ECHINODERMATA				-
Echinoidea				-
Ophiuroidea				-
Other Echinodermata				-
PISCES				-
Clupeidae				-
Gadidae				-
Scrombridae				-
Scorpaenidae				-
Bothidae				-
Pleuronectidae				-
Other Pisces				-
OTHER PHYLA				-
ANIMAL REMAINS				22.4
SAND AND ROCK				0.3
Number of stomachs				23
Percent empty				8.7
Mean wt. per stomach(g)				0.14
Mean predator length(cm)				24.2

Table 63. Yearly summary of the stomach contents of the longnose grenadier, *Coelorhynchus carminatus*, expressed as percent weight, for fish collected during the spring and autumn survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969	1970	1971	1972
POLYCHAETA	NONE	NONE	NONE	35.8
Terebelliformia				-
Sabelliformia				-
Nereidiformia				-
Other Polychaeta				35.8
CRUSTACEA				24.8
Axiidae				-
Cancridae				-
Crangonidae				-
Majidae				-
Paguridae				-
Pandalidae				-
Other Decapoda				23.6
Euphausiacea				-
Mysidacea				-
Amphipoda				-
Other Crustacea				1.2
MOLLUSCA				-
Pelecypoda				-
Gastropoda				-
Cephalopoda				-
Other Mollusca				-
ECHINODERMATA				-
Echinoidea				-
Ophiuroidea				-
Other Echinodermata				-
PISCES				+
Clupeidae				-
Gadidae				-
Scrombridae				-
Scorpaenidae				-
Bothidae				-
Pleuronectidae				-
Other Pisces				+
OTHER PHYLA				2.8
ANIMAL REMAINS				36.6
SAND AND ROCK				-
Number of stomachs				11
Percent empty				36.4
Mean wt. per stomach(g)				0.09
Mean predator length(cm)				19.3

Table 64. Yearly summary of the stomach contents of the fawn cusk-eel, *Lepophidium cervinum*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969		1970		1971		1972	
POLYCHAETA	15.5		2.5		52.2		11.4	
Terebelliformia		-		-		-		-
Sabelliformia		-		-		-		-
Nereidiformia		8.5		1.1		4.4		-
Other Polychaeta		7.0		1.4		47.8		11.4
CRUSTACEA	-		19.6		21.7		60.9	
Axiidae		-		-		-		0.9
Cancridae		-		-		-		-
Crangonidae		-		3.5		17.4		13.3
Majidae		-		-		-		-
Paguridae		-		-		-		-
Pandalidae		-		-		-		-
Other Decapoda		-		0.4		-		0.5
Euphausiacea		-		-		-		-
Mysidacea		-		-		-		-
Amphipoda		-		0.4		4.3		14.2
Other Crustacea		-		15.3		-		32.0
MOLLUSCA	-		-		-		0.5	
Pelecypoda		-		-		-		-
Gastropoda		-		-		-		-
Cephalopoda		-		-		-		-
Other Mollusca		-		-		-		0.5
ECHINODERMATA	1.4		0.4		-		-	
Echinoidea		-		-		-		-
Ophiuroidea		-		0.4		-		-
Other Echinodermata		1.4		-		-		-
PISCES	-		5.3		-		-	
Clupeidae		-		-		-		-
Gadidae		-		-		-		-
Scrombridae		-		-		-		-
Scorpaenidae		-		-		-		-
Bothidae		-		-		-		-
Pleuronectidae		-		-		-		-
Other Pisces		-		5.3		-		-
OTHER PHYLA	22.5		41.4		-		22.6	
ANIMAL REMAINS	60.6		30.8		26.1		4.6	
SAND AND ROCK	-		-		-		-	
Number of stomachs	20		29		19		41	
Percent empty	-		10.3		63.2		24.4	
Mean wt. per stomach(g)	0.04		0.05		0.01		0.03	
Mean predator length(cm)	21.4		20.6		23.2		22.8	

Table 65. Yearly summary of the stomach contents of the ocean pout, *Macrozoarces americanus*, expressed as percent weight, for fish collected during the spring and autumn groundfish survey cruises 1969-1972. (+ indicates <0.1%).

PREY	1969		1970		1971		1972	
POLYCHAETA	-		-		1.2		3.5	
Terebelliformia		-		-		-		+
Sabelliformia		-		-		-		-
Nereidiformia		-		-		1.1		3.2
Other Polychaeta		-		-		0.1		0.3
CRUSTACEA	47.0		81.5		11.1		11.0	
Axiidae		-		-		-		-
Cancridae		3.7		-		0.1		3.2
Crangonidae		-		-		-		+
Majidae		-		-		-		0.4
Paguridae		14.1		-		-		0.5
Pandalidae		-		-		-		+
Other Decapoda		-		-		-		0.9
Euphausiacea		-		-		-		-
Mysidacea		-		-		-		-
Amphipoda		-		-		8.3		5.3
Other Crustacea		29.2		81.5		2.7		0.7
MOLLUSCA	0.3		-		4.5		3.9	
Pelecypoda		-		-		1.2		3.5
Gastropoda		-		-		3.3		0.3
Cephalopoda		-		-		-		-
Other Mollusca		0.3		-		-		0.1
ECHINODERMATA	16.0		-		77.2		70.3	
Echinoidea		16.0		-		77.2		63.7
Ophiuroidea		-		-		-		6.0
Other Echinodermata		-		-		-		0.6
PISCES	-		-		-		0.1	
Clupeidae		-		-		-		-
Gadidae		-		-		-		-
Scrombridae		-		-		-		-
Scorpaenidae		-		-		-		-
Bothidae		-		-		-		-
Pleuronectidae		-		-		-		-
Other Pisces		-		-		-		0.1
OTHER PHYLA	14.1		18.5		0.2		2.9	
ANIMAL REMAINS	-		-		1.0		4.4	
SAND AND ROCK	22.6		-		4.8		3.9	
Number of stomachs	35		8		32		276	
Percent empty	45.7		75.0		9.4		23.9	
Mean wt. per stomach(g)	0.25		0.16		7.96		7.79	
Mean predator length(cm)	36.8		37.3		47.4		47.2	

Table 66. A relative measure of the quantity of food in the stomach, expressed as grams prey/kilogram predator, for the years 1969-1972 for 15 species of gadiform fishes.

