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FOOD OF THE HADDOCK*
(*Melanogrammus aeglifinus* Linnaeus)

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ABSTRACT

A study of more than fifteen thousand haddock stomachs indicates that the food includes a great variety of biological groups with pisces, echinodermata, crustacea, mollusca, and chaetopoda important constituents. More than two hundred species of organisms have been identified. The type of food varies with locality, age, and season depending on availability. The organisms important in the food are present at or burrowing in the bottom. Slow moving forms predominate.

INTRODUCTION

During the past fifty years the importance of a detailed knowledge of the food and feeding habits of the economically important fishes has come to be realized. The relations of fishes to one another and to the other forms of life which serve them as food constitute an important part of their biology. In addition, a knowledge of the feeding habits of the haddock is of great importance because it is believed that they exert

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a considerable influence on the location of the haddock schools on the main feeding grounds lying off the North Atlantic coast of North America.

Since 1900 a great deal of work has been done on the food and feeding habits of the haddock. Practically all of it has been undertaken on the European side of the North Atlantic where British and Danish workers have taken the lead.

MacIntosh (1874) in his work on the marine fauna of St. Andrews, Scotland, listed a large number of species as commonly occurring in haddock stomachs. Brook (1887), Scott (1888, 1902), and Smith (1889-92) examined the contents of haddock stomachs in an attempt to identify the species present and to show the relative frequency of the various biological groups in stomachs collected from different localities. These workers listed the different food organisms and gave the total number of stomachs in which each species occurred. No record of the size, weight, volume of the stomach contents were made. Nor was any attempt made to correlate a seasonal variation in the type and quantity of food taken and stages of sexual development of the fish from which stomachs were removed, were not determined.

Todd (1905, 1907), in carrying out his investigations on the food of fishes in the North Sea, examined the stomachs and intestines of over seventeen hundred haddock captured by means of steam trawlers. The number of stomachs and intestines in which a particular organism was found to be present as food was recorded. A variation in the type of food on different fishing grounds was observed. Todd found only four empty stomachs among the large number examined by him. This was in all probability due to the fact that Todd collected only what he considered were stomachs containing food. Carr (1908) examined the stomachs of a small number of haddock taken in the Irish Sea by a steam trawler. He observed that the majority of empty stomachs was found in fish landed during the period from December to March and the author concluded that haddock eat little during the late winter months.

Poulsen (1928) examined the contents of a few hundred stomachs taken from haddock captured in the Belt Sea and in the Western Baltic Sea with a Danish seine. He weighed the contents of each stomach and identified the food organisms present. The relative importance of the different food groups was determined on a basis of percentage weights, and from this he attempted to show why haddock in the Baltic Sea area have a faster rate of growth than do haddock in the North Sea.

Idelson (1929) studied the relation between the food of the haddock and the distribution of bottom animals in the Barents Sea. The stomachs were taken from haddock caught by steam trawler. His analyses were based on the frequency of occurrence in the stomachs of the more important food groups, with no regard to size or weight. The author found that the distribution and the nutrition of the haddock corresponds quite well with the distribution of the bottom animals.

Ritchie (1932) examined the stomachs of some hundreds of haddock taken on the Faeroe trawling grounds by steam trawlers. He found that the sand-eel (*Ammodytes tobianus* Linnaeus) was the most important food of the haddock. Ritchie stated that about one hundred and eighty-eight species of organisms had been identified as being food for haddock in European waters.

On the American side of the North Atlantic study of the food of fishes has, in general, been slow to develop. Atwood (1865) examined the stomach contents of a few dozen haddock caught off the Maine coast. He prepared a list of the different species of organisms found but gave no information as to the relative importance of the different types eaten. Baird (1886) summarized the work done on the food of fishes in the United States to 1878. A list of the different organisms found in haddock stomachs is given. Willis (1890) listed a number of mollusks taken from haddock stomachs. A report was published by Kendall (1898) on the food of fishes which gives a long list of organisms found in haddock stomachs. Clapp (1912) examined the contents from the stomachs of fifteen

hundred haddock captured by a steam trawler on Georges Banks. He compared the species found in the stomachs with species obtained in dredge hauls made on the same ground at practically the same time. He found a marked degree of similarity between the species eaten by the haddock and those brought up by the dredge. This is in agreement with results obtained by Stevens (1930) in European waters.

Needler, (MS., 1928) and Vladykov (1932) examined the stomach contents of haddock captured at various points on the Atlantic coast of Nova Scotia. They determined the relative proportions of the many biological groups eaten by the haddock in this area.

MATERIAL AND METHODS

The present work is based on the examination of the stomach contents of more than fifteen thousand haddock. These fish were caught in the coastal waters of the Maritime Provinces and on the offshore Banks, lying mainly off Nova Scotia. The areas from which samples were obtained are shown in figure 1. Some of the material was collected during 1926 and 1927, but the largest portion of it was collected during the period from 1934 to 1937. Haddock samples from the coastal waters were captured by means of line trawls, hand-lines, trap-nets, and small seines. The haddock from the Banks areas were practically all caught by means of steam trawlers.

During 1926 and 1927 the contents of haddock stomachs and intestines were examined and the contents of representative stomachs and intestines were preserved in seven to eight per cent formalin for detailed examination at a later date. It was soon found that food organisms in the intestines were usually unrecognizable and so the examination of the contents of the intestines was discontinued, since it was believed that a more accurate picture could be obtained by doing so. In the case of the material collected during 1934 to 1937 the stomachs were removed from the haddock and preserved

along with their contents in six to eight per cent formalin. For examination purposes the mass of food in each stomach was sorted out into the various biological groups and the species in each group were identified as closely as possible.

The various species in each stomach were counted and representative specimens were measured. The main groups of organisms were weighed. This method gave rather complete information. Mud, sand, and gravel commonly found in haddock stomachs has been included in the miscellaneous column in the tables.

RESULTS

In Table I are given the percentage food composition for haddock caught on the offshore banks and for haddock taken in the coastal areas. It can be seen from the table that there is a distinct difference in the types of food comprising the main proportions of the diet of the haddock on the offshore banks as contrasted with the coastal areas. We will, therefore, consider the two regions separately.

TABLE I

PERCENTAGE FOOD COMPOSITION OF HADDOCK CAPTURED ON WESTERN BANKS AND IN THE COASTAL AREAS

Group	Western Banks	Coastal Areas
Pisces	53.0	3.1
Annelida	11.2	3.0
Asteroidea	0.5	0.5
Ophiuroidea	1.6	41.8
Echinoidea	7.0	0.7
Holothuroidea	0.3	1.0
Amphipoda	4.3	3.5
Isopoda	0.2	0.2
Shizopoda	0.1	0.3
Cumacea	0.1	0.2
Decapoda	4.4	1.8
Amphineura	0.1	0.5
Gasteropoda	3.1	8.1
Pelecypoda	1.0	25.0
Tunicata	1.5	1.2
Miscellaneous	10.7	9.6

FOOD OF WESTERN BANKS HADDOCK

The stomach contents of more than ten thousand haddock were examined. Pisces constitute by far the most important item in the food of the Banks haddock. Still more striking is the fact that a single species, the sand-launce (*Ammodytes americanus* De Kay), makes up the fish diet. Other species of fish, five in all, were found in only twenty instances out of more than ten thousand examinations. Fifty-three per cent, by weight, of all the food eaten by Western Banks haddock consist of the sand-launce. This fish, sometimes called the sand-eel, is a slender little fish, its body about one-tenth as deep as the total length. The sand-launce has the custom of burying itself several inches deep in the sand, into which it burrows with considerable rapidity, thanks to its sharply pointed snout. The American sand-eel, along with its European counterpart (*Ammodytes tobianus* Linneaus), plays a very important role in the economy of northern seas as food for larger animals. In addition to being eaten by haddock, the sand-launce is relentlessly pursued by all kinds of fishes. According to Kyle (1926), the sand-launce is one of the most abundant of all fishes, not even the herring yielding larger numbers of young fry to the plankton nets.

