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FOOD OF THE HAKE ON THE ATLANTIC COAST

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ABSTRACT

A study of the food of young and adult hake from various localities on the Canadian Atlantic Coast extending over a period of years, shows that this fish apparently accepts the most abundant small Crustacean food (Euphausiacea, Amphipoda, Decapoda, etc.) available in the locality. In some regions, hake tend to be more piscivorous preying upon smaller fish of other species. Molluscan food aside from squid appears to be definitely shunned.

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INTRODUCTION

Food is one of the dominant factors which influence to a large degree the distribution and abundance of fish in their particular habitats. The study of the food of the common hake (Urophycis chuss, Walbaum (U. tenuis (?) Mitchill)) of the north Atlantic coast was undertaken as part of an investigation into the life history of this fish. Qualitative and quantititive examinations were made of the food of the both large and small hake for a number of representative localities from Prince Edward Island on the north to the mouth of the Bay of Fundy. The purpose of this paper is to present the data collected on the types of oceanic organisms which serve as food for the hake and to compare the diet of young and adult fish. Having once determined the nature of the food, further investigation into any correlation existing between the habits of the hake and the food supply can more readily be undertaken by a study of the life history of those organisms which serve as prey.

The food of the hake has been referred to by a number of investigators all of whom agree that crustacea generally comprise the major portion of the diet but there is sometimes a tendency to be piscivorous and occasionally squid are taken in large numbers. Perley (1851) stated that fishing for Phycis americanus in the Bay of Fundy and the Gulf of St. Lawrence was carried on mainly at night when the hake feed heavily on small crustacea. Goode (1884) found the same to be true off the New England coast and recorded that occasionally they indulge in a fish diet. One specimen taken at Gloucester in July 1878 had a menhaden in its stomach. Kendall (1898) examined Phycis tenuis (Mitchill) and Phycis chuss (Walbaum) from two to three inches long at Eastport, Maine, and found their food to consist principally of small crustaceans such as amphipods and copepods. Adults, however, seemed to feed universally on thysanopodas (Thysanopoda inermis (?)) and prawns (Pandalus annulicornis).

Linton (1899) records that the stomachs of several specimens of Phycis tenuis taken off the New England coast were empty and the intestine of some alcoholic specimens contained a whitish chyle which became chalky when dry and contained a large proportion of carbonate of lime. In the alimentary canal of a specimen of Phycis chuss taken in 30 fathoms off Gay Head, August 5, 1899, he found shrimps and amphipods. Smaller crustaceans and the lenses of small fish were present in four young hake from Katama Bay (August 30, 1899). Herrick (1904) studied U. tenuis at Woods Hole and found the stomach contents showed that the normal food is largely crustacean particularly shrimp. He observed these fish feeding in experimental tanks at Woods Hole and states: "---the hake receives both tactile and gustatory stimuli by means of the free fin rays and to some extent doubtless by other parts of the outer body surface. What role may be played by the sense of smell remains obscure!' These fish have keen sight but only recognize food when in motion by sight since they seem to depend chiefly on the sense of touch possessed by the ventral feelers.

Breder (1922) found Phycis chuss crammed full of large prawns in Sandy Hook Bay in 1920. Bigelow and Welch (1924) state that, "Less is known of the diet of the hakes than of cod, haddock or pollock. However, it is certain that they are not shell eaters to any extent, for it is seldom that their stomachs contain even the smaller univalves or bivalves, and so far as we know no one has ever found large mollusks, echinoderms, nor any of the large hard-shelled crustaceans (e.g. rock crabs or lobsters), in a hake. The stomach contents so far recorded show that prawns (Pandalus), shrimps, amphipods and other small crustacea which they find on the bottom are their chief dependence at most times and localities. They also feed greedily on squid as do others of the cod tribe, while a variety of small fish have been found in hake stomachs at Woods Hole, among them alewives, butterfish, cunners, eels, herring, flatfish, tautog, mackerel, manhaden, launce, silversides, silver hake, sculpins, sea robins, smelt and tomcod-----. In the northeastern part of the Gulf, hake feed far enough off bottom to capture the pelagic euphausiid shrimps (Meganyctiphanes and Thysanoessa) so plentiful there, while the general character of their diet is sufficient evidence that they do not root in the ground like haddock."

