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Studies of Feeding of Silver Hake,
Merluccius Bilinearis (Mitchill),
and Red Hake, Urophycis Chuss Walbaum,
in the Northwest Atlantic Area, 1965-1967.

by

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Abstract

The present paper contains the results of the studies of the feeding of silver hake, Merluccius bilinearis (Mitchill), and red hake, Urophycis chuss Walb, conducted in 1965-1967 on the Nova Scotia shelf, Georges Bank and on the Shelf south of New England from Cape Cod to Cape Hatteras (Fig.1,2). Feeding of both males and females of various size groups were studied, as well as, the species composition of the food and feeding of these species by areas and seasons. The data obtained give evidence of the differences in the pattern of feeding of silver hake and red hake of various size groups and difference in the species composition of the food by areas and seasons. Coefficients of food similarity between silver hake and red hake were calculated. There is no actual food competition between these species.

INTRODUCTION

Pattern of feeding and food correlation are often the factors determining the behaviour and distribution of fish during their whole life history. Due to their abundance in the North-West Atlantic, silver hake and red hake present a great interest from the point of view of their food correlation.

Nevertheless, the pattern of feeding of these species had been practically ignored until recently. Some information on silver hake and red hake feeding is only given in works by Bigelow and Schroeder (1953), Schaefer R.H. (1960), Sauskan V.I. (1960), and Rikhter V.A. (1968).

Beginning from 1965 the West-Atlantic Laboratory, AtlanticIRO, has been collecting the material for investigation on pattern of feeding and food competitions of these two species. The present paper has the objective to summarize the available material and to fill in some gaps still existing in this question.

MATERIAL AND METHODS

The present paper is based on the data obtained during the studies of feeding pattern of S. hake and R. hake in 1965-1967. Usually, samples of 100 specimens of each species with a distinct grade of stomach filling (by 4-grade table: 0 - empty, 1-hardly filled, 2 - half filled, 3 - full, 4 - overfilled) and identifiable food composition, were taken. Species constituting the food of these two fishes were identified at the Laboratory and partially at sea. Quantitative analysis of the material was only limited to determination of frequency of occurrence (percentage) of the food components. Only stomachs containing food were used to estimate this frequency of occurrence. Rate of feeding was determined by grades of filling of full and empty stomachs except for the regurgitated ones. Proportion of feeding specimens was determined relative to the total number of the analysed stomachs except for the regurgitated ones. For purposes of comparison of food components of silver hake and red hake there was used a method of comparison of frequencies of occurrence of food organisms which was suggested by Yanulov (1963) for the comparison of feeding of red fish (*mentella* and *marinus*) and cod from the Newfoundland and Labrador areas. According to this method the coefficient of food similarity, $CFS = \frac{n \times 100}{N}$, where N is a sum of the highest

percentages of frequency of occurrence of food organisms for the compared species, while n is a sum of the lowest percentages of frequency of occurrence of the general food components.

Totally, 42,515 and 5,486 stomachs of silver hake and red hake, respectively, from ICNAF Subarea 6 and divisions 4W, 4X, and 5Z were analysed.

In further treatment of the data on food composition in silver hake and red hake, all the organisms were distributed by groups.

RESULTS

Feeding of Silver Hake

a) Species composition of the food in silver hake.

As shown in Table 1, 59 species of invertebra and pisces were found in silver hake stomachs, among them: 2 species of fishes and crustaceans, 3 species of molluscs (mostly squids), 3 - Echinoidea and 5 "other organisms".

Of the total number, 41 organisms are typical plankton and bathypelagic species, 18 are benthic or more or less related to the bottom organisms.

Invertebra are dominant by number of species (3/4) in the silver hake stomachs (57.6%). Almost all of them are widely spread, euribathic mass organisms.

23 organisms, of which 11 are pisces, are common in silver hake stomachs while the rest occur rarely.

Vertebra are presented by 24 pisces with anchovy, herring, hakes, argentines, mackerel and sand lance being most common in the silver hake stomachs.

Invertebra in the silver hake feeding both by number of species and by frequency of occurrence are mostly presented by crustaceans. The bulk of the food are Euphausiacea (62% by frequency of occurrence): *Meganyc tiphanes norvegica* and *Thysanoessa inermis* (Table 2).

b) Feeding of Silver hake by size groups and sex.