The marine annelids are the next group in order of importance. They accounted for about eleven per cent of the food taken. The commonly occurring species were *Pectinaria granulata* (Linnaeus), small worms which form tubes of sand open at both ends, which can be carried about by them; the sea-mouse (*Aphrodita aculeata* Linnaeus); the green clam worm (*Nereis virens* Sars); and *Nephthys caeca* (Fabricius), sometimes called the "White-Cat" in England. These four species comprised the bulk of the annelids eaten. Other species were eaten more rarely.

The third group in order of importance are the echinoderms. They made up approximately nine per cent of the diet. The common sanddollar (*Echinarachnius parma* Lamarck),

was the most important echinoderm from the haddock's point of view. Sea-urchins (*Strongylocentrotus drobachiensis*, O. F. Muller), were eaten in fair numbers, followed by brittle-stars (*Ophiopholus aculeata* Linnaeus), and a few *Ophiura robusta* (Ayers). Three species of asteroids and four species of holothuroids were eaten in very small numbers.

The echinoderms are closely followed by the crustaceans which occur to the extent of nine per cent of the food composition. Amphipods and decapods form about equal parts, by weight, of the crustaceans eaten by the haddock on the banks, comprising between them practically the total weight of all crustaceans found in the stomachs. The hermit-crabs (*Paguridae*) with their "houses" were the decapods most commonly eaten. Two species, *Pagarus acadianus* Benedict and *Pagarus Kroyeri* Stimpson, were found. The first named occurred in largest quantities. A third species was found on a few occasions. Other decapods commonly found were the rock crab (*Cancer irroratus* Say), the common shrimp (*Crago septemspinosus* Say), the deep-water prawns (*Pandulus propinquus* G. O. Sars and *Dichelopandulus leptoceros* Smith), the shallow water prawns *Spirontocaris pusiola* (Kroyer) and *Spirontocaris spina* (Sowerby), in the order given.

The pelagic shrimp (*Meganyctiphanes norvegica* M. Sars) which annually swarms at the surface of the Bay of Fundy in enormous numbers, was found in large numbers in the stomachs of haddock caught on Sable Island Bank in August, 1935.

The amphipods which normally occurred in the stomachs in large numbers were *Aeginia longicornis* (Krorey), *Themisto compressa* Goes *forma compressa* Goes, *Unciola irrorata* Say, *Monoculodes edwardsii* Holmes, *Tmetonx nobilis* (Stimpson), *Hyperia galba* (Montagu). *Leptocheirus pinguis* (Stimpson), *Syrrhoe crenulata* Goes, and *Ampelischa macrocephala* Lilljeborg.

The Mollusks are the least important of the main biological groups eaten by the banks haddock. Gasteropods comprise much the greater part by weight and by numbers of the

mollusks eaten. The moon shell (*Polynices heros* Montfort), and the bubble-shell (*Haminea solitaria* Dall) were the two gasteropods eaten in largest numbers. Other gasteropods eaten in large quantities were the wavy top shells (*Margarita obscura* Gould and *M. cinerea* Couthuoy), a small, white tectibranchiate (*Cyclinchna alba* Stimpson), the trumpet shell (*Sipho pygamaeus* Couthuoy), the ladder shell (*Scala groenlandica* Chemnitz), and a spindle shell (*Bela cancellata* Stimpson). Among the pelecypods eaten by the banks haddock were the so-called deep-water clam (*Yoldia myalis* Gould), the chestnut shell (*Astarte elliptica* Brown), the thin nut shell (*Nucula tenuis* Mighels), the finely-grooved leda (*Leda tenuisulcata* Couthuoy), a cockle shell (*Cardium pinnatulum* Conrad), and the bank clam (*Glycimerus siliqua* Lamarck), in order of occurrence. Three species of chitons were found in the stomach contents occasionally.

Among the organisms classed under the miscellaneous column may be mentioned the tunicata (mostly *Pelonaia corrugata* Goodsir, and *Bostrichobranchus pilularis* Verrill), coelenterata (ctenophores, anthozoans, and fish eggs (chiefly eggs of *Clupea harengus* Linnaeus). All of the above were eaten in very small quantities except the fish eggs which may be eaten in large quantities at certain times of the year.

FOOD OF HADDOCK IN THE COASTAL AREAS

The stomach contents of almost six thousand haddock were examined. In strong contrast with the diet of banks haddock, pisces are of little importance in the diet of shore haddock. The only fish found in the stomachs were the elver stage of the eel (*Anguilla rostata* Le Suer), the herring (*Clupea harengus* Linnaeus), the silverside (*Menidia notata* Mitchill) and the sand-launce (*Ammodytes americanus* De Kay), and these were found only very occasionally.

The principal food of the inshore haddock was the echinoderm, *Ophiopholus aculeata* Linnaeus. This brittle-star made up ninety-five per cent, by weight, of all echinoderms eaten

and it accounted for forty-four per cent, by weight, of all food taken by the inshore haddock. The sea-floor of the coastal area apparently swarms with brittle-stars which effect movement by means of muscular jerks of the arms, instead of by the slow protrusion and retraction of the tubefeet as is the case with the true starfish. Brittle-stars are the most active of all echinoderms. Several other species of echinoderms were eaten in small quantities: among them were the sea-cucumbers, *Thyone briareus* (Le Seur) and *Cucumaria calcigera* (Blainville).

Mollusks, the least important major food group in the diet of Banks haddock, is the second most important group in the diet of the shore haddock, amounting to thirty-four per cent of the total weight of food eaten. Echinoderms and mollusks together account for seventy-eight per cent of the food of inshore fish. A feature of the mollusk diet is that whereas the banks haddock ate more gasteropods, the inshore haddock mostly ate pelecypods. The so-called deep-water clam (*Yoldia myalis* Couthuoy), forms by far the largest portion of the molluscan diet. Also eaten in considerable numbers were the finely-grooved leda (*Leda tenuisulcata* Couthuoy), a cockle shell (*Cardium pinnatulum* Conrad), the chestnut shell (*Astarte elliptica* Brown), the thin nut shell (*Nucula tenuis* Mighels), the little macoma (*Macoma balthica* Linnaeus), and *Macoma calcarea* Gmelin, and the small file yoldia (*Yoldia sapotilla* Gould), given in order of importance as food organisms. Gasteropods usually found in the stomachs of shore haddock were the moon shell (*Polynices heros* Montfort), the wavy top shell (*Margarita obscura* Gould), the tower shells (*Turritela erosa* Couthuoy and *Turritela acicula* Stimpson), the dog whelk (*Nassa trivitta* Say), and the spindle shell (*Bela cancellata* Stimpson).