Hildebrand and Schroeder (1927) examined Urophycis chuss in Chesapeake Bay and found the food in eight stomachs consisted wholly of crustaceans, principally shrimp. Off Sandy Hook, N.J., they have been observed gorged with sand lance (Ammodytes) in some cases the tails extending into their mouths because their stomachs could hold no more.

Breder (1929) sums up the data of previous investigators as follows: Phycis tenuis, "Feeds largely over muddy bottoms on small shrimp, squid and fish;" Phycis chuss, "Feeds largely on shrimps, other small crustaceans and fish."

MATERIALS AND METHOD

The specimens for which stomach analyses are recorded in this paper were collected along the Atlantic coast on a number of different expeditions over a period of years from 1919 to 1932. Figure 1 shows the locations of the stations from which hake were examined. Dots refer to fish up to 20 cm. in length, circles to fish from 21 to 40 cm. and crosses those longer than 40 cm., measuring from the tip of the snout to the extremity of the tail.

Small fish up to 40 cm. in length were taken by seine, gill net or shrimp trawl, larger fish by line trawl or hand line. Many of the latter contain no food because the stomach apparently evacuates rapidly when the line is hauled, the reduced pressure causing an expansion of the air bladder and ejection of the food. Not infrequently the bait alone remains in the stomach which may indicate that they were without food when captured. Fish taken by seine, gill net or shrimp trawl seldom have an empty stomach. The teeth of the hake seem to be specialized for seizing prey but not for macerating it since food is invariably swallowed whole.

When convenient, stomach contents were examined while fresh. Otherwise the stomach or the whole fish if small was preserved in toto in five percent. formalin for future examination. The various constituents of the food were generally examined by means of a low power binocular and the analyses are based on the total constituents of the stomach.

RESULTS

The results of the stomach analyses have been summarized in Tables I, II, III, IV and V. These show for each locality the following:

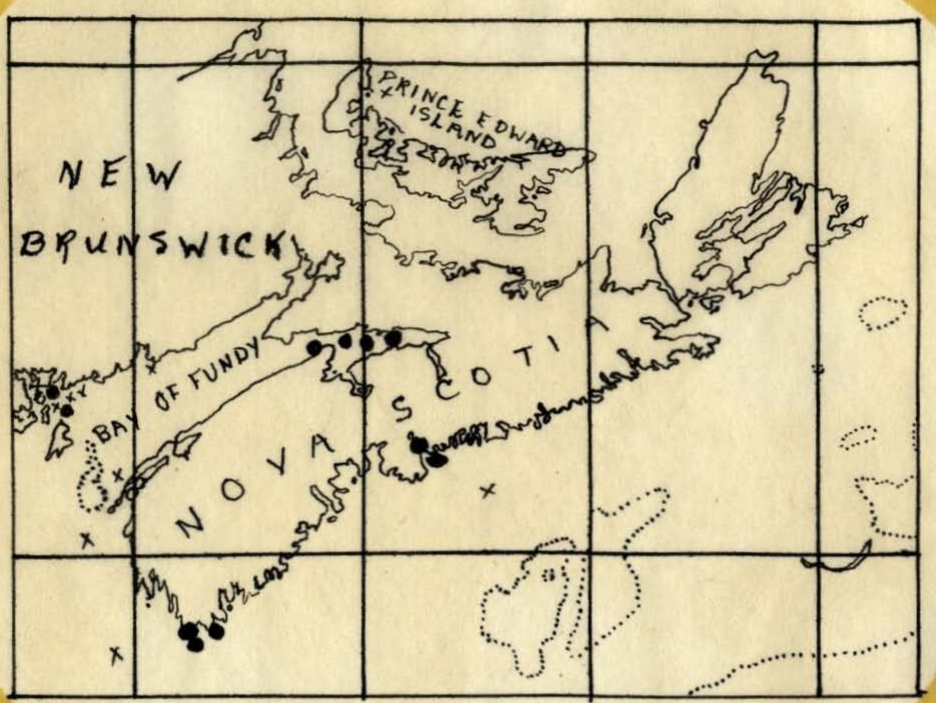

Figure 1 Map of the Atlantic Coast showing the locations from which hake stomach contents were analyzed. Dots refer to collections of fish up to 20 cm. in length; circles to fish from 21 to 40 cm. and crosses to those longer than 40 cm. measuring from the tip of the snout to the extremity of the tail.