All the material was analysed by size groups and an obvious picture of the qualitative changes in the food composition was obtained (Table 2).

Immature specimens are not larger than 28 cm and feed mostly on Euphausiacea (70 - 90% by frequency of occurrence).

Mature specimens feed on almost all the food groups, however, the bulk of their food is made by Euphausiacea. Their occurrence increases with silver hake growth in length, but on reaching the length of 35 cm silver hake feeds intensively on pisces. Specimens of smaller size groups at the beginning feed on lantern fish, young fish and then change to mature fish of ~~young~~ various species. Occurrence of Euphausiacea in older S. hake stomachs sharply decreases, while other food groups disappear completely and are substituted by shrimps and squids.

The main food for specimens larger than 40 cm are, nevertheless, pisces. Judging by frequency of occurrence in males with their growth in length, Euphausiacea are most common in S. hake stomachs. Then come pisces and squids. Percentage of occurrence of fish food in the males stomachs of all size groups remains constant, while that of Euphausiacea varies from 59.5 to 69.4%. Of pisces males feed on anchovy, young fish, and also young hake. Euphausiacea and pisces, being the main food groups, are always present in silver hake ration.

In female feeding, four food groups are well traced: Euphausiacea, fish, shrimp and squid. Proportion of fish and squid in females stomachs increases with the fish length, while the frequency of occurrence of Euphausiacea and shrimp decreases. Females of maximum size feed exclusively on pisces.

c) Pattern of silver hake feeding by areas and seasons.

Analysis of silver hake feeding by areas and seasons shows a considerable change in qualitative compositions of food while two food groups, Euphausiacea and fish, are present in all the areas and seasons (Table 3).

The most intensive feeding of silver hake is observed in spring-summer and autumn periods. Lowering of feeding rate on the Georges Bank in summer is associated with the silver

hake spawning. Late in summer and in autumn another rise of feeding rate is observed. In winter, feeding rate drops in all the areas, but in the Hoodson Canyon area S. hake feeds intensively even in winter time. This fact was also noted by Richter (1968).

As was stated already, the basic food for S. hake in all the areas under studies are pisces and Euphausiacea. No significant differences by areas in feeding on fish and Euphausiacea were observed, except for the Nova Scotia shelf where Euphausiacea was highly dominant. Differences in silver hake feeding within one year lie in the fact that species composition of the fish food, as well as the rate of silver hake feeding varies from area to area. While on the Nova Scotia shelf the maximum of feeding intensity occurs in spring months, and sand lance, argentine, lantern fish and young silver hake are present in silver hake ration, on the Georges Bank the maximum of feeding rate occurs in autumn months and Atlantic herring, mackerel, young silver hake and lantern fish are common in the silver hake stomachs. It is possible that different frequency of occurrence of the food groups in the silver hake stomachs from all the areas is stipulated by availability of these organisms and by density of their concentrations in that or other area or season, that is, by their vulnerability. However, Euphausiacea and fishes are the main and the most available food for this species.

Red hake feeding

a) Species composition of the red hake food.

In the red hake stomachs there were found 56 species of invertebra and pisces (Table 4). Fishes are presented by 19 species, crustaceans - by 18, molluscs - by 9, and Echinoidea - by 8 species.

Only 8 species of invertebra and 8 species of pisces from the whole list are typical pelagic and bathypelagic organisms, while the other 40 species (71.4%) are benthic or closely related to bottom life. Invertebra dominate in red hake feeding by

number of species (36, that is 64.2%). 27 organisms from the whole list are common in the red hake stomachs, while the rest are rare. The most common pisces in the red hake stomachs are Atlantic herring, silver hake, yellowtail flounder, butterfish, mailed sculpin and haddock which constitute 16% of the total.

The main food for red hake are Amphipoda (42% in frequency of occurrence), which are presented by two species : *Themisto compressa* and *Talorchestia longicornis*. Less common are squid - 3.1%, shrimp - 6.0% as well as, Decapoda, Euphausiacea, mollusc, polychaeta and Echinoidea

b) Red hake feeding by various size groups and sex.