Crustaceans provided about six per cent of the diet of inshore haddock. Amphipods made up most of the weight of crustaceans eaten. The most commonly occurring species were *Leptocheirus pinguis* (Stimpson), *Hyperia galba* (Montagu), *Ampelischa macrocephala* Lilljeborg, and *Unciola irrorata*

TABLE II

REPRESENTATION OF THE MAIN GROUPS OF FOOD ORGANISMS IN PERCENTAGE, BY WEIGHT, OF HADDOCK CAPTURED AT VARIOUS PLACES ON THE WESTERN BANKS

Group	Locality															
	Emerald Bank	North of Emerald Bank	N. W. of Emerald Bank	West of Emerald Bank	Gully	N. W. Sable Island Bank	West Sable Island Bank	S. W. Sable Island Bank	North of Sable Island	South of Sable Island	Between Sable Island and Middle Ground	Middle Ground Bank	West of Middle Ground	South of Middle Ground	Banquereau	Between Banquereau and Sable Island Bank
Number of Stomachs Examined	1716	501	968	990	610	297	355	340	622	605	514	314	1160	923	668	195
Pisces	100	...	24	92	18	18	71	37	10	19	15	66	30	86	7	46
Annelida	....	20	24	...	15	4	10	15	40	23	14	2	18	2	49	14
Asteroidea	....	...	...	...	1	1	1	2	1	...	1	...	....	...	...	...
Ophiuroidea	....	20	2	8	20	6	...	...	1	2	5	6	4	...	1	4
Echinoidea	....	...	...	...	3	37	2	6	10	7	19	11	5	1	3	...
Holothuroidea	....	...	...	...	...	...	...	4	2	...	1	1	2	...	...	...
Amphipoda	....	...	5	...	16	3	6	3	6	3	10	1	2	3	8	3
Decapoda	....	...	5	...	6	15	2	4	6	15	11	4	3	1	8	6
Gasterpoda	....	21	7	...	5	2	3	12	8	11	2	1	...	...	6	7
Pelecypoda	....	14	14	...	2	1	1	5	2	8	4	1	1	1	7	10
Tunicata	....	3	...	...	6	1	...	...	1	19	5	...	....	...	...	...
Miscellaneous	....	22	19	...	8	12	4	12	13	12	13	7	36	6	11	10

Say, in the order given. Shrimps and prawns are eaten in relatively small quantities. The commonest ones found were the shrimp (*Crago septemspinosus* Say), the shallow-water prawns (*Spirontocaris pusiola* Kroyer and *Sclerocrangon boreas* Phipps). The hermit crabs (*Pagurus acadianus* Benedict and *Pagurus Kroyer* Stimpson) were found occasionally in the stomachs. The pelagic shrimp (*Meganyctiphanes norvegica* Sars) was found in large quantities in stomachs from haddock caught in Passamaquoddy Bay.

GEOGRAPHICAL VARIATION

In table II is given a representation of the chief food groups of food organisms eaten by haddock captured by steam trawlers on the various fishing grounds which make up the very large area known as the Western Banks.

Emerald Bank. The stomachs of one thousand, seven hundred and sixteen haddock were examined. The sand-launce was the only food found. Tremendous numbers of this fish were frequently found to have been eaten by the haddock. On one occasion a stomach contained forty-three specimens, ranging in length from twenty-five to one hundred millimeters, and weighing one hundred and seventy-two grams.

North of Emerald Bank. Five hundred and one stomachs were examined. The haddock had eaten a considerable variety of organisms. Mollusks (gasteropods and pelecypods) made up the biggest portion of the food, but annelids and ophiurids had been eaten in large quantities. Not a single sand-launce was found.

North-West of Emerald Bank. Stomachs from a total of nine hundred and sixty-eight haddock were examined. The sand-launce and annelids were the most important items in the food composition, comprising between them about one-half the total amount of food eaten. A variety of other biological groups made up the remainder.

West of Emerald Bank. A total of nine hundred and ninety stomachs were examined from this area. The sand-launce accounted for more than nine-tenths of the food eaten. Ophiurans constituted the remainder.

Gully. This fishing ground lies between Emerald Bank and Sable Island Bank. The stomachs were removed from six hundred and ten haddock and examined. Ophiurans, the sand-launce, amphipods, and annelids made up about seventy per cent of the food composition. The remainder of the food included representatives of a large number of biological groups.

North-west of Sable Island Bank. Stomachs from two hundred and ninety-seven haddock were examined. These haddock had been feeding chiefly on echinoids. The sand-launce and decapods (hermit crabs) formed the greater part of the remainder of the food.

West Sable Island Bank. Three hundred and fifty-five stomachs were examined. Seventy per cent of the food of the haddock in this area consisted of sand-launces. A large number of other biological groups made up the remainder.

South-west Sable Island Bank. Three hundred and forty stomachs were examined. The sand-launce, mollusks, and annelids were the chief food supply of haddock in this area.

North of Sable Island. A total of six hundred and twenty-two stomachs were examined. The haddock in this area had been feeding mainly on annelids. The sand-launce and echinoids were the next most important biological groups in the food composition. Many other groups were represented in small amounts.

South of Sable Island. The stomachs from six hundred and five haddock were examined. These haddock, as was the case with those taken on the north side of the island, had been feeding on a wide variety of organisms. Annelids, tunicates, sand-launces, mollusks, and decapods were the main groups

present in the food composition. This was the only area where tunicates formed a large portion of the food eaten.

Between Sable Island Bank and Middle Ground Bank. This is an area somewhat similar in physical features to the Gully between Emerald Bank and Sable Island Bank. The stomachs from five hundred and fourteen haddock were examined. These haddock had been feeding on a large variety of organisms, such as echinoids, sand-launces, annelids, amphipods, decapods, and many others.

Middle Ground Bank. A total of three hundred and fourteen stomachs were examined. Sand-launces comprised two-thirds of all the food present. The remainder included a large variety of organisms in relatively small quantities.

West of Middle Ground. One thousand, one hundred and sixty stomachs were examined. Sand-launces and annelids were the chief food found. Large quantities of sand were present in many stomachs.

South of Middle Ground. Nine hundred and twenty-three stomachs were examined. These haddock were feeding almost exclusively upon sand-launces.

Banquereau. Six hundred and sixty-eight stomachs were examined. Annelids formed the most important item in the diet. Other food groups were represented in small amounts.

Between Banquereau and Sable Island Bank. A gully-like area. One hundred and ninety-five stomachs were examined. Sand-launces and annelids accounted for sixty per cent of the total food present in the stomachs. The bulk of the remainder consisted of mollusks and crustaceans.

A very brief summary of the above shows that the sand-launce was by far the most important item of food to the haddock on Emerald Bank, on the extensive fishing grounds

west of Emerald Bank, on Middle Ground and south and west of Middle Ground, on the western portions or Sable Island Bank, and in the area between Sable Island Bank and Banquereau. Haddock captured on the south and north sides of Sable Island had been feeding on a wide variety or organisms, consisting mainly of annelids, gasteropods, tunicates, and echinoids. Annelids were the most important food of haddock taken on fishing grounds north-west of Emerald Bank and on Banquereau. Haddock taken on fishing grounds between Sable Island Bank and Middle Ground and on the north-west part of Sable Island Bank ("Cow-Pen") had been feeding on large quantities of echinoids. Crustaceans and ophiurans were the most important food items to haddock caught in the "Gully." North of Emerald Bank there is an area where the haddock had been feeding mainly on mollusks.

In table III is given a representation of the chief groups of food organisms eaten by haddock at various fishing localities along the coastline of the Maritime Provinces.

Passamaquoddy Bay, N. B. The stomachs of seven hundred and forty-nine haddock were examined. Mollusks accounted for seventy-one per cent of the food present. Most of the haddock had been feeding on the deep-water clam (*Yoldia myalis* Couthuoy). Sixty-one per cent of all the food eaten consisted of this clam. As an illustration of the enormous quantities eaten, one sample of seventy-two stomachs contained approximately fourteen thousand specimens of this species which ranged in length from five to twenty-seven millimetres, and weighed about one thousand, five hundred grams. Ophiurans and shizopods made up most of the remainder of the food.

