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Preliminary Results From Feeding Analysis for the Most Abundant Demersal Fishes in Flemish Cap During Summer (1993-2000).

by

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Abstract

The food and feeding of 15 fish species taken by demersal trawl from Flemish Cap Bank in summer (1993-2000) are described using 35 645 stomachs. In general the feeding intensity was high in all the species with a maximum value for *Gadus morhua* (96.8%) and a minimum for *Lycodes reticulatus* (51.5%). The prey spectrum was wide with a total of 175 items for all the stomachs analysed. In frequency of occurrence the crustaceans make up the most important prey group (F.O.= 71.4%), while in volume (V= 38.2%) they are less significant than fish (V= 41.4%). The main prey taxa in frequency of occurrence were Hyperiidea, Pisces, Ophiuroidea, *Pandalus borealis* and Chaetognata. Three categories, relating with diet breadth, were made: specialists, low diversity feeders and high diversity feeders.

Introduction

Flemish Cap Bank is an well-isolated ecosystem from the continental shelf (Konstantinov *et al*., 1983). It is located in international waters, beyond the 200 miles economic zone, where fishing is regulated by the Northwest Atlantic Fisheries Organization (NAFO).

The effort of the Spanish fleet in Flemish Cap Bank increased after the establishment of the 200-Mile Fishing Zone Boundary by Canada. With the aim of studying the fishing resources of this bank a series of research cruises, financed by The European Union, began in 1988. The study of stomach contents of some of the fish species of commercial interest has continued since the first survey (Vazquez *et al*., 1989; Paz *et al*., 1989; 1993; Perez-Gandaras *et al*., 1993; Rodriguez-Marin et al, 1994; Rodriguez-Marin, 1995).

The study of feeding habits of fishes contributes to the knowledge of intra and interspecific relationship and thus to understand the structure and dynamics of marine communities. When commercially exploited species are involved, in the role of predators and/or as main prey species, the study of feeding habits of fishes are a basic step to multispecies assessment approaches, therefore, being important to the definition of fishery management options (Silva, 1995).

Numerous and diverse monospecific feeding studies had been carried out in Flemish Cap Bank: cod feeding (Lilly, 1979; 1983; 1985; 1987; De Cardenas *et al*., 1993; Casas and Paz, 1994), redfish (Gavaris and Legge, 1981; Saborido-Rey, 1993), a few species together cod and beaked redfish (Albikovskaya *et al*., 1988; Albikovskaya and Gerasimova, 1993) or for the same fifteen species but only for a few years (Rodriguez-Marin et al, 1994; Rodriguez-Marin, 1995). Other studies make reference to trophic relationships (Turuk and Postolaky, 1980; Konstantinov *et al*., 1985; Lilly and Evans, 1986; Lilly, 1987; Rodriguez-Marin and del Rio, 1999).

Materials and Methods

Stomach sampling was carried out during eight random stratified bottom-trawl surveys on the Flemish Cap Bank (NAFO Div. 3M) in Summer (1993-2000). Within the frame of the project "Study of Exploited fish Stocks on the Flemish Cap" (UE DG XIV). It was designed a stomach sampling program with the same methodology from 1993 (Rodriguez-Marin *et al*, 1994).

The surveys have been carried out according to NAFO methodological specifications (Doubleday, 1981) for a random stratified survey. Fishing was based on daytime trawling, between 6,30 h and 23,30 h, with hauls of 30 minutes duration. Samples were taken at depths from 127 to 738 m.

The objective species were selected in order to their abundance in the area (Vazquez, 1993; 1994; 1995): redfish (*Sebastes fasciatus, Sebastes marinus* and *Sebastes mentella*), cod (*Gadus morhua*), wolffishes (*Anarhichas denticulatus, Anarhichas lupus* and *Anarhichas minor*), Greenland halibut (*Reinhardtius hippoglossoides*), American plaice (*Hippoglossoides platessoides*), witch *flounder (Glytocephalus cynoglossus*), thorny skate (*Raja radiata*), *grenadiers (Macrourus berglax* and *Nezumia bairdi*), arctic eelpout (*Lycodes reticulatus*) and longfin hake (*Urophycis chesteri*).