Young immature red hake below 25 cm in length feed mostly on crustaceans - Amphipoda (Table 5). Size groups from 26 to 40 cm have in their ration all the mentioned food groups of which the main are Amphipoda which are followed by pisces, squis, shrimp and other Decapoda. As it grows in length, red hake like silver hake tends to become ichthyophagos and the maximum sizes have in their stomachs three food groups: fish, squid and Amphipoda, with the fish constituting 57.2% in frequency of occurrence. Analysis of red hake feeding by size groups indicates that qualitative composition of food does not experience great differences. The only difference lies in the fact that smaller individuals feed on smaller organisms, while the larger ones - the other way round.

As for the qualitative aspect in the equal size groups, Amphipoda and shrimp dominate in male stomachs, while squid and Decapoda - in females.

c) Red hake feeding by areas and seasons

Intensity of red hake feeding throughout the whole area of distribution increases in spring during prespawning and postspawning periods; it reaches the peak by the mid autumn (October) and decreases sharply in winter.

In June, the ration of red hake on the north-west slopes of the Georges Bank is made almost of all the mentioned food

groups except for Euphausiacea (Table 6). Feeding rate is grade 2.3. Late in autumn (November) consumption of Amphipoda increases sharply, while in winter the variety of food groups increases, but the average grade of stomachs filling sharply declines. In autumn, the feeding rate reaches grade 3.5, while in winter it is reduced to almost a zero.

On the southern slopes of the Georges Bank, the main food for red hake in spring and summer are Amphipoda, pisces, squid, and Decapode (mostly Cancer and Pagurus) (Table 6).

In the same period on the Nantucket Shoals and on the slopes of the shelf, red hake feeds on the same organisms as on the slopes of the Georges Bank, in autumn, however, crabs, brittlestars and Euphausiacea are the main food. In winter, the food variety increases, while the feeding rate is lower. In the Hudson area, the feeding rate of the species is also low, food variety is high, and benthos organisms constitute a significant percentage (polychaeta, molluscs, and brittlestars).

Comparison of feeding of silver
hake and red hake.

Coefficient of food similarity was determined for the following ICNAF subdivisions: 5Ze - 13.1; 5Ze₂-28.3; 5Zw-23.3; 6a - 30.1 (Figures 1,2).

The main food for silver and red hake in summer-autumn period on the Georges Bank are fish, shrimp, and Euphausiacea. In winter-spring period on the Nantucket Sound in the Hudson area, besides the above mentioned organisms, squid, fish and Amphipoda are also common both species. Since in winter both species have a decreased feeding rate and a high variety in food, the chances for a food competition are very small. Beginning from April the food spectrum of red hake and particularly of silver hake considerably narrows, but by that time a feeding migration of both species already begins.

SUMMARY

1. Euphausiacea and fish are the main food for silver hake.
2. Immature S. hake feeds mostly on Euphausiacea, and with its growth in size a gradual change from crustaceans to fish takes place. In its pattern of feeding older silver hake is nectophagos.
3. Males of 35 cm are abundant. 36 - 40 cm are few and above 40 cm in length are absent in the catches. Pattern of feeding in males and females of these size groups is virtually the same. Females above 40 cm in length are exclusively ichthyophagos.
4. Feeding rate of S. hake reaches its maximum in spring, decreasing in summer due to the spawning and becomes minimum in winter.
5. Immature red hake feeds on Amphipoda, while with reaching maturity proportion of bottom crustaceans, benthos and fish in its ration increases.
6. Patterns of feeding of S. hake and R. hake overlap insignificantly and chances of food competitions among them in most of the area are very few.

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Table 1. List of organisms found in the Silver Hake stomachs.
+ very seldom, ++ seldom, +++often, ++++very often.