Species	Overall mean	1969	1970	1971	1972
Atlantic cod	14.79	9.59	14.01	12.57	22.98
Pollock	10.56	6.49	4.11	20.38	11.25
Silver hake	16.95	24.60	4.61	19.85	18.76
White hake	21.95	15.11	7.43	44.29	20.95
Offshore hake	10.31	-	-	-	10.31
Cusk	0.98	0.82	-	0.49	1.64
Red hake	11.88	7.57	5.85	19.95	14.14
Spotted hake	19.72	13.75	22.76	29.72	12.64
Haddock	10.76	6.43	20.83	5.03	3.97
Longfin hake	3.86	-	-	-	3.86
Fourbeard rockling	3.18	-	4.85	3.41	1.28
Marlin-spike	3.71	-	-	-	3.71
Longnose grenadier	1.97	-	-	-	1.97
Fawn cusk-eel	2.62	3.26	4.57	0.64	2.02
Ocean pout	8.23	1.12	0.69	15.62	15.50

Diet Overlap

The percentage similarity, as a relative measure of similarity between diets, for the 15 species of fish is shown in Figure 5 and may be calculated by summing the smaller of the two values when comparing the percent weights for the same prey groups for two predators. Thus a value of 0% would imply that the diets are completely different while a value of 100% would mean that the diets were identical. The values calculated here from the data in Table 2 range from 1 to a maximum of 75 and, in order to facilitate the comparison between species, have been grouped into three categories representing low (0<30%), intermediate (30<60%), and high (60-100%) levels of diet overlap. Accordingly, it may easily be seen that the greatest similarity in diet exists between the silver and white hake hake (75%), the marlin-spike and longnose grenadier (75%), the red and spotted hake (71%) and the pollock and silver hake (63%). The number of fish having an intermediate level of overlap are indicated in the figure by the hatched area. The largest grouping in this category occurs in the upper left section of the diagram. In other words the diet of Atlantic cod, pollock, silver hake, white hake, offshore hake, cusk, red hake, and spotted hake are reasonably similar. Most all of these predators are piscivorous, which accounts for this overlap in diet. Several of these species, notably the red and spotted hake, however, qualify as "mixed feeders" preying on both fish and invertebrates. In contrast to the eight predators listed above, the remaining seven species, shown in the righthand section of the diagram: haddock, longfin hake, fourbeard rockling, marlin-spike,

longnose grenadier, fawn cusk-eel, and ocean pout, prey almost exclusively on invertebrates. Of these fish only the haddock apparently preyed extensively on other fish and, as has been explained in the text, this was actually due to predation on herring eggs rather than juvenile or adult fishes. The very low level of overlap between the piscivorous species and the invertebrate feeders is understandable because of the major shift in prey. The relative lack of a high level of similarity between the diet of the invertebrate feeders is more difficult to interpret and may in part be due to the more numerous categories of potential prey but also represents a reasonable degree of resource partitioning. In some instances, such as for the marlin-spike, longnose grenadier, and fourbeard rockling, a complete picture of the potential prey is not available and, therefore, the extent of diet overlap with the other species of fish is not totally accurate because of the small number of fish examined and/or the small amount of prey in the stomachs.

An areal breakdown of diet overlap is presented in Figures 6-10. The percent similarity has been calculated for each fish in the five individual geographic areas based on the food habits data in Tables 3-17 The 15 species of fish were not omnipresent and were only included in the following figures if 10 or more individuals of that species were collected in a geographic area for stomach contents analysis.

	Atlantic Cod	Pollock	Silver Hake	White Hake	Offshore Hake	Cusk	Red Hake	Spotted Hake	Haddock	Longfin Hake	Fourbeard Rockling	Marlin-spike	Longnose Grenadier	Fawn Cusk-eel	Ocean Pout
Atlantic Cod															
Pollock	59														
Silver Hake	58	63													
White Hake	57	52	75												
Offshore Hake	33	32	44	51											
Cusk	37	42	41	55	39										
Red Hake	53	45	44	45	31	44									
Spotted Hake	51	43	47	44	34	44	71								
Haddock	34	25	26	24	7	16	33	21							
Longfin Hake	13	53	25	18	7	21	32	26	10						
Fourbeard Rockling	13	10	13	16	6	11	31	21	27	16					
Marlin-spike	13	14	7	6	2	16	37	40	35	25	41				
Longnose Grenadier	9	13	6	6	2	14	27	28	26	18	48	75			
Fawn Cusk-eel	11	8	10	7	3	7	30	23	30	16	45	44	41		
Ocean Pout	18	5	5	5	1	9	19	16	34	3	7	15	9	17	

0 < 30 | 30 < 60 | 60 < 100

Figure 5. The percent similarity between the diets of 15 species of gadiform fish -- all geographic areas combined.

Middle Atlantic (Figure 6)

Only six of the 15 predators were collected in sufficiently large numbers in the Middle Atlantic to warrant an analysis of diet overlap. Three of these six fish, silver, red, and spotted hake, showed intermediate levels of diet overlap while the similarity in diet for the haddock, fawn, cusk-eel, and ocean pout were low.

Middle Atlantic

	Silver Hake	Red Hake	Spotted Hake	Haddock	Fawn Cusk-eel	Ocean Pout
Silver Hake						
Red Hake	59					
Spotted Hake	59	59				
Haddock	3	4	4			
Fawn Cusk-eel	14	19	20	7		
Ocean Pout	6	10	12	4	6	

0 < 30 | 30 < 60 | 60 < 100

Figure 6. The percent similarity between the diets of six species of gadiform fish -- Middle Atlantic.