In each haul a maximum of ten stomachs were analysed by 10 cm predator length groups for the priority species (redfish, cod, Greenland halibut, witch flounder and American plaice), while for the remaining species only 10 chosen at random specimens were analysed. Fish whose stomachs were everted or contained preys ingested in the fishing gear were discarded. Specimens, which presented total or partial regurgitation, were taken into account to estimate the emptiness indices. Owing to the fact that an empty stomach or one with little food can be confused with one totally or partially regurgitated, special attention was paid to the size and colour of the gall bladder, according to the criteria of A.P. Robb (Anon., 1991).

From each predator, data was collected of total length rounded to the cm. (anal length for family Macrouridae), sex and stage of sexual maturity. From each stomach content, volume was quantified in cc. through the use of trophometer (Olaso, 1990), as well as the percentage with respect to this volume, state of digestion and number of each prey. In the case that the prey was a fish, size in mm was noted, and where this was not possible owing to the degree of digestion, the otolith was measured. Prey were identified to species for fish, decapod crustaceans and cephalopods whenever their state of digestion made this possible. The rest of the preys were identified to upper taxonomic levels.

To evaluate the importance of the stomach content two methods were used:

- Frequency of occurrence (percentage), FO: $FO = n_s/N_s*100$, where n_s is the number of stomachs with a specific prey, and N_s is the total number of stomachs analysed. This method does not give quantitative information and produce bias overvaluing small and numerous individuals, but is quick and requires a minimum of apparatus, giving a somewhat qualitative picture of the food spectrum (Hyslop, 1980).

- Percentage by volume, V: $V = v/V_T*100$, where v is the volume of a specific prey, and V_T is the total prey volume. This method overvalues the importance of large organism (Hyslop, 1980), nevertheless in terms of production, the biomass, estimated from volume, is determining.

To calculate diet breadths, the niche width index (*B*) was used, as described by Levins (1968): $B=[\Sigma p_i^2]^{-1}$, where p_i is the proportion of the *ith* item in the diet. Low values indicate specialists and high values generalists.

Results and Discussion

From the fifteen demersal fish selected 35 645 stomachs were analysed. The characteristics of the stomach sampling are shown in detail in Table 1. The high average of full stomachs 75.6%, found particularly in cod, common grenadier (*Nezumia bairdi*), thorny skate, longfin hake, witch flounder, rough-head grenadier and American plaice, may be considered a normal feature of the summer (Konstantinov *et al*., 1985; Vazquez *et al*., 1989; Rodriguez-Marin *et al*., 1994). The number of regurgitated stomachs in *U. chesteri, M. berglax* and *Sebastes* sp. was high, particularly for this last genus, where values of 22 to 30% were found.

The frequency of occurrence by percentage of prey species found in the fish stomachs is listed in Table 2. The prey spectrum was wide with a total of 175 items for all the stomachs analysed. In this way, feeding studies provide information on species whose habits or length make their sampling by the fishing gear impossible (Rodriguez-Marin and del Rio, 1999; Banon *et al*., 1999). Furthermore, the preys also indicate the environment in which the predator lives. However, predation is mainly directed to a few taxonomic groups or species, so amphipods hyperiids make up the most important prey group (F.O.= 34.3%), copepods primarily calanoid (F.O.= 8.3), pisces (F.O.= 17.6%), brittle stars (F.O.= 14.9%), *Pandalus borealis* (F.O.= 13.9%) and chaetognaths (F.O.= 11.5%) are other relevant taxa.

Table 3 shows a summary of the main preys by volume found for each predator and for each prey as a whole. In this way Pisces (V= 41.4%), together with Crustaceans (V= 38.2%), are the main food resource for demersal fish in Flemish Cap area.