Phacophyta	
1. <i>Jucus</i> sp.	++
Polychaeta	
2. <i>Tomopteris</i> sp.	++
Copepoda	
3. <i>Calanus finmarchicus</i> (Gunnerus)	++++
4. <i>Calanus hyperboreus</i> Kröyer	+++
5. <i>Centropages typicus</i> Kröyer	++
Thoracica	
6. <i>Balanus eburneus</i> Leach	+
Mysidacea	
7. <i>Mysis stenolepis</i> (Smith)	++++
Hyperiidia	
8. <i>Hyperia galba</i> (Montagu)	++
9. <i>Themisto compressa</i> Goës	++++
10. <i>Themisto libellula</i> Mandt	+++
Gammaridea	
11. <i>Palorchestia longicornis</i> (Say)	++++
Euphasiacea	
12. <i>Meganyctiphanes norvegica</i> (M. Sars)	++++
13. <i>Thysanoëssa inermis</i> (Kröyer)	++++
14. <i>Thysanoëssa raschii</i> (M.Sars)	++
15. <i>Thysanoëssa longicaudata</i> (Kröyer)	++
16. <i>Nematoscelis megalops</i> Sars	+
Decapoda	
17. <i>Pandalus montagui</i> Leach	++++
18. <i>Pandalus borealis</i> Kröyer	++++
19. <i>Crago septempinosus</i> (Say)	++
20. <i>Homarus americanus</i> Milne-Edwards	+
21. <i>Panulirus argus</i> (Latreille)	+
22. <i>Pagurus bernhardus</i> (Linnaeus)	++
23. <i>Pagurus longicarpus</i> Say	+
24. <i>Cancer irroratus</i> Say	+
25. <i>Cancer borealis</i> Stimpson	+
26. <i>Panopeus herbstii</i> Milne-Edwards	+
Pelecypoda	
27. <i>Mucula tenuis</i> Montagu	+
Cephalopoda	
28. <i>Illex illecebrosus</i> (Lesueur)	++++

23. <i>Squilla peali</i> Desueur	+++
<i>Chaetognatha</i>	
26. <i>Sagitta elegans</i> Verrill	++
27. <i>Sagitta serratodentata</i> Krohn	+
28. <i>Eulachna hamata</i> Möbius	+
<i>Asteroida</i>	
33. <i>Leptasterias groenlandica</i> (Lütken)	+
34. <i>Ophiuroidea</i>	
34. <i>Gorgonocephalus arcticus</i> Leach	+
<i>Echinoidea</i>	
35. <i>Echinorachnius parma</i> (Lamarck)	++
<i>Pisces</i>	
36. <i>Etrumeus sadina</i> (Mitchill)	+++
37. <i>Clupea harengus harengus</i> Linnaeus	++++
38. <i>Alosa pseudoharengus</i> (Wilson)	+++
39. <i>Alosa aestivalis</i> (Mitchill)	++
40. <i>Anchoa mitchilli</i> (Guvier and Valenciennes)	+++
41. <i>Mallotus villosus</i> (Miller)	+
42. <i>Argentina silus</i> Ascanius	+++
43. <i>Ceratoscopelus maderensis</i> (Lowe)	+++
44. <i>Diaphus effulgens</i> (Goode and Bean)	+
45. <i>Myctophum affine</i> (Lütken)	++++
46. <i>Maurolicus pennanti</i> (Walbaum)	++++
47. <i>Scorpaenopsis saurus</i> (Walbaum)	+
48. <i>Merluccius bilinearis</i> (Mitchill)	++++
49. <i>Urophycis chuss</i> (Walbaum)	+++
50. <i>Hippoglossoides platessoides</i> (Fabricius)	++
51. <i>Limanda ferruginea</i> (Storer)	+
52. <i>Citharichthys arctifrons</i> Goode	+
53. <i>Paralepis</i> sp.	+
54. <i>Scomber scombrus</i> Linnaeus	++++
55. <i>Poronotus triacanthus</i> (Peck)	++
56. <i>Stenitonus versicolor</i> (Mitchill)	++
57. <i>Sebastes marinus</i> (Linnaeus)	++
58. <i>Amodytes americanus</i> De Kay	++++
59. <i>Macrozoarces americanus</i> (Bloch and Schneider)	+