Digby, N. S. Three hundred and fifty-eight stomachs from haddock caught on line trawl were examined. These haddock had been feeding mostly on crustaceans (amphipods and decapods) and to a lesser extent on pelecypods and holo-

TABLE III

REPRESENTATION OF THE MAIN GROUPS OF FOOD ORGANISMS IN PERCENTAGE, BY WEIGHT, OF HADDOCK CAPTURED ON VARIOUS FISHING GROUNDS ALONG THE COAST OF THE MARITIME PROVINCES

Group	Locality																	
	Passamaquoddy Bay, N. B.	Digby, N. S.	Yarmouth, N. S.	Lockeport, N. S.	Roseway Bank	Lunenburg, N. S.	St. Margaret Bay, N. S.	Halifax Harbour	Liscomb, N. S.	Canso, N. S.	Canso Bank	Queensport, N. S.	Petit de Grat, C. B.	Ingonish, C. B.	Port Hood, C. B.	East Point, P. E. I.	North Rustico, P. E. I.	North Point, P. E. I.
Number of Stomachs Examined	749	358	108	200	108	73	715	420	36	131	73	164	258	1508	496	236	80	200
Pisces	...	1	...	...	...	...	24	...	...	...	...	...	...	4	...	...	...	...
Annelida	1	3	...	2	...	...	1	6	3	11	6	1	1	5	27	12	13	14
Echinoidea	...	...	...	...	...	...	...	...	...	...	...	...	...	30	...	...	...	...
Ophiuroidea	14	2	92	93	99	100	67	64	85	84	86	95	80	....	9	68	75	2
Holothuroidea	...	18	4	...	1	...	1	2	...	...	...	...	...	...	...	...	...	41
Pelecypoda	61	20	4	3	...	...	1	8	...	2	4	1	2	....	15	7	9	12
Gasteropoda	10	2	...	1	...	...	1	2	1	...	...	1	...	...	19	...	1	...
Amphipoda	...	28	...	1	...	...	1	1	...	...	...	1	3	29	18	1	1	4
Shizopoda	8	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Decapoda	1	16	...	...	...	...	1	...	...	1	3	...	...	11	3	6	...	...
Tunicata	...	...	...	...	...	...	...	2	1	...	...	...	...	...	...	...	...	...
Miscellaneous	5	10	...	...	...	...	3	15	9	2	1	1	14	21	9	6	1	26

thurians. A few stomachs contained large quantities of mud and one or two small stones.

Yarmouth, N. S. One hundred and eight stomachs from haddock caught on line trawl were examined. More than ninety per cent of the food consisted of ophiurans (brittle stars).

Lockeport, N. S. Approximately two hundred stomachs from haddock caught on line trawl were examined. Brittle stars composed more than ninety per cent of the total weight of food found in the stomachs.

Roseway Bank (off Lockeport, N. S.) One hundred and eight stomachs taken from haddock caught on line trawl were examined. Practically the entire stomach contents consisted of brittle stars..

Lunenburg, N. S. Seventy-three stomachs from haddock caught on line trawl were examined. The entire stomach contents consisted of brittle stars.

St. Margaret Bay, N. S. A total of seven hundred and fifteen stomachs were examined. Five hundred and ten of these were taken from haddock caught in trap-nets and two hundred and five were caught on hook and line. Brittle stars were the most important item of food, accounting for sixty-seven per cent of the total food present. The remainder consisted of pisces (*Clupea harengus* Linnaeus), mollusks, crustaceans, and annelids.

Halifax, N. S. Four hundred and twenty stomachs taken from haddock caught on line trawl and on hook and line were examined. Brittle stars were the most important item of food, amounting to sixty-four per cent of the total. The remainder consisted of mollusks, crustaceans, annelids, and tunicates.

Liscomb, N. S. The stomachs of thirty-seven haddock caught on line trawl were examined. More than eighty per

cent of the food consisted of brittle stars. Annelids, gasteropods and tunicates were eaten in small quantities.

Canso, N. S. One hundred and thirty-one stomachs from haddock caught on line trawl were examined. Brittle stars amounted to more than eighty per cent of the food. The remainder was mostly made up of annelids.

Canso Bank. Seventy-three stomachs from haddock caught on line trawl were examined. Eighty-six per cent of the food present consisted of brittle stars. The remainder consisted largely of annelids and pelecypods.

Queensport, N. S. One hundred and sixty-four stomachs taken from haddock caught on line trawl were examined. Ninety-five per cent of the entire contents were brittle stars.

Petit de Grat, C. B. Two hundred and fifty-eight stomachs taken from haddock caught on line trawl were examined. Brittle stars accounted for eighty per cent of the food present. Mollusks and crustaceans were present in small amounts. A few stomachs were filled with gravel.

Ingonish, C. B. Stomachs taken from more than one thousand, five hundred haddock caught in trap-nets were examined. These fish might have been kept for several hours before being removed from the trap. Approximately sixty-five per cent of all stomachs examined were empty. Of the stomachs which contained food, the majority showed that the haddock had fed mostly on sand-dollars and amphipods. Quite a number were gorged with eggs (haddock eggs?). A few decapods and annelids were also found. Early in the trapping season elvers (*anguilla rostata* LeSeur) of the "glass-eel" stage were common in the stomachs.

Port Hood, C. B. Almost five hundred stomachs taken from haddock caught on handlines and line trawls were examined. Annelids were the chief food eaten (about one-third of the stomach contents by weight). There were many

sea-mice (*Aphrodita aculeata* Linnaeus) up to three inches in length. Pelecypods and gasteropods were fairly well represented. Amphipods and ophiurans were present in small quantities. Many small pieces of coal were also found.

East Point, P. E. I. Two hundred and thirty-six stomachs taken from haddock caught on handlines and line trawls were examined. Almost seventy per cent of the food present consisted of brittle stars. The remainder was largely made up of annelids. Gasteropods and amphipods occurred in small quantities.

North Rustico, P. E. I. Eighty stomachs taken from haddock caught on handlines and line trawls were examined. Ophiurans made up seventy-five per cent of the food present. Most of the remainder consisted of annelids. A few pelecypods, gasteropods, and amphipods were found.

North Point, P. E. I. Stomachs from two hundred haddock were examined. Holothurians made up forty per cent of the food. Annelids and gasteropods made up most of the remainder. A few amphipods and ophiurans were found.

SEASONAL VARIATION IN THE KIND OF FOOD TAKEN

Although samples of haddock stomachs were collected extensively over a period of twenty consecutive months from the Western Banks areas, it is hardly possible to draw other than very general observations regarding a change of food with a change of season, due to the irregular method by which the samples were gathered. This irregularity was unavoidable since the supply of material for examination was limited to what could be obtained from three trawlers. The trawlers rarely fished in the same area consecutively. Therefore, systematic collecting of samples from a restricted area over a period of time was impossible. Furthermore, such a study should be correlated with quantitive studies of the bottom fauna to yield best results.

TABLE IV

SEASONAL VARIATION OF IMPORTANT GROUPS OF FOOD ORGANISMS IN PERCENTAGES, BY WEIGHT, FOUND IN WESTERN BANKS HADDOCK BETWEEN AUGUST, 1934, AND JULY, 1935

Group	January	February	March	April	May	June	July	August	September	October	November	December
Number of Stomachs Examined	274	597	467	811	345	665	383	449	390	367	322	288
Pisces	4	...	3	20	32	13	92	49	73	57	26	7
Annelids	29	31	32	20	18	12	2	21	10	9	11	17
Echinoderms	3	12	24	8	7	31	1	7	1	12	7	9
Crustaceans	34	5	4	11	4	8	3	13	13	10	15	23
Mollusks	10	12	14	5	2	4	1	...	2	1	20	20
Fish Eggs	...	...	...	5	5	16	1	...	...	...	...	...
Miscellaneous	20	40	23	30	31	16	...	10	1	11	21	14

A study of table IV will indicate a few very general observations on the seasonal occurrence of the chief groups which make up the bulk of the organisms eaten by the Western Banks haddock. The quantity of *Ammodytes americanus* DeKay found in the stomach contents varies widely, from being completely absent to composing ninety-two per cent of the total food taken at different times of the year. In September of 1934 and of 1935 this fish amounted to fifty-seven and seventy-three per cent, respectively, of the total weight of food eaten. In October 1935, the amount was fifty-seven per cent of the food eaten. In December 1935, the amount was eighty-two per cent and in January 1936, the amount was sixty-six per cent of the food consumed.