Although the feeding habits of most predators change as they grow, in this preliminary study we have treated each predator as an entity. From Table 3, last line, Levins' index, and taking account of the diversity in the diet of each predator, three categories were established with respect to their feeding:

1. Specialists. They are determined by only one prey taxa, with a percentage by volume between 50 and 75%. Furthermore, they have a very small number of main prey taxa (low values of Levins' index: 1.6 to 2.8):

   Anarhichas denticulatus, Northern wolffish. From the analysis of 315 stomachs, 60.3% contained food. It is the most pelagic feeder of the three wolffish species. It shows a very monospefic diet, feeding essentially on Ctenofora (V= 76.5%), together with a small proportion of Gadiformes fish (V= 16.3%).

   Glytocephalus cynoglossus, witch flounder. From the analysis of 768 stomachs, 89.6% contained food. It is a typical benthic predator. Its basic diet is made up of polychaetes (V= 74.3%) and gammaridean amphipods (V= 8.9%)

   Hippoglosoides platessoides, American plaice. From the analysis of 2 226 stomachs, 81.2% contained food. Feeds mainly on brittle stars (V= 74.3%) and amphipods hiperiids (V= 7.5%).

   Sebastes sp. (juvenile). From the analysis of 1 232 stomachs, 82.4% contained food. Copepods (V= 57%), chaetognaths (V= 13.6%) and amphipods hiperiids (V= 12.9%) are the main prey taxa.

   Urophycis chesteri, longfin hake. From the analysis of 671 stomachs, 90.8% contained food. Its diet is based almost exclusively on Northern shrimp (V= 58.1%), together with a small proportion of fish (V= 10.1%) and other natant decapods (V= 7.6%). Longfin hake´s feeding habits belong to a benthopelagic predator pattern (Methven and Mckelvie, 1986; Rodriguez-Marin, 1995).

2. Low diversity feeders. There is a dominant taxa in their diet with a percentage by volume between 30 and 50%. They present intermediate values of Levins' index (3.8 to 5.5):

   Gadus morhua, Atlantic cod. This species presents the higher fullness value, 96.8% from the analysis of 3 631 stomachs, which indicates its strong feeding activity in this area in summer (Turuk, 1981; Paz *et al*., 1989; 1993; Vazquez *et al*., 1989; Rodriquez-Marin *et al*., 1994). Atlantic cod presents a very wide prey spectrum, but the amphipods hiperiids group (V= 44%) is the main prey (De Cardenas *et al*., 1993; Casas and Paz, 1994; Rodriguez-Marin *et al*., 1994), together with Pisces Perciformes (V= 23.4%) and Northern shrimp (V= 9.6%).

   Lycodes reticulatus, Arctic eelpout. From the analysis of 1628 stomachs, 51.5% contained food. It presents the lower fullness value. It could be due to a regurgitation phenomena that have not been noticed. This species feeds mainly on brittle stars (V= 33.5%), Northern shrimp (V= 22.7%) and polychaetes (V= 10.1%).

Nezumia bairdi, marlinspike or common grenadier. From the analysis of 1 348 stomachs, 92.8% contained food. The diet is mostly made up of crustaceans (V= 80.4%), where amphipods hiperiids (V= 47.1%) constitute the main prey. A small proportion of polychaetes (V= 8.6%) is also eaten.

Raja radiata, thorny skate. From the analysis of 656 stomachs, 92.5% contained food. It feeds mainly on Northern shrimp (V= 33.8%), Pisces Perciformes (V= 19.2%) and cephalopods (V= 11%)

Sebastes fasciatus, acadian redfish. From the analysis of 3788 stomachs, 71.9% contained food. Copepods (V= 35.7%), Northern shrimp (V= 13.8%), euphausids (V= 12.6%) and amphipods hiperiids (V= 11.4%) constitute its main food resource.