Food components	S I L V E R H A K E S T O M A C H S (S O H)						Total Nos.
	21	21 - 25	26 - 30	31-35	36-40	41-45	
	s.e	s.e	s.e	s.e	s.e	s.e	
Copepoda	2.6	0.9	2.1	1.1	0.5	0.1	118
		1.4	0.5	0.10			0.71
Euphausiacea	69.5	67.0	88.2	64.9	56.3	41.7	10319
	59.5	79.2	68.0	55.4	62.1	26.4	4.7
		62.4					4.3
Amphipoda		5.1	2.5	2.4	2.2	2.2	424
		1.4	2.8	2.60		1.5	2.61
Shrimp	16.7	11.3	5.2	5.2	2.9	2.2	58
	13.1	5.7	4.6	2.2		4.7	5.48
Benthic organisms		0.1	0.10	0.10		0.1	14
		1.7	0.10	0.10			0.08
Squid		1.1	1.2	2.0	4.4	8.2	266
		0.8	1.1	1.0	3.4		1.60
Anchovy		5.4	4.5	1.5	0.2	1.1	494
	2.2	1.7	2.8	1.4			2.98
Herring		0.1	0.03	0.5	1.1	2.2	52
	2.4		0.10	0.1			0.30
Band lance		0.2	2.5	14.0	13.7	3.8	1001
		0.5	2.8	2.1			6.06
S.hake	2.8	1.5	1.0	0.6	2.2	4.4	151
	0.8	1.1	0.4	0.6	3.4		0.21
Other pieces	6.7	1.7	5.9	2.6	24.0	45.1	1521
	1.2	6.0	6.90	8.10	10.5	54.7	9.18
Summarizes per centage of pieces	9.5	3.4	13.8	5.9	15.60	26.10	2219
	14.2	13.2	12.90	17.30	41.70	56.6	95.7
Food remnants	11.2	10.6	10.2	5.9	6.00	4.4	19.39
	13.1	8.1	2.10	5.2	17.2		1.18
No. of stomachs with food	36	58	17	3078	917	182	16597
	84	1317	4205	1406	29	64	23

Table 2. Occurrence of food components in the Silver Hake stomachs by size groups in ICNAF subareas 4, 5 and in statistical subarea 6, percent (1965 - 1967).

Note: in numerator - in females
in denominator - in males

Food groups	ICNAF Areas												Total %																									
	IV	V	VI	VII	VIII	IX	X	XI	XII	I	II	III		IV	V	VI	VII	VIII	IX	X	XI	XII																
Copepoda	0.3		10.4	5.7	4.8																					0.6	0.2											
Euphausiacea	52.0	77.8	67.0	68.1	57.0	27.3	92.1	78.8	60.0	79.7	61.7	28.7	66.8	42.0	66.2	67.1	66.2	24.7	78.7	77.4	77.5	100	81.8	76.4	16.6	45.5	47.5	58.4										
Amphipoda	8.0	10.7	31.0		0.5	11.8			31.6	4.5					0.6											18.2	0.2											
Shrimp	0.1		12.0		3.2	19.5			2.9	0.3	35.6	22.5	9.5	12.0	26.7				0.8							10.8	0.9	1.8	0.5									
Penaeid crustaceans										0.3											1.4	0.9	0.5				0.3											
Amphov	0.1		3.3		4.7				0.4		0.3										2.5	2.9	5.0															
Squid	0.2	7.0	1.0						1.3	2.8	1.8	0.9									13.5	3.9	11.5	0.3	6.7	8.3	0.3	2.8	2.7	15.2								
Herrings											0.3	1.6																		8.9								
Sand lance	2.3		10.7		25.8																																	
S. hake	2.0		1.0																												1.0							
Unidentified fishes	46.0	11.2	15.3	4.9	11.0	0.8	1.7	40.0	9.4	8.4	19.3	33.8	9.2	15.3	17.3	6.2	33.8	58.9	13.2	4.00	22.2				11.5	15.3	4.33	50.8	42.8									
Total %	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Table 3, Percentage of food groups occurrence in the Silver Hake stomachs by months in ICNAF divisions 4W, 5Z and in subarea 6 (1965 - 1967)

Table 4. List of organisms found in the Red Hake stomachs.
 + very seldom, ++ seldom, +++ often, ++++ very often.