Southern New England (Figure 7)

In Southern New England 10 of the 15 predators were present. The greatest similarity in diet occurred between the red and spotted hake. These two fish fed on both fish and invertebrates, and shared many of the same species as prey (see Tables 9 and 10). Intermediate levels diet overlap were generally found between the four piscivorous predators, Atlantic cod, silver hake, white hake, and offshore hake and also between these same four fish and the red and spotted hake. The only other intermediate levels of overlap occurred between the fawn cusk-eel and the red hake and haddock. Little similarity was found between the diet of the haddock, longfin hake, fawn cusk-eel, ocean pout and the other more piscivorous predators mentioned above.

Southern New England

	Atlantic Cod	Silver Hake	White Hake	Offshore Hake	Red Hake	Spotted Hake	Haddock	Longfin Hake	Fawn Cusk-eel	Ocean Pout
Atlantic Cod										
Silver Hake	32									
White Hake	35	51								
Offshore Hake	25	33	42							
Red Hake	45	41	35	27						
Spotted Hake	43	39	48	26	65					
Haddock	15	10	4	3	28	16				
Longfin Hake	5	13	1	1	12	6	8			
Fawn Cusk-eel	12	9	3	1	32	17	38	12		
Ocean Pout	21	9	5	1	23	13	26	3	19	

0 < 30 | 30 < 60 | 60 < 100

Figure 7. The percent similarity between the diets of ten species of gadiform fish -- Southern New England.

Georges Bank (Figure 8)

For the fish taken on Georges Bank the greatest diet overlap occurred between the offshore and silver hake and between the pollock and longfin hake. The high overlap between the pollock, which have normally been considered piscivorous, and the longfin hake, an invertebrate feeder, may be explained by the dependence on Crustacea as a major food source for Georges Bank pollock (Table 4). It should also be noted that the average length pollock on Georges Bank was smaller than in the other geographic areas which might explain the reliance on crustaceans rather than fish. Intermediate levels of diet similarity were found for a number of fish as indicated by the hatched areas in the figure. Most notable is the overlap between Atlantic cod and haddock which may be traced to the heavy predation on herring eggs by the Georges Bank haddock. Since Atlantic cod were preying on either juvenile or adult herring this measure of overlap is somewhat misleading. Low levels of similarity were again observed between the invertebrate feeders.

Georges Bank

	Atlantic Cod	Pollock	Silver Hake	White Hake	Offshore Hake	Red Hake	Haddock	Longfin Hake	Fourbeard Rockling	Ocean Pout
Atlantic Cod										
Pollock	30									
Silver Hake	24	39								
White Hake	58	30	27							
Offshore Hake	22	26	84	31						
Red Hake	28	16	12	25	13					
Haddock	44	12	9	38	4	24				
Longfin Hake	9	60	22	27	15	24	10			
Fourbeard Rockling	8	8	7	18	8	38	22	13		
Ocean Pout	15	5	2	6	1	11	19	3	7	

0 < 30 | 30 < 60 | 60 < 100

Figure 8. The percent similarity between the diets of ten species of gadiform fish -- Georges Bank

Gulf of Maine (Figure 9)

High and intermediate levels of diet overlap were found between the Atlantic cod, pollock, silver hake, white hake, and red hake, but little similarity was observed between the diet of these same predators and the haddock, longfin hake, fourbeard rockling, and ocean pout. The cusk showed an intermediate level of diet overlap with the pollock, red hake, and fourbeard rockling while the diet of the ocean pout was found to have an intermediate degree of similarity with the haddock. All the remaining fish showed a low level of dietary overlap.

Gulf of Maine

	Atlantic Cod	Pollock	Silver Hake	White Hake	Cusk	Red Hake	Haddock	Longfin Hake	Fourbeard Rockling	Ocean Pout
Atlantic Cod										
Pollock	69									
Silver Hake	59	69								
White Hake	61	57	56							
Cusk	27	30	16	23						
Red Hake	41	47	37	48	38					
Haddock	18	15	14	14	19	23				
Longfin Hake	2	5	2	1	13	7	6			
Fourbeard Rockling	18	20	8	6	42	14	25	4		
Ocean Pout	6	3	3	4	6	11	31	28	4	

0 < 30 | 30 < 60 | 60 < 100

Figure 9. The percent similarity between the diets of ten species of gadiform fish -- Gulf of Maine.

Western Nova Scotia (Figure 10)

In Western Nova Scotia the highest level of diet overlap was found between the Atlantic cod and white hake. Intermediate overlap was generally found between the diet of the Atlantic cod, pollock, silver hake, white hake, and cusk. Longfin hake also showed an intermediate level of overlap with the pollock, silver hake and marlin-spike. The last intermediate level occurred between the marlin-spike and haddock. Little similarity in diet was found for the other gadiform fish collected on the Scotian Shelf.

Western Nova Scotia

	Atlantic Cod	Pollock	Silver Hake	White Hake	Cusk	Red Hake	Haddock	Longfin Hake	Marlin-spike
Atlantic Cod									
Pollock	53								
Silver Hake	33	46							
White Hake	60	44	45						
Cusk	41	32	15	57					
Red Hake	15	12	5	13	2				
Haddock	26	10	9	13	5	16			
Longfin Hake	13	59	34	6	2	11	5		
Marlin-spike	10	6	6	5	2	15	30	32	

0 < 30 | 30 < 60 | 60 < 100

Figure 10. The percent similarity between the diets of nine species of gadiform fish -- Western Nova Scotia.