3. High diversity feeders. Species with a highly diversified diet. They prey on a high a number of taxa, but none is dominant and no percentage by volume reaches 30%. They present high values of Levins' index (6.4 to 8.8):

Anarhichas lupus, Atlantic wolfish. From the analysis of 2129 stomachs, 58.7% contained food (the lowest value together with *Lycodes reticulatus*). It presents a very varied diet. Its most characteristic preys are the echinoderms group: brittle stars (V= 21.4%) and echinoderms (V= 11.8%), followed by fish (V= 26.4%) and Northern shrimp (V= 10%). This species feeds mainly on benthic preys (Templeman, 1985, Nelson and Ross, 1992). However, it was observed that its ability to feed in the water column increases as it grows and the percentage of benthopelagic species in its diet rises (*Pandalus borealis* and *Sebastes sp*.) (Rodriguez-Marin *et al*., 1994; Rodriguez-Marin, 1995).

Anarhichas minor, spotted wolfish. From the analysis of 1382 stomachs, 67.7% contained food. It is the most ichthyophagous of the three wolffish species: Perciformes (V= 24.2%) and Gadiformes (V= 8.9%), although it also feeds on ctenophores (V= 26.0%) and Ophiuroidea (V= 8.3%).

Macrourus berglax, rough-head grenadier. From the analysis of 1181 stomachs, 85.2% contained food. It feeds mainly on Northern shrimp (V= 29%), other Pisces (V= 15.5%), other Natantia (V= 9.2%) and Cnidaria (V= 8.5%).

Reinhardtius hippoglossoides, Greenland halibut. From the analysis of 7 098 stomachs, 64.8% contained food. Northern shrimp (V= 17.8%), Perciformes (V= 18.3%), other Pisces (V= 17.4%) and Anguilliformes (V= 16.8%) constitute its main food resource.

Sebastes marinus, golden redfish. From the analysis of 3146 stomachs, 75.3% contained food. It feeds mainly on hyperids (V= 15.1%), chaetognaths (V= 17%), copepods (V= 15.1%), euphausids (V= 13.1%) and Myctophiformes (V= 11.5%). Of the three species of Flemish Cap refish, this one seems to have the most pelagic feeding pattern (Konstantinov *et al*., 1985; Vazquez *et al*., 1989; Rodriguez-Marin *et al*., 1994)..

Sebastes mentella, deepwater redfish or beaked redfish. From the analysis of 4446 stomachs, 79.5% contained food. Other Pisces (V= 19.3%), euphausids (V= 12.7%), Northern shrimp (V= 12.4%), amphipods hyperiids (V= 10.8%)., copepods (V= 10.5%) and other Natantia (V= 10.3%) were dominant in its diet. It is the most icthyophagous of the three species of the genera and presents a wider prey spectrum, being the only one which preys upon cephalopods (Rodriguez-Marin *et al*., 1994).

Results from stomachs analysis form a feeding database containing information from nearly 36 000 stomachs. Owing to the consistency of the feeding patterns every summer, other factors can be studied by grouping surveys together. This will permit the analysis of factors of variability such as depth and geographical position. The results of the analysis of predator size, annual, depth and geographical variability in the feeding of the 15 species in Flemish Cap from all the surveys, will be studied applying multivariate analysis.

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Table 1. Characteristics of stomach sampling. Nº Hauls: Number of Hauls, Nº Full: Number of full stomachs, Nº Reg.: Number of regurgitated stomachs, % Food: Fullness percentage, % Empty: Emptiness percentage.