Phaeophyta	
1. Fucus sp.	++
Polychaeta	
2. Aphrodite aculeata Linnaeus	++++
Thoracica	
3. Lepas hilli Leach	++
4. Balanus eburneus Gould	++++
Amphipoda	
5. Themisto compressa Goës	++++
6. Themisto libellula Mandt	+++
7. Talorchestia longicornis (Say)	++++
Euphausiacea	
8. Meganyctiphanes norvegica (M. Sars)	++++
9. Thysanoëssa raschii (M.Sars)	+++
10. Thysanoëssa longicaudata (Kröyer)	+
Decapoda	
Macrura natantia	
11. Pandalus montagui Leach	++++
12. Pandalus borealis Kröyer	+++
Macrura reptantia	
13. Homarus americanus Milne-Edwards	++
14. Panulirus argus (Latreille)	+++
Anomura	
15. Pagurus bernhardus (Linnaeus)	++++
16. Pagurus longicarpus Say	+++
17. Cancer irroratus Say	++++
18. Cancer borealis Stimpson	+++
19. Placopus herbstii Milne-Edwards	++
Stomatopoda	
20. Squilla empusa Say	++
Pelecypoda	
21. Nucula tenuisulcata (Couthouy)	+++
22. Nucula proxima (Say)	+++
23. Pecten islandicus (Müller)	++
24. Pecten magillanicus (Guélin)	++
25. Lytilus edulis Linnaeus	++
Gastropoda	
26. Cerithiopsis sp.	++
27. Nassa sp.	++
Cephalopoda	
28. Illex illecebrossus Lesueur	+++
29. Loligo pealii Leueur	+++
Asteroidea	
30. Ctenodiscus crispatus (Retzius)	++
31. Pentagonaster granularis (O.F. Müller)	++
32. Henricia sanguinolanta (O.F. Müller)	++

33. <i>Leptasterias groenlandica</i> (Lütken)	+++
Ophiuroidea	
34. <i>Gorgonocephalus arcticus</i> Leach	+++
35. <i>Amphiura denticulata</i> Kochler	++
36. <i>Ophiura robusta</i> Ayres	+
Echinoidea	
37. <i>Echinarachius parma</i> (Lamarck)	++++
Pisces	
38. <i>Myxine glutinosa</i> Linnaeus	+
39. <i>Clupea harengus harengus</i> Linnaeus	+++
40. <i>Alosa pseudoharengus</i> (Wilson)	++
41. <i>Brevoortia tyrannus</i> (Latrobe)	+
42. <i>Merluccius bilinearis</i> (Mitchill)	++++
43. <i>Lepophidium cervinum</i> (Goode and Bean)	+
44. <i>Limanda ferruginea</i> (Storer)	+++
45. <i>Pseudopleuronectes americanus</i> (Walbaum)	++
46. <i>Scomber scombrus</i> Linnaeus	++
47. <i>Poronotus triacanthus</i> (Peck)	+++
48. <i>Triglops ommatistius</i> Gilbert	++++
49. <i>Myoxocephalus scorpius</i> (Linnaeus)	++
50. <i>Aspidophoroides monoptyerygis</i> (Bloch)	++
51. <i>Cyclopterus lumpus</i> Linnaeus	+
52. <i>Prionotus carolinus</i> (Linnaeus)	+
53. <i>Tautoglabrus adspersus</i> (Walbaum)	++
54. <i>Tautoga onitis</i> (Linnaeus)	++
55. <i>Annodytes americanus</i> De Kay	++
56. <i>Melanogrammus aeglefinus</i> (Linnaeus)	+++

Table 5. Occurrence of food components in the Red Hake stomachs by size groups in ICNAF subareas 5 and 6, per cent (1965-1967).

Food components	Red hake length (cm)							Total number %
	21-25	26-30	31-35	36-40	41-45	46-50	51-55	
Euphausiacea	<u>1.4</u>	<u>4.5</u>	<u>4.2</u>	<u>5.4</u>	<u>5.0</u>	-	-	<u>76</u>
	-	4.1	2.8	3.4	-	-	-	3.80
Amphipoda	<u>62.5</u>	<u>45.0</u>	<u>38.6</u>	<u>37.1</u>	<u>27.3</u>	<u>40.5</u>	<u>28.5</u>	<u>837</u>
	69.1	43.9	44.5	41.9	35.8	50.0	-	41.85
Shrimp	<u>6.2</u>	<u>10.0</u>	<u>6.6</u>	<u>5.4</u>	<u>4.4</u>	<u>2.1</u>	-	<u>110</u>
	5.6	2.7	6.0	6.2	-	50.0	-	5.90
Polychaeta	-	<u>2.0</u>	<u>2.2</u>	<u>0.6</u>	-	<u>2.1</u>	-	<u>22</u>
	-	0.4	1.0	0.8	-	-	-	1.10
Decapoda	<u>2.2</u>	<u>4.0</u>	<u>3.9</u>	<u>7.7</u>	<u>7.6</u>	<u>2.1</u>	-	<u>90</u>
	2.8	4.0	3.5	6.9	7.1	-	-	4.90
Molluscs	-	<u>0.5</u>	<u>1.7</u>	<u>1.2</u>	<u>6.3</u>	<u>8.5</u>	-	<u>20</u>
	-	2.0	1.2	0.8	-	-	-	1.80
Crustacean benthic organisms	-	<u>0.5</u>	<u>1.4</u>	<u>1.8</u>	-	-	-	<u>20</u>
	-	-	1.0	3.3	-	-	-	0.35
Squids	<u>6.2</u>	<u>7.0</u>	<u>5.8</u>	<u>5.9</u>	<u>14.6</u>	<u>12.8</u>	<u>14.3</u>	<u>122</u>
	2.8	3.7	4.7	3.4	7.1	-	-	10.10
Summarized percentage of pisces	<u>10.4</u>	<u>12.0</u>	<u>15.6</u>	<u>23.0</u>	<u>27.9</u>	<u>21.3</u>	<u>57.2</u>	<u>329</u>
	4.2	11.0	14.6	14.6	28.6	-	-	16.30
Food remnants	<u>10.4</u>	<u>14.5</u>	<u>20.0</u>	<u>11.9</u>	<u>6.9</u>	<u>10.6</u>	-	<u>346</u>
	14.1	27.2	20.7	18.0	14.3	-	-	17.30
No. of stomachs with food	<u>500</u>	<u>207</u>	<u>360</u>	<u>335</u>	<u>158</u>	<u>47</u>	<u>7</u>	<u>2013</u>
	71	246	398	118	14	2	-	