Partition Plot

A large number of different prey species were found in the stomachs of the fish examined during the course of this study. Many of these species, however, even when combined in broader taxonomic categories, did not contribute significantly to the total weight of the prey consumed. For this reason major prey were defined as any category of prey contributing $\geq$10% of the diet by weight for any one of the 15 predators. The data was then arrayed in a partition plot Figure 11. Fifteen of the 32 possible categories of prey qualified as major prey according to the definition given above. The major prey for each predator was identified and indicated in the table with a solid circle. For comparative purposes the arrangement of predators and prey were organized to group predators sharing similar major prey. In other words, the more widely separated two predators are the less likely it is that their major dietary components were the same.

Some of the major prey groupings include a large number of different species, with the result that categories such as "Other Pisces" are shared by many of the predators. Although this tends to compromise the value of a partition plot, the results from this type of analysis should be considered in conjunction with a more detailed listing of the predator's food habits (see Table 2 and text). Such a listing will clarify what specific prey, within these broader taxonomic groupings, the predators do or do not share in common and how complete the resource partitioning actually is.

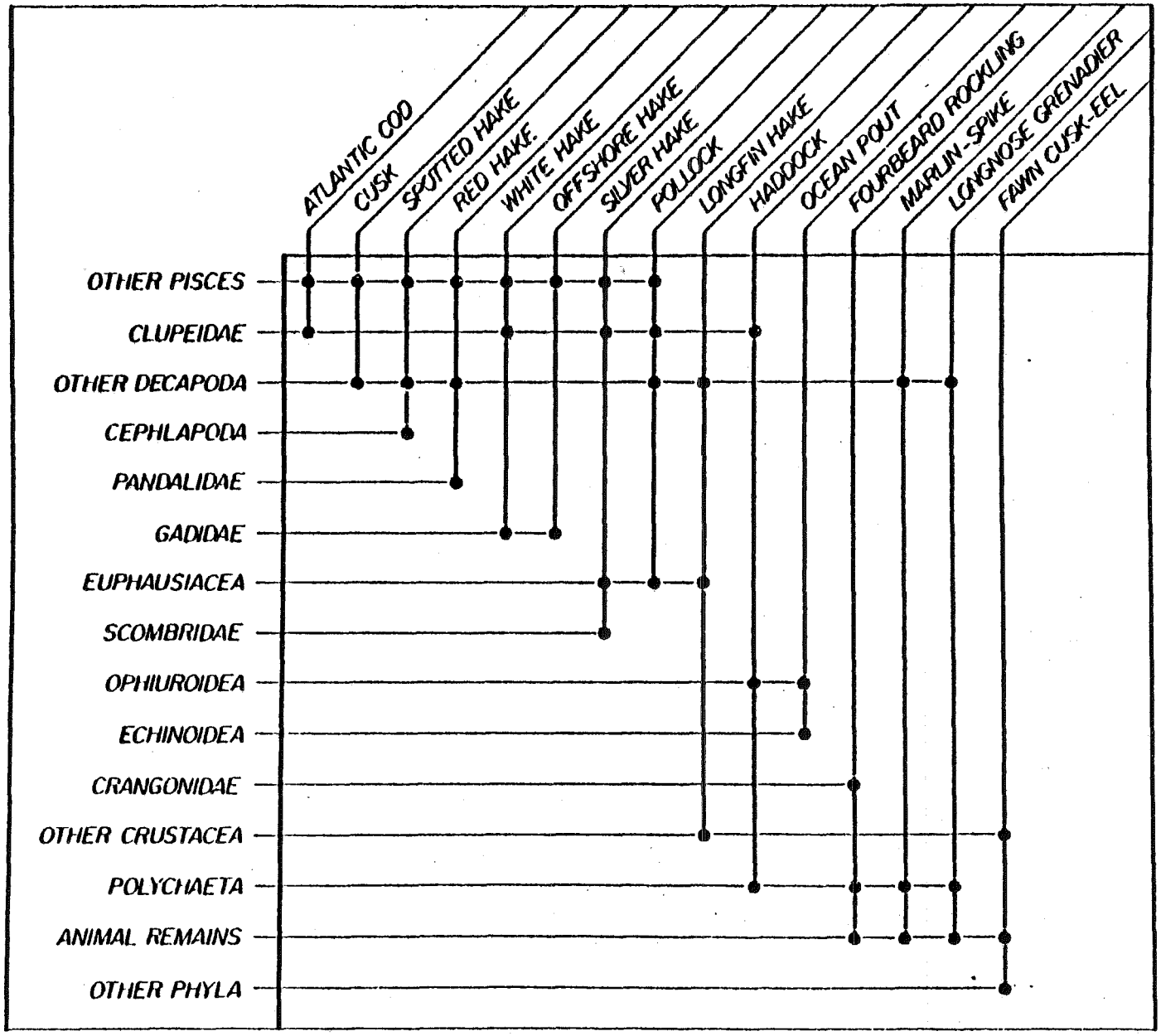


Figure 11. A partition plot indicating the major prey of each of the 15 predators. Major prey is defined as any prey category making up $\geq$10% by weight of the diet for any one predator.

DISCUSSION

Food Habits

The availability of literature on the food habits of the 15 gadiform fishes examined in this report is highly variable, being totally dependent upon the species under consideration. In some cases the literature is extremely extensive, primarily because of the long-established fishery for species like the Atlantic cod and haddock. Other fish, such as the longfin hake, fawn cusk-eel, longnose grenadier, and marlin-spike, have rarely been studied, resulting in a lack of comparative food habits data. In the discussion below the food habits of each of the species for which there is comparative data are treated separately and discussed in relation to the pertinent literature with an emphasis on other studies conducted in the Northwest Atlantic.