In general, it may be said that the sand-launce is an important article of food for the haddock during the summer, fall, and early winter months. Marine annelids are a fairly steady part of the diet throughout the winter.

Fish eggs constitute a negligable portion of the food of the haddock on the Western Banks. They are found in the stomach contents during the spring and early summer months.

The echinoderms are eaten in largest quantities shortly before the haddock commence to spawn (February-March), and immediately afterwards (June and August). Echinoderms made up sixteen per cent of the total stomach contents in February, 1935, and twenty per cent in March, 1935. In February, 1936, they made up twenty-nine per cent of the food eaten. The largest amounts of echinoderms eaten during any one period was in June, 1935, when they comprised thirty-one per cent of the total weight of food found in the stomachs.

The crustaceans are eaten in largest amounts by haddock during the winter months. The greatest quantities were consumed in December, 1934, (18 per cent of the total food consumption), in January, 1935, (23 per cent), and in February, 1936, (34 per cent).

Mollusks are eaten in largest quantities during the late fall and winter months. In November and December of 1934,

and in November of 1935 they accounted for twenty per cent, sixteen per cent, and twenty per cent, respectively, of the total stomach contents. They were also eaten in considerable quantities during January, February, and March.

Generally speaking, the inshore collections of haddock stomachs were only made during the summer and fall months, coinciding with the period when the commercial inshore haddock fishery is carried on. Consequently, no concrete conclusions as to seasonal variation can be made. However, in

TABLE V

SEASONAL VARIATION OF IMPORTANT FOOD GROUPS IN PERCENTAGES, BY WEIGHT, FOR A SINGLE LOCALITY, PASSAMAQUODDY BAY, N. B.

Group	June, 1936	July	August	September	October	November	January 1937	March
Number of Stomachs Examined	72	104	81	79	91	131	123	68
Pisces	..	2	2	..	1	...	...	..
Annelids	..	...	..	..	..	25	...	..
Echinoderms	30	30	20	10	..	13	100	95
Crustaceans	..	7	68	21	2	23	...	4
Mollusks	64	61	..	61	66	26	...	..
Miscellaneous	6	....	10	8	31	13	...	1

Passamaquoddy Bay, an attempt was made, not entirely successful, to collect monthly samples of haddock stomachs. These monthly catches were all made in the same locality. These results show that haddock in Passamaquoddy Bay do appear to have a seasonal variation in their diet. Table V shows that in June and July, 1936, haddock had been feeding mainly on mollusks (all *Yoldia*) and to a much lesser extent on

echinoderms (all *Ophiopholis*). In August, the food taken was chiefly crustaceans (*Meganyctiphanes*). Great numbers of these euphausiids were swarming in the bay during this time. No *Yoldia* were found and only small numbers of *Ophiopholis*. In September, the main part of the diet was *Yoldia*. Small quantities of *Meganyctiphanes* and *Ophiopholis* were also found. In October, the haddock were feeding mainly on *Yoldia*. November samples showed that the diet consisted of mollusks (*Yoldia*), annelids, for the first time, crustaceans, and echinoderms, in the order given. In January, all stomachs with food contained only *Ophiopholis*. In March, the food was practically all *Ophiopholis*. To summarize briefly, the haddock in Passamaquoddy Bay appear to feed chiefly on *Yoldia* during the summer and fall months, with the exception of August when the staple diet is forsaken for the pelagic shrimps which swarm in the bay at that time. The diet was apparently almost exclusively restricted to brittle stars during the winter and spring months.

RELATION BETWEEN FEEDING AND SPAWNING

The very close relationship between feeding and spawning has been described in detail by one of the authors in a paper submitted for publication elsewhere. The facts advanced make it reasonably certain that haddock cease to take food just previous to spawning. These haddock continue to fast throughout the spawning period. Following the completion of spawning a short time elapses while the haddock is in the spent condition, before it regains its appetite. Once the appetite is regained, feeding is carried on very vigorously in order to regain lost strength and weight.

FOOD OF SMALL HADDOCK

Knowledge of the feeding habits of the very small haddock is practically non-existent. Investigators everywhere have been handicapped by the great difficulty experienced in obtaining small haddock. In table VI are given some data on the

type of food eaten by the smaller-sized haddock in our waters. Two very small haddock obtained near Shelburne, N. S., had their tiny stomachs filled with cumaceans. A number of small haddock caught at Hubbards, N. S., had been feeding chiefly on the glass-shrimp and to a much lesser extent on tiny mollusks. A fairly large sample of small haddock obtained

TABLE VI

REPRESENTATION OF FOOD ORGANISMS IN PERCENTAGE, BY WEIGHT, OF SMALL HADDOCK

Group	Locality					
	Shelburne	Hubbards	Georges Banks	Halifax Harbour	Halifax Harbour	Sable Island Banks
Number of Stomachs Examined	2	22	179	49	289	192
Pisces	...	...	...	...	...	1
Annelida	...	...	...	...	7	5
Echinoderms	...	...	...	...	46	18
Crustaceans	100	70	...	90	...	70
Mollusks	...	20	100	10	31	2
Miscellaneous	...	10	...	...	16	4
Size of Haddock in cms.	5-10	10-30	10-30	20-30	23-38	24-40

from George's Banks through the kindness of W. C. Herrington, United States Bureau of Fisheries, had their stomachs crammed exclusively with a shell-less gasterropod (*Aeolis papillosa* Linnaeus). A sample of small haddock taken from Halifax Harbour were feeding almost entirely on small crustaceans. A second sample of slightly larger haddock from the

same area had been feeding mainly on echinoderms, and to a lesser extent on mollusks and annelids. Samples obtained from Sable Island Banks (including some fish up to 40 cm.) were feeding on crustaceans (shrimps and crabs) and echinoderms (mostly small sanddollars).

From the above meagre data it may be suggested that the very young fish feed chiefly on small free-swimming crustaceans and nudibranch mollusks, such as cumaceans and *Aeolis papillosa* (Linnaeus). As the haddock advances in age and increases in size it turns to more sedentary forms such as brittle stars, gasteropods, pelecypods, etc.

SIZE OF FOOD ORGANISMS

The size of the food organisms is relatively small. Sand-launce up to 250 millimetres have been found in very large haddock, but these were only rarely found. The average length of sand-launces was much less. Annelids longer than 200 millimetres were never found, the majority being less than 150 millimetres. Mollusks with shells over 25 millimetres in the greatest diameter were rare and found only in very large haddock. The largest mollusks found, were a bank clam (*Glycimeris siliqua* Lamarck) meauring 56 millimetres in length and a small squid (*Illex illecebrosus* LeSeur) which was 75 millimetres in length (without tentacles). Ophiurans had a maximum diameter of 20 millimetres for the central disc. Echinoids over 25 millimetres in diameter were rare. Only a few holothurians with a length as great as 75 millimetres were found. Decapods were found with carapaces usually not more than 40 millimetres in length. These instances will serve to give some idea of the maximum sizes of the food organisms found in haddock stomachs. Exceptions occur, as for example, the presence of a herring 300 millimetres in length in the stomach of a large haddock caught in St. Margaret Bay; but such cases are rare. The small size of the food organisms is striking when compared with those of cod of similar lengths and comparable size.