Note: in numerator - in females
in denominator - in males

Food groups	I C N A F a r e a s														
	5 Z ei	5 Z e2	5 Z w	VI	VII	XI	XII	II	VII	XI	XII	I	III	IV	
Euphiasacea	1.7	4.7	22.0						5.2	50.8	6.5	31.0	72.8	21.3	24.7
Amphipoda	33.2	53.7	80.9	47.1	28.5	30.0	27.4	71.6	57.4	44.0	64.7		49.2	3.6	
Shrimps	38.4	6.6	6.5	2.4			26.4	1.1	500	4.1	1.8	38.4	13.3		
Decapoda	1.0	3.4	1.9	6.2	4.8	1.9	5.5	12.6	4.6	6.8	30.0	4.7	10.2	30.0	
Polychae		0.6	0.3	1.2	0.7			4.6				5.6	7.3	1.7	
Molluscs		6.4	4.7					2.3				5.8		7.3	
Bentic organisms		4.5		0.2	0.9	1.9				0.5	19.2	2.8		1.7	
Squids	9.3	2.3		4.8	15.7	5.7	11.3	13.5		13.2	6.5		5.3	2.3	
Pisces	18.1	20.8	1.0	38.3	28.1	61.5	27.5	15.8	26.5	26.2	7.4	7.3	27.2	7.5	32.1
T o t a l	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
%															

Table 6. Percentage of food groups occurrence in the Red Hake stomachs by months in ICNAF subareas 5 and 6 (1965 - 1967)

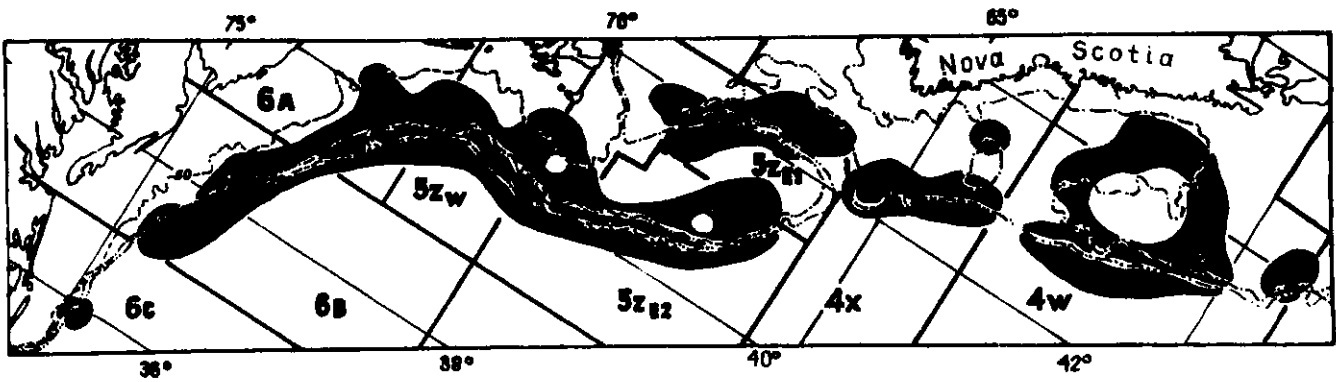


Figure 1. Sampling areas in the studies of Silver Hake feeding.