SPECIES	Size range (cm)	Nº hauls	Nº Full	Nº Reg.	% Food	Nº Empty	% Empty	TOTAL
Anarhichas denticulatus	7-121	195	163	27	60.3	125	39.7	315
Anarhichas lupus	6-76	309	1176	74	58.7	879	41.3	2129
Anarhichas minor	10-110	335	867	69	67.7	446	32.3	1382
Gadus morhua	13-113	316	3359	156	96.8	116	3.2	3631
Glyptocephalus cynoglossus	9-60	256	684	4	89.6	80	10.4	768
Hippoglossoides platessoides	5-60	308	1777	31	81.2	418	18.8	2226
Lycodes reticulatus	11-49	278	777	61	51.5	790	48.5	1628
Macrourus berglax	4.0-35.0	171	824	182	85.2	175	14.8	1181
Nezumia bairdi	2.0-9.5	211	1157	94	92.8	97	7.2	1348
Raja radiata	12-82	297	576	31	92.5	49	7.5	656
Reinhardtius hippoglossoides	9-82	399	4524	79	64.8	2495	35.2	7098
Sebastes juvenil	6-22	131	646	369	82.4	217	17.6	1232
Sebastes fasciatus	5-40	331	1892	832	71.9	1064	28.1	3788
Sebastes marinus	9-57	311	1683	687	75.3	776	24.7	3146
Sebastes mentella	9-49	326	2364	1169	79.5	913	20.5	4446
Urophycis chesteri	10-35	168	511	98	90.8	62	9.2	671
TOTAL			**22980**	**3963**	**75.6**	**8702**	**24.4**	**35645**

Table 2. List of prey groups found in stomachs of 15 demersal fish. F.O. = Frequency of occurrence percentage. * = Values less than 0.5.