Atlantic cod

Since food is one of the important factors regulating the abundance, growth, and general physiological condition of fish, food habits of the commercially important species, such as Atlantic cod, have been studied extensively (see the synopsis of cod by Wise, 1961). Observations on the food habits of North Sea cod date back to Brook (1886). Other data on the diet of the European cod stocks have been presented by Smith (1889, 1890, 1891, 1892), Todd (1905, 1907), Carr (1908), Nagabhushanam (1965), and Rae (1967). The latest update was recently completed by Daan (1973, 1974, 1975) who carried out a detailed study on the biology of the North Sea cod. The cod in the Barents Sea have also been studied quite thoroughly by various Russian investigators (Idelson 1929; Zenkevich 1931; Zatsepin and Petrova 1939; Mironova 1961; Maslov 1960; Ponomarenko 1961; and Novikova 1966). In Kiel Bay of the Baltic Sea, Arntz (1971, 1973, 1974) compared the food habits of the cod with the availability of macrobenthos in an attempt to understand the fish's feeding ecology. The food habits of the cod found around Iceland and westward to the Canadian coast have again been well documented (Brown and Cheng 1946; Hansen 1949; Powles 1958; Brunel 1960; Rae 1968; Popova 1963; Sidorenko 1963; Kohler and Fitzgerald 1969; and Tyler 1972). Data on the diet of the Atlantic cod occurring off the US coast in the Gulf of Maine have been summarized by Bigelow and Schroeder (1953) but, surprisingly, there is little other information for the region of the present study.

From some of the earliest studies it was concluded that cod will eat almost any food available, and this may be substantiated by examining the lengthy list of prey given in many of the papers mentioned above.

Despite this wide diversity in the species composition of the diet, a rather simple picture of the cod's food habits may be drawn from most of the available data. In general, crustaceans and fish are the major prey, while the actual percentage of the diet made up of each of these two taxonomic groups is determined by prey size and prey availability. Small cod prey on small crustaceans, such as amphipods and mysids. Slightly larger cod prey more on decapod crabs and shrimp. The larger cod prey almost exclusively on fish. Our observations on the food habits of Atlantic cod caught off the US coast are in agreement with this rather simplistic description. Although we did not separate the data into size classes, it can be seen that fish and crustaceans were the most important prey categories (Table 2). We did not include the smaller cod (<20 cm) in our data base, and the average length of the 1,541 animals we analyzed was 54.7 cm (Table 2). Cod of approximately 50 cm in length have previously been shown to prey heavily on both fish and crustaceans (see, for example, Powles 1958; Popova 1962; Rae 1968) so that our data may be taken as confirmation that the diet of the US cod stocks is very similar to the other populations which have previously been investigated.

Pollock

The diet of pollock was equally divided between fish and crustaceans (Table 2). Atlantic herring, *Clupea harengus*, was the major species of fish preyed upon while the euphausiid, *Meganyctiphanes norvegica*, was the single most important prey. The significance of euphausiids in the diet of pollock had previously been noted by Kendall (1898) who found that *Thysanopoda*

were virtually the exclusive prey for pollock taken off Eastport, Maine. Bigelow and Schroeder (1953) included Kendall's observations in their treatise on fishes in the Gulf of Maine but also mentioned that young herring were an equally important prey. Steele (1963) and Dexter (1969) again confirmed the importance of euphausiids such as M. norvegica as major prey for pollock in the Gulf of Maine. However, Steele also remarked that fish were eaten in addition to euphausiids by the larger (75+ cm) pollock. The mean predator length for pollock taken in the Gulf of Maine (Table 4) during the present study (66.4 cm) was greater than for the fish caught on either Georges Bank (38.2 cm) or in Western Nova Scotia (44.6 cm). Accordingly fish, especially Atlantic herring, were much more important as prey for the Gulf of Maine pollock than in either of the other two areas. In European waters the food habits of pollock appear to be similar to their American counterparts as they have also been reported to prey heavily on euphausiids (Wagner 1959; Mironova 1961; and see Nagabhushanam, 1965 for a brief review in tabular form).

Silver hake

Fish accounted for almost three-quarters of the diet of silver hake, with crustaceans making up the remaining prey (Table 2). Fish had previously been recognized as the major prey of the silver hake by Bigelow and Schroeder (1953). They described these predators as preying on herring or most any other smaller schooling fish or, even the young of almost any of the fish commonly found in the Gulf of Maine. For example, Nichols and Breder (1927) found 75 herring, 7.62 cm long, in the stomach of a 59-cm silver hake. Bigelow and Schroeder (1953) also

noted that silver hake ate squid if available while smaller hake fed on the shrimp, Pandalus. Jensen and Fritz (1960) reported on the diet of silver hake collected in the Northwest Atlantic. Expressing the food habits as the frequency of occurrence of prey, they also found that fish predominated in the stomachs of the larger silver hake while crustaceans, mostly euphausiids, were more common in the stomachs of the smaller fish. More recently, Vinogradov (1972) examined a total of 42,515 silver hake stomachs collected from fish caught in the Northwest Atlantic. He also found that the smaller hake preyed on crustaceans, especially euphausiids, with a shift to fish as the major prey for hake greater than 40 cm in length. Interestingly, all of these authors have commented on the cannibalistic nature of silver hake which was again recognized in this report, especially for fish taken in the Middle Atlantic (Table 5).

White hake

The white hake and red hake resemble each other closely and the landings of these two hake have only been reported separately since 1944. Therefore, studies on the food habits of white hake alone are relatively rare. Linton (1899) examined the stomachs of some white hake but they were empty and Hansen (1915) found some euphausiids, Thysanoessa inermis, in the stomachs he examined. Bigelow and Schroeder (1953) consider the food habits of the two hake together although they specifically mention the occurrence of squid, crabs, butterfish, mackerel, and flounder in the stomachs of small white hake. Apart from the data given here (Table 2), which identifies white hake as being primarily piscivorous, the only other recent reports discussing the food habits of this fish are by Tyler (1971, 1972) and Petrov (1973). Tyler observed seasonal changes

in the distribution and the diet of fishes in Passamaquoddy Bay, New Brunswick, Canada. White hake were present in the bay during the summer and the autumn. For the smaller white hake (length range 15-26 cm) Tyler identified mysids, amphipods, and euphausiids as principal prey while the larger fish (28-45 cm) preyed upon shrimp, mysids, euphausiids, and fish. The food habits data reported here are generally for larger fish than those considered by Tyler (average length 46.4 cm, see Table 2) and this may explain our observation that white hake are primarily piscivorous. Petrov collected food habits data for the years 1969, 1971, and 1972 in ICNAF Subarea 3 which is north of our study area, off the eastern coast of Canada. Petrov's data are based on a subsample of the entire population and, although based on frequency of occurrence, show very similar results to those reported here (Table 2). Fish predominated in the diet with crustaceans being of secondary importance.