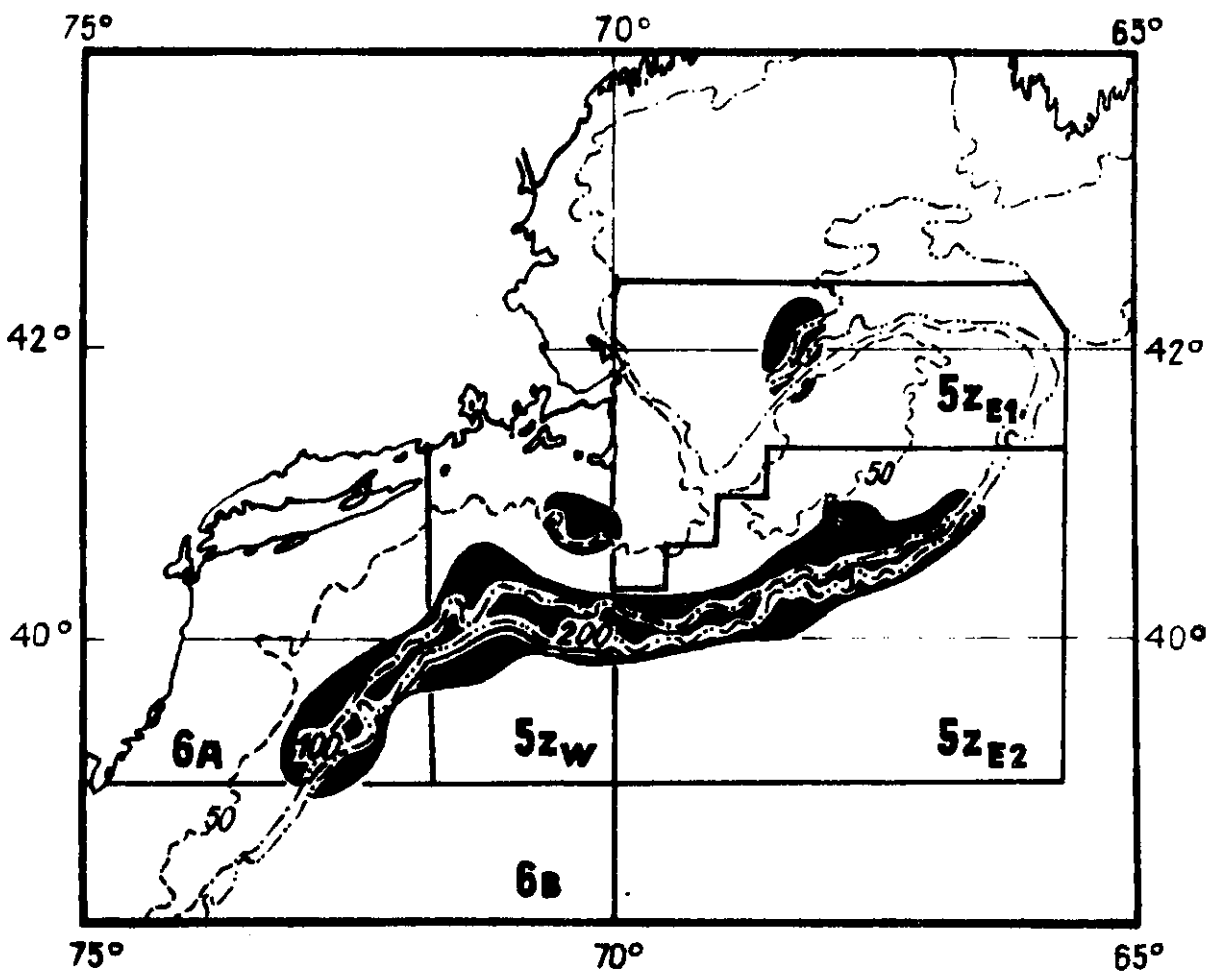


Figure 2. Sampling areas in the studies of Red Hake feeding.