SPECIES	F.O.	SPECIES	F.O.	SPECIES	F.O.	SPECIES	F.O.
CRUSTACEA	71.4	**Echinoidea**	2.1	**Gadiformes**	1.1	**Pleuronectiformes**	*
Amphipoda	37.4	Regularia	0.8	Gadidae	*	Pleuronectidae	*
Caprellidae	*	Irregularia	1.0	Gadus morhua	*	Hippoglossoides platessoides	*
Gammaridea	3.8	Other Echinoidea	*	Gaidropsarus sp.	*	Reinhardtius hippoglossoides	*
Other Gammaridea	3.6	**Holoturoidea**	*	Onogadus ensis	*	**Rajiformes**	*
Rhachotropis aculeata	*	**Ophiuroidea**	14.9	Urophycis chesteri	*	Rajidae	*
Hyperiidea	34.3	Other Echinodermata	*	Urophycis sp.	*	Other Rajidae	*
Other Amphipoda	0.8			Macrouridae	0.8	Raja radiata	*
Copepoda	18.3	**MOLLUSCA**	7.8	Coryphaenoides rupestris	*	Saccopharyngiformes	*
Calanoida	11.6	**Bivalvia**	3.9	Macrourus berglax	*	Saccopharyngidae	*
Other Copepoda	6.8	Pectinidae	*	Nezumia bairdi	0.5	**Salmoniformes**	*
Cumacea	*	Other Bivalvia	3.9	Other Macrouridae	*	Alepocephalidae	*
Decapoda	22.9	**Cephalopoda**	3.0	Moridae	*	Alepocephalus sp.	*
Anomura	*	Decapoda	1.9	Antimora rostrata	*	Argentinidae	*
Galatheidae	*	Brachioteuthis sp.	*	Ophidiidae	*	Other Argentinidae	*
Other Paguridea	*	Histioteuthis sp.	*	Brotulotaenia brevicauda	*	Bathylagidae	*
Brachyura	*	Illex illecebrosus	*	**Myctophiformes**	2.7	Batilagus euriops	*
Chionoecetes opilio	*	Onichotheuthys banksii	*	Anotopteridae	*	Chauliodontidae	*
Hyas coarctatus	*	Semirossia sp.	*	Anotopterus pharao	*	Chauliodus sloani	*
Hyas sp.	*	Other Sepiida	*	Myctophidae	2.5	Gonostomatidae	*
Lithodes maja	*	Other Sepiolidae	*	Benthosema glaciale	*	Cyclothone microdon	*
Other Brachyura	*	Other Teuthida	*	Ceratoscopelus maderensis	*	Malacosteidae	*
Natantia	22.4	Other Decapoda Cefalopoda	1.3	Lampadena speculigera	*	Malacosteus niger	*
Acanthephyra pelagica	*	Octopoda	*	Myctophum punctatun	*	Osmeridae	*
Acanthephyra purpurea	*	Bathypolypus arcticus	*	Notoscopelus spp.	*	Mallotus villosus	*
Gennadas elegans	*	Other Octopoda	*	Protomictophum arcticum	*	Sternoptychidae	*
Gennadas sp.	*	Other Cephalopoda	1.0	Other Myctophidae	1.9	Argyropelecus hemigymnus	*
Lebbeus polaris	1.6	**Gastropoda**	1.1	Paralepididae	*	Stomiidae	*
Oplophorus spinosus	*	Prosobranchia	1.0	Notolepis rissoi	*	Stomias boa	*
Pandalus borealis	13.9	Opistobranchia	*	Parelepis atlantica	*	**Fish larvae**	*
Parapasiphaea sulcatifrons	*	Gasteropods eggs	*	Other Paralepidae	*	**Pisces eggs**	*
Pasiphaea tarda	*	Gasteropod pelagic larvae	*	**Perciformes**	5.6	**Unidentified Pisces**	7.9
Pontophilus norvegicus	*	**Poliplacophora**	*	Agonidae	*		
Sabinea sarsi	*	**Scaphopoda**	*	Agonus decagonus	*	**OTHER INVERTEBRATES**	24.0
Sergestes arcticus	2.0	**Other Mollusca**	*	Aspidophoroides monopterygius	*	**Brachiopoda**	*
Sergia robusta	*	**Mollusca eggs**	*	Ammodytidae	*	**Bryozoa**	*
Spirontocaris lilljeborgi	0.9			Ammodytes sp.	*	**Chaetognata**	11.5
Spirontocaris sp.	*	**OTHERS**	1.1	Anarhichadidae	0.7	**Cnidaria**	1.4
Other Caridea	*	**Bird pieces**	*	Anarhichas minor	*	Anthozoa	0.6
Other Crangonidae	*	**Unidentified**	*	Anarhichas sp.	0.7	Hydrozoa	*
Other Pasiphaeidae	*	**Phycophyta**	*	Anarhichididae	*	Siphonophora	*
Other Penaeidea	*	Chlorophyceae	*	Anarhichas denticulatus	*	Thecaphora	*
Other Natantia	5.6	Rhodophyceae	*	Anarhichas lupus	*	Scyphozoa	0.9
Other Decapoda Crustacea	*	**Stones**	*	Chiasmodontidae	*	Other Cnidaria	*
Euphausiacea	9.0	**Unidentified eggs**	*	Chiasmodon niger	*	**Ctenofora**	1.2
Bentheuphausia amblyops	1.7	**Cooking waste**	*	Pseudoscopelus scriptus	*	**Nematoda**	*
Meganyctiphanes norvegica	2.9	**Offal (waste products)**	*	Cottidae	0.7	**Polychaeta**	9.9
Thysanoessa longicaudata	1.0			Cottunculus sp.	*	Polychaeta errantia	0.8
Other Euphausiacea	3.8	**PISCES**	17.6	Triglops murrayi	0.7	Aphroditidae	*
Isopoda	*	**Anguilliformes**	1.2	Cyclopteridae	*	Polynoidae	*
Tole spinosa	*	Nemichthyidae	*	Liparis spp.	*	Other Polychaeta errantia	0.8
Other Isopoda	*	Nemichthys scolopaceus	*	Scorpaenidae	1.6	Polychaeta sedentaria	0.9
Mysidacea	4.6	Serrivomeridae	1.2	Sebastes juvenil	*	Opheliidae	*
Erythrops sp.	*	Serrivomer beani	1.2	Sebastes marinus	*	Ammotrypane aulogaster	*
Eucopia grimaldii	*	Synaphobranchidae	*	Sebastes mentella	*	Serpulidae	*
Pseudomma sp.	*	Synaphobranchus Kaupi	*	Sebastes sp.	1.5	Other Polychaeta sedentaria	0.9
Other Mysidacea	4.0	Other Anguilliformes	*	Stichaeidae	2.5	Other Polychaeta	7.9
Pantopoda (Pycnogonidae)	*	**Atheriniformes**	*	Lumpenus lumpretaeformis	2.5	**Porifera**	*
Otros Crustacea	4.9	Scomberesocidae	*	Zoarcidae	*	**Priapulida**	*
ECHINODERMATA	16.6	Scomberesox saurius	*	Lycodes reticulatus	*	**Sipunculida**	1.2
Asteroidea	1.2	**Beryciformes**	*	Lycodes esmarki	*	**Tunicata (Thaliacea)**	*
Crinoidea	*	Melamphaeidae	*	Lycodes sp.	*		
		Poromitra sp.	*	Lycodes valhi	*		
		Scopelogadus beanii	*				