Offshore hake

Biological data on the offshore hake, *M. albidus*, is rare and information on its food habits has only just become available. Rohr and Guthery (1977) described the offshore hake as an active predator, preying on crustaceans and fish including other offshore hake. Juveniles were found to prey heavily on shrimp while maturing adults fed on fish, shrimp, and squid. The primary prey of adults was fish, but they also preyed upon caridean shrimp and squid. The offshore hake examined during the course of the present study confirm the observations of Rohr and Guthery. The hake we examined preyed heavily on fish but had also consumed crustaceans, (i.e., caridean shrimp and euphausiids), and squid (Table 2).

Cusk

Cusk were identified as being primarily fish-eaters, although crustaceans and echinoderms were also important prey, but to a lesser extent (Table 2). The cusk's piscivorous habits may be accounted for because of their heavy reliance on fish as prey in Western Nova Scotia (Table 8). In contrast, crustaceans made up 90% of the diet in the Gulf of Maine (Table 8), but because of the total weight of fish eaten when combining all five ecological areas, crustaceans are of secondary importance (Table 2). Little comparative data exist on the food habits of this animal but it has been reported that crabs and occasionally molluscs were found in the stomachs of several cusk caught on Platt's Bank in the Gulf of Maine in 1924 (Bigelow and Schroeder, 1953). Leim and Scott (1966) also noted that the cusk eat crabs and molluscs together with an occasional starfish. Our data confirm these observations but add fish as an important potential prey. Bigelow and Schroeder (1953) mention that the cusk is not fastidious as to the bait it will accept, taking clams, cockles, and herring quite readily. The diversity in the prey for the different geographic areas (Table 8) tends to corroborate their observations, that is, the cusk will prey on whatever animals are available.

Red hake

The dietary information summarized by Bigelow and Schroeder (1953) is generally for both red and white hake combined although they do mention one instance where the bellies of red hake were distended with sand lance.

In an earlier paper, Linton (1899), reported finding shrimp, amphipods and the lenses of some small fish in red hake stomachs and Breder (1922) noted that the one stomach he examined was full of prawns. From the current study (Table 2), red hake has been identified as a mixed feeder, preying on both fish and invertebrates. Crustaceans were the most important prey, followed by fish, molluscs, polychaetes, and echinoderms, in decreasing quantities. Vinogradov (1972) examined the stomachs of 5,486 red hake collected in the Northwest Atlantic and, based on frequency of occurrence, found that invertebrates were the most important prey although substantial numbers of fish and squid were also consumed. Vinogradov's study was carried out from 1965 through 1967, and our study from 1969 through 1972. Over these years the major prey of Northwest Atlantic red hake appears to have been the same, with any differences observed in the species composition of the diet most likely relating to differences in the sampling sites and local abundance of certain prey.

Spotted hake

Based on their food habits, spotted hake were identified as mixed feeders, relying on both crustaceans and fish as major prey (Table 2, Figure 9) although cephalopods were also somewhat important. Comparative data on the diet of these predators is scanty. Hildebrand and Schroeder (1928) noted mysids in the stomachs of small hake from Chesapeake Bay and Bigelow and Schroeder (1953) only mention the food habits of spotted hake in passing, noting that it fed on fish, squid, and crustaceans. More recently, Sikora et al. (1972) examined the gut contents of 341 juvenile spotted hake and identified crustaceans, especially the macruran mud shrimp, *Upogebia affinis*, as the most important prey, while fish ranked second in the diet. Comparative information on the food habits of adult spotted hake is completely lacking.

Haddock

Haddock has a long history of commercial importance and as a result a voluminous amount of dietary information has been collected over the years. A good deal of information has been reported by European scientists, beginning with MacIntosh (1874). Other papers of importance are by authors such as Trechman (1888), Smith (1889, 1890, 1891, 1892), Scott, A. (1896), Scott, T. (1902), Todd (1905, 1907), Carr (1908, 1909), Bowman (1923), Poulsen (1928), Ritchie (1937), Jones (1954), and Nagabhushanam (1965). In the Barents Sea the diet of the haddock has also been thoroughly studied by a number of Russian workers (Idelson 1929; Zenkevich 1931; Petrova-Grinkevich 1944; Tseeb 1960; Nivokova 1966). Haddock stocks in Icelandic waters have been examined by Thompson (1929), Brown and Cheng (1946), and Fridriksson and Timmermann (1950). Finally, the North American literature is also reasonably extensive (Atwood 1865; Verrill 1871, 1873; Baird 1889; Willis 1890; Kendall 1898; Clapp 1912; Needler 1929; Vladykov 1933; Homans and Needler 1944; Bigelow and Schroeder 1953; Wigley 1956; Templeman 1964; Wigley and Theroux 1965; Kohler and Fitzgerald 1969; Tyler 1972).

In one of the earliest papers, Baird (1889) remarked that a complete listing of the prey of haddock would include almost all the fauna of any given area. An examination of the papers listed above gives much credibility to such a statement. It would be impossible to generally classify the haddock's dietary preferences except to say that they usually prey more heavily on benthic invertebrates than fish although they are highly opportunistic and will prey on, for example, fish eggs if they

are available in any abundance. Within one of the geographic areas considered here the diversity in the haddock's diet has been clearly demonstrated by Wigley (1956). He investigated the haddock's food habits on Georges Bank and found that the data warranted a division of the bank into three distinct food-type areas.