(a) occurrence - the number of fish in which each species of food organism occurs.

(b) average percent. - the average percentage by weight which each food organism constitutes of the food of all fish included in the group.

(c) maximum percent. - the greatest percentage which each species of food organism constitutes in the stomach contents of any one fish in the group.

Typical food organisms were weighed after permitting excess surface moisture to evaporate from the specimens for about ten minutes at room temperature. From these weights the average and maximum percentages which each organism represents were calculated. Such values must be considered as approximations only. x indicates that the organism represents less than one percent. of the total stomach contents.

Cursory examinations of the stomach contents of adult hake at North Head, Grand Manan, and Digby in 1931 indicated that euphausiids, prawns, squid and bony fish including herring, mackerel, sculpins, tomcod, etc. formed a large part of the diet. They exhibit great greediness at times as indicated by the presence of a chicken's foot in the stomach of one specimen at Beaver Harbour, and coal in another at Wilson's Beach.

Dr. Needler made the gill net collections off Bird Cove, Malpeque Bay, P.E.I. In material which he examined himself he found, Menidia (10 to 15 cm.), the most important food constituent, followed in descending order by Crago and Gasterosteus. He also found off Port Hood, C.B. 1926 (?) that the food included Pandalus and fish.

In the Strait of Belle Isle expedition of 1923, hake were taken in seines at Old Ferolle Harbour on August 30th and Brig Bay on September 1st. Analyses of the stomach contents is as follows:

		Old Ferolle Harbour	Brig Bay
No. specimens		1	4
Length in cm.	Maximum	-	107
	Minimum	-	85
	Average	95	96
Food:	Crustacean remains	+	+
	Gammarus	+	+ (?)
	Palaeomonetes	+	-
	Alga (Nemalion?)	-	+

+ indicates presence of a food organism

The food of the hake is largely crustacean and teleostean but we have two records of molluscs aside from Loligo pealei: (a) Biological Station, St. Andrews, August 17, 1932, line trawl, length 35 cm., food: 1 Yoldia sapotilla 12 mm.; 1 Aphrodita 40 mm.; 1 Crango vulgaris 30 mm. (b) Prince Station 135, St. Marys Bay, September 4, 1919, shrimp trawl (1) length 12.2 cm., food: 1-3 mm. Mytilus, 2 Caprella, 1 Gammarus (2) length 12.8 cm., 1 Littorea sp. 2 Diastylis, 3 Caprella, 1 Gammarus, Fishermen state that the bruised nose condition so frequently found among cod and haddock is entirely lacking in hake because they do not seek molluscs as food. Echinoderms seem to be shunned also although there is a single record of an arm of a small specimen of Asterias in the stomach of a hake brought in at Wilsons Beach, Campobello, in July 1932. Aphrodita is the only annelid recorded as a food organism and has been found in the Bay of Fundy and off the south-east coast of Nova Scotia.

Table VI is a compilation of data given in tables I to V to show the relative abundance of crustacea, squid and teleosts in the diet of the hake. Crustacea everywhere forms the greatest percentage of food except in Prince Edward Island. The larger proportion of teleosts in the food of these specimens can probably be explained by the prevalence of many small fish such as Menidia in the coastal waters along with the hake.

SUMMARY

1. Food of young and adult hake on the Atlantic Coast consists mainly of crustacea, teleosts and squid. Exceptional records include algae, hydroids, medusae, echinoderms, annelids, univalve and bivalve mollusca, insects, ova and foreign matter such as coal and sand.

2. Crustacea form the greatest percentage of the food. Young hake choose any abundant small forms such as Amphipoda, Isopoda, Cumacea; adult fish prefer Euphausiacea and Decapoda.