POSITION OF FOOD ORGANISMS

The food of haddock indicates that they are very strictly bottom feeders. All the important food organisms are found on the bottom, most of them on the bottom only, and many buried beneath the surface of the bottom. It is evident that to obtain much of their food haddock root (grub) around in the bottom somewhat in the manner of a pig. This is borne out by the frequent presence of considerable amounts of mud, gravel, and sand in their stomachs.

MOBILITY OF FOOD ORGANISMS

The majority of the organisms found in haddock stomachs are slow-moving. This is very definite. The preponderance of echinoderms, mollusks and annelids is in keeping with this fact. The relatively fast-swimming sand-launce is caught while burrowing in the sand. Of the crustaceans, amphipods and crabs are by far the most common. Fish, other than the sand-launce are unimportant components of the food. Certain swift moving crustaceans are sometimes found in the diet in considerable quantities, but this is not a general rule.

FEEDING HABITS SHOWN BY THE FISHERY

Haddock are caught readily with a variety of baits including herring, mackerel, squid, and clams (*mya arenaria* Linnaeus). The first three are cut into pieces which are placed on the hooks; the latter are used whole, but shelled. None of these occur to any considerable extent in the natural food of the haddock. They are, however, taken readily when made available by killing and cutting into pieces on the one hand and by digging and shelling on the other.

Fishing experience confirms the opinion that haddock feed only very close to the bottom. Fishermen agree that they will not follow bait close to the surface nearly as readily as cod will during hand-lining. Relatively more haddock

are caught on line trawls than on handlines. The former are set right on the bottom, whereas handlines are often, if not generally, used in such a manner that the baited hooks are several feet from the bottom. On rare occasions haddock have been reported feeding near the surface. This is commonly reported for cod.

INDIVIDUAL VARIATIONS IN THE STOMACH CONTENTS OF HADDOCK AND POSSIBLE DISCRIMINATION AND EXERCISE OF CHOICE

At certain times and places there is a considerable amount of variotion between the stomach contents of individual haddock. The following facts, however, indicate that individual choice and discrimination on the part of the haddock is unimportant and that the variations in the food are determined chiefly by the nature of the food organisms available.

The different groups of organisms found in individual stomachs are such as would naturally occur close together in similar situations. Variations in the nature of the bottom would explain much of the individual variation in the food.

Entirely different groups of organisms are somtimes found in the stomach and in the intestine. This corroborates the suggestion that the nature of the bottom causes the variations in food, not individual choice. Instances of this kind indicate movement from one sort of bottom to another.

When stomachs are full, a large variety of organisms is usually present, or all haddock caught together have similar food. It is chiefly among stomachs containing small amounts of food that the individual variations are noticeable.

Many of the food organisms are likely to occur in considerable numbers close to one another and, supposing haddock to feed indiscriminately on all food of convenient size available, it would often happen that many organisms of one kind were taken together. This would give an erroneous appearance of selection on the part of the haddock.

The fact that herring, mackerel, squid, and clams, which do not occur in the natural food, are taken readily as bait, indicates that ease of capture is the deciding factor in these cases. A similar instance is the frequent occurrence of mackerel entrails in the food at Ingonish when these were made available, by the rotting of gilled mackerel.

THE FORM OF THE MOUTH AS A FACTOR IN DETERMINING THE NATURE OF THE FOOD

We have seen that haddock food is limited to rather small slow-moving animals found close to or burrowing in the bottom, but that within these limits a great variety of forms are eaten and feeding appears to be indiscriminate. Cod and hake taken on the same trawls eat larger and more quickly moving animals—even considering only fish of comparable size.

The nature of the mouths of these three species is significant. The mouths of hake and cod are much larger than those of haddock and practically if not absolutely terminal. They are provided with sharp teeth and all the mouth parts are strong. Haddock, on the other hand, have small mouths placed ventrally to quite a degree. Their mouth parts are soft and teeth ordinarily dull. They are, however, provided with better developed muscular lips. Cod and hake are well provided for the capture of large or fast-moving objects. But haddock with their smaller ventrally placed mouths are ill fitted for capturing moving objects or ingesting large ones and are best fitted for picking small animals off or out of the bottom, in which process the position of the mouth and the somewhat prehensive lips are useful. In addition, the heaviest built portion of the haddock is the anterior part of the body and it may be that this helps them to remain more easily in a forwardly tilted position while feeding.

LIST OF FOOD ORGANISMS

Two hundred and eighteen different food organisms have been taken from haddock stomachs examined by the authors.

A list of these is given in the Appendix, along with information as to the quantity in which each food organism occurred in the diet.

The authors are responsible for some of the identifications, particularly the mollusks and pisces. However, we are indebted to the following members of the United States National Museum: Mr. J. O. Maloney, Dr. Mary J. Rathbun, Dr. Waldo L. Schmitt, and Mr. C. R. Shoemaker, and to Dr. Aaron L. Treadwell of Vassar College, for the identification of the majority of the organisms and the checking of others.

REFERENCES

Atwood, N. E. On the Habits and Distribution of the Haddock. Proc. Bost. Soc. Nat. Hist., **X**: 322, 1864-65.

Baird, S. F. Natural Food of Fishes of Eastern North America. Sea-Fisheries of Eastern North America, Rept. U. S. Commissioner of Fisheries, 34-44, 73-80, 1886.

Brook, G. Preliminary Report on the Food of Haddock. 4th Ann. Scott. Fish. Report, 128-134, 1886.

Carr, A. M. Food of Fishes. Rept. Northumberland Sea-Fisheries Comm., 1907: 68-71, 1908.

Clapp, W. F. Collecting from Haddock on the Georges Banks. Nautilus, 25: 104-106, 1912.

Idelson, M. S. Ou the Nourishment of Food Fishes in the Barents Sea. Russ. Hydrobiol. Zeitsch., **VII**: 269-285, 1929.

Kendall, W. C. Notes on four species of the Cod Family. Rept. of the Commissioner, Comm. of Fish., Part 2, 1896: 177, 1898.

Kyle, K. M. The Biology of Fishes. New York, 396 pp., 1926.

McIntosh, W. C. On the Invertebrate Marine Fauna and Fishes of St. Andrews. Ann. Nat. Hist. Mag., 13, 14, 1874.

Poulsen, E. A. Food of the Haddock in the Belt Sea. Rept. Dan. Biol. Stat., Vol. **XXXIV**: 99-121, 1928.

Ritchie, A. The Food and Feeding Habits of the Haddock. App. C., pp. 16-19 of Bowman's report on the Effect on the Stock of the Capture of Undersized Fish. Cons. Perm. Intern. p. l'Explor. de la Mer., Rapp. et Proc.-Verb., **LXXX**, 1932.

Scott, Thomas. Notes on the Contents of the Stomachs of Herrings and Haddocks. 6th Scott. Fish. Rpt., **III**: 225-231, 1888.

Scott, Thomas. Observations on the Food of Fishes. 20th Scott. Fish. Rept., **III**: 486-538, 1902.

Smith, W. R. On the Food of Fishes.
7th Scott. Fish. Rept., **III**: 222-258, 1889.
8th Scott. Fish. Rept., **III**: 230-256, 1890.
9th Scott. Fish. Rept., **III**: 222-242, 1891.
10th Scott. Fish. Rept., **III**: 211-231, 1892.
10th Ann. Rept. Fish. Bd. for Scot., **III**: 486, 1902.