The results from our study (Table 2) indicate that ophiuroids were the most important prey and that polychaetes, crustaceans, and fish ranked second in importance. The significance of fish in the diet is of some interest. The Clupidae were the major fish prey and then only on Georges Bank (Table 11) in 1970. This, however, was not due to predation on adult or juvenile fish, but was due to the consumption of herring eggs. Bigelow and Schroeder (1953) state that haddock have been accused of feeding on herring spawn but they doubted that this was true. Our observations do, in fact, confirm that haddock will prey greedily on herring spawn as had also been reported by Bowman (1923) and Nikolsky (1963). This type of feeding behavior is not uncommon since haddock have also been found to consume quantities of fish eggs when the capelin spawn in the Barents Sea (Tseeb 1960) and on the Grand Banks of Newfoundland (Templeman 1964). These results simply confirm the opportunistic nature of the haddock with regard to their feeding behavior.

Fourbeard rockling

According to Bigelow and Schroeder (1953) the food habits of the fourbeard rockling have not been investigated on this side of the Atlantic. From reports on the stomach contents of British and Scandanavian fish they concluded that the American fourbeard rockling would probably

eat shrimp, isopods, other small crustaceans, and fish fry. Leim and Scott (1966) commented that much of the biology of the fourbeard rockling is unknown since it is rarely caught in commercial trawls because of its small size. They also suggested that it would eat small crustaceans and fish but gave no further details. In the study reported here, a total of 48 stomachs were examined and our observations confirm the suppositions of these previous authors. The major prey were found to be crustaceans, with the sand shrimp, Crangon septemspinosa, being of primary importance (Table 2).

Macrouridae

Two members of the Macrouridae have been included in this study on the Gadiformes. There is, however, very little information on the food habits of either the marlin-spike or the longnose grenadier. The dietary habits of some other grenadiers have been studied, as they are a fairly ubiquitous deepwater family, and these papers afford some comparative information. Pearcy and Ambler (1974) completed a study on the food habits of five species of the genus Coryphaenoides collected off the coast of Oregon and Washington. Three of the species were collected in reasonably large numbers and the major prey was identified as either the crustacean, Crangon abyssorum, or gonatid squid. A variety of other crustaceans were also preyed upon as were polychaetes, molluscs, fish, and echinoderms. It was concluded that these abyssal fishes are generalists in their feeding habits, consuming a wide variety of prey because of the low food density. Haedrich and Henderson (1974) examined the food habits of C. armatus, taken in the Hudson Canyon area of the

Atlantic, and also concluded that this grenadier had very generalized feeding habits. The only data available on either of the two macrourids we examined from the Northwest Atlantic is that of Hanson (1915), who found the euphausiid, Thysanoessa longicaudata, in the stomach of a marlin-spike, and Bigelow and Schroeder (1953) who found amphipods, a few worms, and euphausiids in the stomachs of some Georges Bank fish. We also found that crustaceans and polychaetes were the major prey of the marlin-spike (Table 2, Figure 11),but too few fish were collected to may any firm conclusions regarding the feeding habits. Based on the reports of Pearcy and Ambler (1974) and Haedrich and Henderson (1974), one might expect to find a variety of prey in the stomachs.

Ocean pout

Ocean pout are a bottom fish which prey heavily on echinoderms and crustaceans (Table 2). Almost three-quarters of their diet consisted of the sand dollar, E. parma, while rock crabs and amphipods accounted for the majority of the crustaceans. Olsen and Merriman (1946) collected ocean pout in the southwestern part of the Gulf of Maine and in Southern New England where they identified the sand dollar, E. parma, as the major prey. They reported rock crabs and the amphipod, Unicola, as being of secondary importance although some fish had also eaten bivalve molluscs such as Yoldia and Pecten. Smith (1950) examined the stomach contents of ocean pout collected in Block Island Sound, in Southern New England. The primary prey in this area was the amphipod, Leptocherius pinguis, with the sand dollar E. parma being the second most important prey. Tunicates were also important, making up almost 10% of the diet by weight. In the

present study tunicates were again found to be a reasonably significant prey item but only in the Gulf of Maine (Table 17). Bigelow and Schroeder (1953) examined the stomachs of ocean pout taken in Massachusetts Bay in 1924 and near the Nantucket Lightship in 1950. They found that the rather large specimen from Massachusetts Bay was full of brittle stars and spider crabs while the animals taken near the Lightship were full of small sea scallops.

Diet Overlap and Resource Partitioning

The percent similarity in diet (Figures 5-10) is a relative measure of overlap of the food habits, where overlap is simply defined as the use of the same resource by more than one predator regardless of the resource abundance. In contrast, resource competition exists only if the demand for prey outstrips the immediate supply (Weatherly 1963; Keast 1965, 1977; Zaret and Rand 1971). The index of diet overlap presented here, therefore, just highlights the potential for food resource competition which could exist if certain prerequisites were met.

The distribution of many of these fish, especially the commercially important species, has been documented from the groundfish survey data collected by the personnel at the NMFS, Woods Hole Laboratory (Fritz 1965; Grosslein and Bowman 1973; Colton 1955, 1972; Grosslein and Clark 1976). The range of many of these predators overlap, however, the major concentrations of the different species of fish are not usually the same. Fritz (1965), for example, has summarized the distribution of seven gadids from the autumn groundfish survey data, 1955-1961. His results showed that silver hake were reasonably ubiquitous, but over the six-year study they were