3. Small fish of other species, Clupea, Scomber, Menidia, Microgadus, etc., as well as squid (Loligo) are sometimes important food items.

4. Off the south-east coast of Nova Scotia and Prince Edward Island, hake seem to be more piscivorous than in the Fundy area.

5. At the mouth of the Bay of Fundy the abundance of adult hake would seem to be related in some degree with the unusual quantities of Euphausiacea to be found there. A study of such oceanic crustacean forms as these might aid materially in solving problems in regard to movements and life history of the hake.

I wish to acknowledge my indebtedness to the Biological Board of Canada for providing facilities to carry on this investigation, to Dr. A. G. Huntsman for invaluable advice, and to my co-workers and the staff of the Atlantic Biological Station for assistance during the conduct of the work.

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TABLE I

Analyses of stomach contents of forty-six hake from the head of the Bay of Fundy

	Stn. 195 and 196 Minas Basin Sept. 8-9, 1920 shrimp trawl			Stn. 122 Scotts Bay Sept. 10, 1920 shrimp trawl			Cobequid Bay Aug. 9,13,21,29, 1921 seine in weir			Stn. 195 Minas Basin Aug. 8, 1925 shrimp trawl		
of Capture												
of specimen	3			34			7			2		
length cm.	17.6			15.7			14.5			14.8		
length cm.	10.8			8.7			7.2			10.5		
length cm.	14.3			11.2			9.3			12.7		
empty stomachs	0			0			0			1		
Food Organisms	a Occurrence	b Average Percent	c Maximum Percent	a Occurrence	b Average Percent	c Maximum Percent	a Occurrence	b Average Percent	c Maximum Percent	a Occurrence	b Average Percent	c Maximum Percent
erate medusa (?)	-	-	-	-	-	-	-	-	-	fragment	50	-
locusta	1	9	20	6	58	100	3	12	60	-	-	-
e maculata	-	-	-	-	-	-	1	1	10	-	-	-
enolepis (?)	1	7	40	2	x	20	-	-	-	-	-	-
a quadrispinosa	-	-	-	4	2	100	1	1	25	-	-	-
vulgaris	2	10	50	7	21	100	6	50	100	-	-	-
a sp.	-	-	-	-	-	-	-	-	-	setae only	50	-
fied crustacean remains	2	37	50	23	20	100	3	17	40	-	-	-
an remains	2 - 50 mm.	37	80	-	-	-	40 mm.*	19	50	-	-	-
fied ova	4 (1 mm.)	-	-	-	-	-	7 (1-1.5 mm.)	x	x	15 (1 mm.)	x	-
matter	-	-	-	-	-	-	sand	-	20	-	-	-

* decomposed

TABLE V

Analyses of stomach contents of twenty-nine hake from Prince Edward Island.

Locality	Alberton			Bird Island (Malpeque)		
Date	August 6 (?) 1932			October 10 - 29, 1932		
Method of Capture	line trawl			gill net		
Number specimen	13			16		
Maximum length cm.	76			32.5		
Minimum length cm.	60			26.0		
Average length cm.	66			29.1		
No. empty stomachs	6			2		
Food Organisms	Occurrence	Average Percent	Maximum Percent	Occurrence	Average Percent	Maximum Percent
Crangon vulgaris	2	27	100	11	19	100
Cancer borealis	0	-	-	1	7	70
Menidia menidia	0	-	-	8	52	100
Clupea harengus	1	55	100	0	-	-
Ostrea spat. (5 mm.)	0	-	-	1	x	x
Unidentified crustacean remains	4	18	100	4	22	100
Unidentified teleostean vertebrae	1	x	x	0	-	-

TABLE VI

Percentages by weight of food organisms of the hake

Locality	No. examined	Lengths (cm.) Min.	Max.	Crustacea	Loligo sp.	Teleosts
Bay of Fundy - head	44	7.2	17.6	81	-	19
- mouth (west shore)	41	6.4	86	87	5	8
- mouth (east shore)	218	7.5	100	53	-	46
South-east coast Nova Scotia	63	6.1	73	78	-	20
Prince Edward Island	29	26	76	47	-	53