Stevens, G. A. Bottom Fauna and the Food of Fishes. Jour. Mar. Biol. Assoc., **XVI**: (3): 677-706, 1930.

Thompson, Harold. General Features in the Biology of the Haddock in Icelandic Waters in the Period 1903-16. (Containing a Section on Haddock Food by A. Ritchie, pp. 48-50.) Rapp. Cons. Explor. Mer., **57**: 1-73, 1928.

Todd, R. A. Report on the Food of Fishes Collected during 1903. Intern. Fish. Invest., Mar. Biol. Assoc., Rept. 1, 1902-03 (Cd. 2670): 227, 1905.

Todd, R. A. Second Report on the Food of Fishes (North Sea) 1904-05. Intern. Fish. Invest., Mar. Biol. Assoc. Rept. II, Part I, 1904-05 (Cd. 3837): 49, 1907.

Vladykov, V. D. Young Haddock in the Halifax area. Ann. Rept. Biol. Bd. Can., 42, 1932.

Willis, J. R. Nova Scotia Shells. Privately printed 1863. Reprinted in Proc. and Trans., N. S. Instit. Nat. Sci., **VII**: (4): 419-428, 1890.

MANUALS USED IN IDENTIFICATION OF FOOD ORGANISMS

Bigelow, H. B. and Welsh, W. W. Fishes of the Gulf of Maine. Bull. U. S. Bur. Fish., Part I, 1924: 567 pp., 1925.

Breder, C. M. Field Book of Marine Fishes of the Atlantic Coast, G. P. Putnam Sons, New York, 332 pp., 1928.

Goode, G. B. and Bean, T. H. Oceanic Ichthyology. Special Bull. U. S. Nat. Mus., 553 pp., 1895.

Gould, A. A. (W. G. Binney, Ed.) Report on the Invertebrata of Massachussetts, 2nd Edit., 524 pp., 1870.

Jordan, D. S. and Evermann, B. W. American Food and Game Fishes. New York, 572 pp., 1902.

Kindle, E. M. and Whittaker, E. J. Bathymetric Check List of the Marine Invertebrates of Eastern Canada with an Index to Whiteaves' Catalogue. Sess. Paper No. 38a, Ottawa, 1918.

Pratt, H. S. A Manual of the Common Invertebrate Animals. P. Blakiston's Son & Co., Inc. Philadelphia, 854 pp., 1935.

Shoemaker, C. R. The Amphipoda of the Cheticamp Expedition of 1917. Contr. Can. Biol. & Fish., N. S., **V**: (10): 227-357 1930.

Vladykov, V. D. and McKenzie, R. A. The Marine Fishes of Nova Scotia. Proc. N. S. Inst. Sci., **XIX**: (I): 17-113, 1935.

Whiteaves, J. F. Catalogue of the Marine Invertebrates of Eastern Canada. Geol. Sur. Canada, Ottawa, 271 pp., 1901.

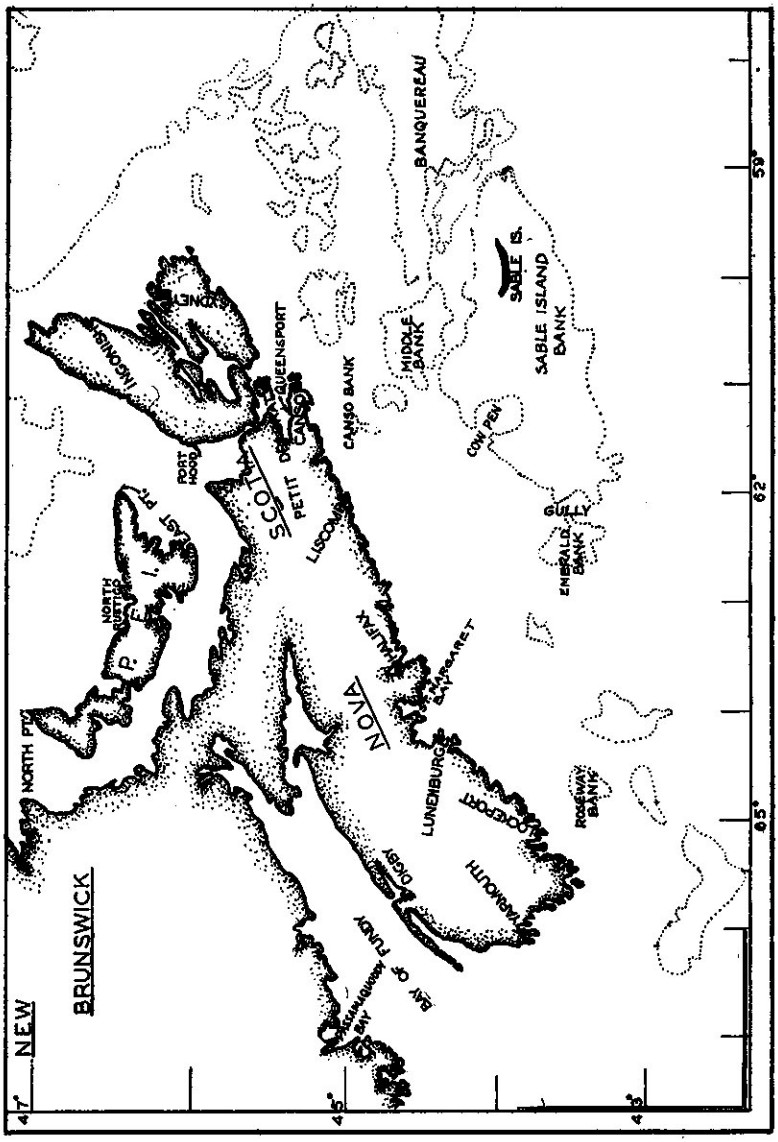

Fig. 1. Map showing banks and inshore localities from which samples of haddock stomachs were obtained.

LIST OF THE FOODS ORGANISMS TAKEN FROM HADDOCK STOMACHS AND THEIR RELATIVE OCCURENCE THEREIN

S—scarce, O—occasional, M—many, A—abundant

COELENTERATA

S Ctenophores sp. ?
O Epizoanthus americanus Verrill
S Metridium dianthus (Ellis)
S Pelagia noctulica

BRACHIOPODA

S Terebratulina septentrionali[S] Couthuoy

ANNELIDA

S Ammotrypane fimbriata Verrill
S Anaitides sp.?
S Amphitrite ornata Verrill
M Aphrodita aculeata L.
S Brada sp.?
S Echiurus sp.?
S Eunice oerstedii Stimp.
S Glycera sp.?
S Goniada maculata Oersted
S Hemipodia canadensis new sp.
S Hyalinoecia sp.?
S Leodice sp.?
S Lepidonotus squamatus L.
S Lumbrinereis hebes Verrill
S Maldane sp?
S Myxicola (probably steenstrupi)
M Nereis virens Sars
M Nephthys caeca (Fabricius)
S Onuphis sp.?
A Pectinaria granulata L.
S Pectinaria hyperborea Malmgen
S Phyllodoce catenula Verrill
S Phyllochaetopterus sp.?
S Sabellaria sp.?
S Sternaspis fossor Stimpson
S Terebellides sp.?