most abundant off Cape Cod and to the south, and also on the western and southeastern part of Georges Bank. Atlantic cod occurred north of 41°00' latitude and were abundant off Nantucket, north of Cape Cod and southeast of Nova Scotia. The haddock, pollock, and white hake might be considered boreal species as they, like the Atlantic cod, all occurred north of 41°00' latitude. The major concentration of haddock was on the northern edge of Georges Bank and on Browns Bank. Pollock were abundant near Nova Scotia but also occurred in moderate concentrations in the Gulf of Maine. White hake were found along the northeastern edge of Georges Bank and also in the Gulf of Maine. Red hake occurred throughout the area ranging from Nova Scotia to Cape May, New Jersey, being most abundant south of Cape Cod. A more recent summary of the groundfish survey data has been prepared by Grosslein and Clark (1976). This document includes both spring and autumn cruise data which gives some idea of the seasonal changes in the distribution of the commercially important gadoids. Although certain species, such as red hake have distinct seasonal migrations the overall distribution of many of thes fish is reasonably constant throughout the year and even from year to year. Colton (1972), for example, found no major change in the general distribution of the haddock during the period 1950-1968 despite changing trends in seawater temperature. From this survey data it may tentatively be concluded that, on a broad scale, although some spatial overlap occurs between many of the 15 gadiform fishes we have studied, the major concentratior of each fish are usually sufficiently distinct so that competition between the various populations for the same food resource would be minimal. On

a more localized scale, however, spatial overlap may occasionally be severe as has been documented by Grosslein and Bowman (1973). They considered the problem of by-catch in ICNAF Subareas 5 and 6 (Georges Bank to Cape Hatteras) pointing out that a bottom trawl fishery in these areas could not be conducted without harvesting a substantial mixture of species. In particular, aggregates of red and silver hake are consistently found in Southern New England as are mixtures of Atlantic cod, haddock, and hake on Georges Bank. For situations such as these, food habits studies would have to be conducted on fish collected from mixed catches to determine if the fish are feeding on the same prey at the same time or if there is significant resource partitioning, thus eliminating the potential for competition as was found by Jones (1975) for some gadoid fishes in European waters

Even if spatial overlap were to occur on a significant scale it may further be counteracted by short-term temporal changes in predator distribution and activity. Daily activity cycles may effectively function to segregate predators although the predators would, at times, share the same prey (Arntz 1974; Daan 1973; Brunel 1972; Graham 1924; Rae 1967; Jenkins and Green 1977, among others).

Finally, even when the spatial and temporal distribution of these species is accounted for it is difficult to make firm conclusions regarding resource limitation without an extensive knowledge of the benthic community available for exploitation. Studies such as those carried out by Arntz (1971, 1973, 1974) which combine food habits investigations, feeding chronology experiments, and a quantitative evaluation of the macrobenthos are needed before we can quantitatively determine the degree to which food resource competition actually exists.

A number of nonbiological factors may influence the calculation of diet overlap and these must be accounted for when interpreting overlap data. The level of identification of the prey will affect the overlap calculations since broader taxonomic groupings actually increase the observed degree of overlap. Moyle (1977) gives an example of this when comparing the diet of sculpins and some salmonids, noting that the greatest overlap occurred when the prey was only identified to the order level. In the present study the same effect may be observed. If, for example, the percent similarity is calculated for the diet of Atlantic cod and silver hake at a phyletic level, the similarity increases from 58% (see Table 2 and Figure 5) to 89%. On the other hand, Keast (1977) justifies the use of broader taxonomic groupings for sorting prey. He argues that the body size of the prey rather than finer taxonomic identity is important for studies on fish food habits. It would appear that there exists an optimal level of taxonomic classification for prey identified for diet overlap calculations. This optimum is probably primarily dependent on the size of the prey, provided the prey shares a similar ecological niche, since size dependent prey selection has been well-documented for fish (Daan 1973; Keast 1965; Tyler 1972, see also Edwards 1976). Apart from the level of taxonomic identification sample size is probably the second most important factor influencing diet overlap calculations. The smaller the sample the more variable the percent similarity. This effect was noted in the results for the marlin-spike and longnose grenadier where a relatively small change in sample size, and, consequently, in the quantity of prey consumed, could have a large influence on the observed composition of the diet and any resulting overlap estimates.

Bearing in mind some of the limitations discussed above, an overall pattern emerges from calculating and categorizing the percent similarity between the fishes' diets (Figures 5-10) which is not as readily apparent from a cursory examination of the tables on stomach contents for each of the 15 predators alone. Generally, the greatest block of similarity occurs in the upper left section of Figure 3 while the lowest level of overlap was found in the upper righthand section of the same figure. This reflects two distinct feeding types as revealed by an examination of the food habits data (Table 2). Thus, fish such as Atlantic cod, pollock, silver hake, white hake, offshore hake, and cusk are decidedly piscivorous while the haddock, longfin hake, fourbeard rockling, marlin-spike, longnose grenadier, fawn cusk-eel, and ocean pout are characterized more as benthic, invertebrate feeders. The red and spotted hake are intermediate, resulting in a very similar diet which overlaps both the piscivores and benthic invertebrate feeders. Within the group of seven invertebrate feeding fish the percent similarity between diets is, usually, relatively low, reflecting a wide diversity in the prey comprising the stomach contents.

Research on the food habits of fish communities as an integrated unit are rare. Food habit papers are often limited to a single species of fish without any consideration being given to diet interactions or dietary segregation between species occurring in the same locality. Calculating the percent similarity between diets for different fish is one method of looking at fish communities and this technique has been discussed above. Such a technique may outline a potential for food resource competition or partitioning but it does not, a priori, clarify if competition does or ever

did exist. Another way to approach community interactions is to identify the major food-energy sources for each predator by means of a partition plot, as outlined by Tyler (1972). From such a diagram (Figure 11) it is clear that the Northwest Atlantic Gadiforms show a reasonable degree of resource partitioning since all but the broadest categories of major prey are rarely shared by more than two or three predators. A similar situation has been described for a number of freshwater and other marine fish communities (Keast 1965, 1977; Nilsson 1967; Zaret and Rand 1971; Kislalioglu and Gibson 1977). It may, therefore, be reasonable to conclude that the Gadiformes evolved in a system where the availability of food was the controlling factor. In other words, competition for food, as the limiting resource, resulted in the development of different food habits for each species of fish.

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