Number of stomachs studied = 35 645.

Table 3. Percentage by volume of most characteristics prey and diet breadths (Lenvin's index, B) for each species. Only have been considered values up to 1. *: Values between 1 and 5 %.

	A. Denticulatus	A. Lupus	A. Minor	Gadus morhua	G. cynnoglossus	H. Platessoides	L. reticulatus	M. Berglax	N. Bairdi	R. Radiata	R. Hippoglossoides	S. Fasciatus	S. Juvenil	S. Marinus	S. Mentella	U. Chesteri	Total
CRUSTACEA	*	15.57	9.54	62.92	14.52	12.77	32.17	42.53	80.42	44.53	24.91	84.60	85.54	61.21	60.33	85.36	38.19
Amphipoda Gammaridea					8.94		*		*	*							0.28
Amphipoda Hyperiidea		*		43.97		7.46			47.08		*	11.41	12.92	18.08	10.78	*	17.44
Copepoda									*			35.68	56.96	15.14	10.51	6.69	0.91
Pandalus borealis		9.95	7.18	9.59		*	22.70	29.04	*	33.76	17.77	13.82		9.59	12.41	58.12	13.15
Other natantia				*		*	5.99	9.21	7.97	5.16	*	5.72	*	*	10.25	7.55	2.81
Euphausiacea				*					*			12.60	*	13.07	12.68	*	2.29
Mysidacea								*	5.01			*	*			*	0.30
Other crustacean	*	*	*	*	5.62	*	*	*	7.02	*	*	*	6.24	*	*	*	1.01
ECHINODERMATA		40.01	13.95		5.37	77.18	34.62	*									5.23
Asteroidea			*														0.65
Echinoidea		11.82	1.78														0.68
Ophiuroidea		21.42	8.32		5.32	74.31	33.48	*									3.87
MOLLUSCA		9.58	*	*	*		5.95	5.74	*	11.00	5.19				*		3.45
Bivalvia		6.94			*		*		*								0.27
Cephalopoda				*			*	*		10.96	5.18				*		2.98
Gastropoda		*															0.22
PECES	21.22	26.36	45.70	31.76	*	*	10.14	35.23	*	38.43	68.70	5.71		18.90	31.35	10.10	41.44
Anguilliformes			*					8.31		*	16.82				*	*	5.72
Gadiformes	16.30	11.98	8.93	*				*		*	8.61						5.69
Myctophiformes				*			6.22	5.61		*	7.54	*		11.53	10.19		3.51
Perciformes	*		24.18	23.41		*	*	*	*	19.19	18.29			*		*	17.74
Other pisces	*	14.36	8.00	*			*	15.53		8.03	17.40	*		*	19.25	*	8.78
OTHER	77.03	7.26	28.10	*	75.62	5.26	16.53	13.30	12.10	*		8.00	13.57	17.31	*	*	10.55
Chaetognata				*		*			*			7.73	13.57	17.04	*	*	0.97
Cnidaria								8.46	*								0.44
Ctenofora	76.48		26.04														7.61
Polychaeta		*			74.26	*	10.12	*	8.57	*							0.99
Sipunculida							6.25										0.04
Offall (waste products)		*	*														0.31
Levin's index, B	1.6	8.8	6.4	3.8	1.8	1.8	5.3	7.1	4.0	5.5	7.0	5.3	2.7	7.8	8.6	2.8	