CRUSTACEA

AMPHIPODA

A Aeginia longicornis (Kroyer)
S Ampelisca eschrichtii Kroyer
A Ampelisca macrocephala Lillj.
O Anonyx nugax (Phipps)
S Amphithoe rubricata (Montagu)
S Apherusca megalops (Bucholz)
S Bathyporeia norvegica G. O. Sars
S Byblis affinus G. O. Sars
S Casco biglowi (Blake)
S Calliopius sp.?
S Corophium sp.?
S Dulichia sp.?
S Ericthonius hunteri Bate
S Eurystheus sp.?
S Eusirus cuspidatus Kroyer
S Haploops tubicola Lillj.
S Harpinia propinqua G. O. Sars
O Hippomedon serratus (Holmes)
A Hyperia galba (Montagu)
S Hyperia medusarum Mueller
O Hyperoche medusarum (Kroyer)
S Ischyrocerus sp.?
A Leptocheirus pinguis (Stimpson)
S Maera danae (Stimpson
O Maera loveni (Bruzeelius)
O Melita dentata (Kroyer)
S Metopa sp.?

S Monoculodes borealis (Boeck)
A Monoculodes edwardsii Holmes
S Monoculodes latimanus (Goes)
S Monoculodes tesselatus Schneider
S Monoculodes tuberculatis (Boeck)
O Neohela monstrosa (Boeck)
S Neopleustes pulchella (Kroyer)
S Orchomenella minuta (Kroyer)
S Orchomenella pinguis (Boeck)
S Paramphithoe hystix (J. C. Ross)
S Pardalischa cuspidata Kroyer
S Paroediceros lynceus (M. Sars)
S Phoxocephalus holbolli (Kroyer)
S Pontoparcia femorata (Kroyer)
S Pleustes panoplus (Kroyer)
S Priscillina armata (Boeck)
S Protemedia sp.?
S Rhachotropis aculeata (Lepechin)
S Rhachotropis oculata (Hansen)
S Stegocephalis inflatus (Kroyer)
S Stenopleustes glaber (Boeck)
M Syrroe crenulata Goes
A Themisto compressa Goes
forma compressa Goes
S Tiron acanthurus Lillj.
A Tmetonyx nobilis (Stimpson)
A Unciola irrorata Say
S Westwoodilla brevicalcar (Goes)
S Westwoodilla caecula (Bate)
S Westwoodilla megalops (G. O. Sars)

CUMACE

S Diastylis rathkii (Kroyer)
M Diastylis quadrispina (G. O. Sars)

SHIZOPODA

S Erythrops erythrophthalma (Goes)
M Meganyctiphanes norvegica M. Sars
S Thysanoessa inermis (Kroyer)

ISOPODA

S Aega psora (L.)
S Calathura branchiata (Stimpson)
O Chiridotea tuftsii (Stimpson)
S Cirolana polita (Stimpson)
O Edotea montosa (Stimpson)
S Phryxus abdominalis (Kroyer)

DECAPODA

S Axius serratus (Stimpson)
A Cancer irroratus Say
M Crago septemspinosus Say
O Dichelopandulus leptocerus (Smith)
S Homarus americanus (Milne-Edwards)
O Hyas coarctatus Leach
S Lithodes maia (L.)
S Megalops sp.?
S Nectocrangon dentatus (M. Sars)
M Pagurus acadianus Benedict
O Pagurus Kroyeri Stimpson
S Pagurus pubescens Kroyer
M Pandulus propinquus G. O. Sars
S Pandulus montagui Leach
S Planes minutus (L.)
S Pontophilus norvegicus (M. Sars)
S Sabinea septemcarinata (Sabine)
S Scleroerangon boreas (Phipps)
S Spirontocaris fabricii (Kroyer)
S Spirontocaris gaimardii (Milne-Edwards)

S Spirontocaris groenlandica (Fabricius)
S Spirontocaris polaris Sabine
A Spirontocaris pusiola (Kroyer)
O Spirontocaris spina (Sowerby)

PANTOPODA

S Nymphon grossipes (Fabricius)

MOLLUSCA

AMPHINEURA

S Hanleyia mendicaria Mighels
S Tonicella marmorea (Fabricius)
S Trachydermon albus (L.)

GASTEROPODA

S Admete couthuoyi Jay
O Aeolis papillosa (L.)
S Bela bicarinata Stimpson
M Bela cancellata Stimpson
S Bela incisula Verrill
S Bela turricola Stimpson
O Buccinum undatum (L.)
S Crucibulum striatum Stimpson
M Cyclichna alba Stimpson
S Eupleura caudata Verrill
S Fasciolaria ligata Mighels
S Fusus ventricosus Gray
A Haminea solitaria Dall
S Lacuna vincta Turton
S Lamellaria perspicua (Stimpson)
S Lepeta caeca (Mueller)
S Littorina rudis (Donovan)
A Margarita cinerea Gould
S Margarita groenlandica (G. O. Sars)
S Margarita obscura Gould
S Margarita olivacea (Brown)
S Nassa obsoleta Say
O Nassa trivitta Say
A Polynices heros Say
S Puncturella princeps Mighels
M Scalaria groenlandica Chemn.
S Scaphander punctostriatus (Mighels)
M Sipho pygmaeus (Gould)
S Trichotropis borealis (Couthuoy)
S Turritella acicula Stimpson
S Turritella erosa Stimpson
S Velutina laevitgata (L.)

PELECYPODA

O Anomia aculeata Gmelin
O Astarte banksii (Leach)
M Astarte elliptica Brown
O Astarte subquilatera Sowerby
S Cardita borealis Conrad
S Cardita Novangliae Morse
O Cardium pinnatulum Conrad
S Ensis directus Conrad
M Glycimerus siliqua Lamarck
S Leda minuta Moller
M Leda tenuisulcata Couthuoy
M Macoma calcarea Gmelin
S Macoma fusca Gould
S Mactra procera (Solander)
S Modiola plicatula Lamarck
S Modiolaria nigra Gray
S odiolus modiolus L.
A Nucula proxima (Say)
A Nucula tenuis (Mighels)
M Nucula delphinodonta Mighels and Adams
Pecten islandicus Mull.
S Saxicava artica (L.)
S Saxicava rugosa (L.)
S Siliqua costata Say
S Siliqua squama (Blainville)
S Solecurtis gibbis (Blainville)
S Thyasira trisinuata Verrill
A Yoldia myalis (Couthuoy)
S Yoldia limatula Say
M Yoldia sapotilla Gould

SCAPHODA

S Dentalium entale (L.)

CEPHALOPODA

S Illex illecebrosus (Leseur)

ECHINODERMATA

ASTEROIDEA

S Asterias tenera Stimpson
S Asterias vulgaris Verrill
S Ctenodiscus crispatus (Retzius)

OPHIUROIDEA

A Ophiopholis aculeata (Linnaeus)
O Ophiura robusta (Ayers)
S Ophiura sarsii (Lutken)
S Stegophiura nodusa (Lutken)

ECHINOIDEA

A Echinarachnius parma (Lamarck)
O Strongylocentrotus drobachiensis (O. F. Muller)

HOLOTHUROIDEA

S Cucumaria calcigera (Blainville)
S Molpadia oolitica (Verrill)
S Psolus phantapsus (Strussenfeldt)
S Thyone briareus (Leseur)
S Thyone unisemita

TUNICATA

THALIACEA

S Salpa (Iasis) zonaria Pallas)

ASCIDIACEA

S Boltenia ovifera (L.)
S Bostrichobranchus pilularis (Verrill)
S Pelonaia corrugata Goodsir and Forbes

PISCES

A Ammodytes americanus DeKay
S Anguilla rostrata (LeSeur)
S Argentina silus (Ascanius)
S Clupea harengus (Mitchill)
S Hippoglossoides platessoides (Fabricius)
S Mallotus villosus (Muller)
S Menidia notata (L.)
S Merluccius bilineatus (Mitchill)
S Sebastes marinus (L.)
S Triglops pingeli (Fabricius)