Northwest Atlantic Fisheries Organization

Serial No. N217

NAFO SCR Doc. 80/IX/143

ANNUAL MEETING OF SCIENTIFIC COUNCIL - SEPTEMBER 1980

Distribution and Relative Abundance of Juvenile Redfish (*Sebastes* sp.) on the Flemish Cap 1978-80 Based on Information from Cod Stomachs

by

G. R. Lilly
Department of Fisheries and Oceans, Research and Resource Services
Northwest Atlantic Fisheries Center, P. O. Box 5667
St. John's, Newfoundland, Canada

ABSTRACT

The number of juvenile redfish less than 10 cm in length recovered from cod stomachs on the Flemish Cap was low in 1978, relatively very high in 1979, and low in 1980. Juvenile redfish appeared to be most abundant at 200-300 m.

INTRODUCTION

As part of the Flemish Cap Project, cod stomachs are being examined to determine the kinds and quantity of food consumed by the cod, and to determine if cannibalism is a factor contributing to variability in year-class strength. No juvenile cod have been found in the detailed stomach examinations in 1978-80. However, juvenile redfish have occurred frequently (Lilly 1979). Since little information is available on the early juvenile stages of redfish on the Flemish Cap, the data from cod stomachs are presented as indications of the distribution of juvenile redfish and the success of recent year-classes. The present discussion is limited to individuals less than 10 cm in length.

MATERIALS AND METHODS

Stomachs were examined from cod caught by otter trawl on the Flemish Cap during research cruises of the Gadus Atlantica during winter-spring of 1978-80 (Table 1). The stomach examinations were in conjunction with other sampling which included measurement of fish length. Two methods of examination were used: a gross examination of fresh stomachs at sea and a detailed examination in the laboratory of stomachs preserved in 10% formalin.

The gross examination at sea consisted of noting what appeared to be the major food item in terms of mass, and estimating the degree of fullness of the stomach on a scale from zero (empty) to 9 (9/10 or full).

The detailed examination in the laboratory involved separating food items into taxonomic categories. Fish prey were counted and measured to the nearest mm whenever digestion was not too far advanced.

Analysis of distribution of juvenile redfish on the Flemish Cap is limited to depth at which the cod were caught and location on the bank with respect to four regions defined by latitude 47°N and longitude 45°W. Note that these regions are not of equal area, the southern ones being much smaller than the northern.

RESULTS

DISTRIBUTION

The collection of cod stomachs for laboratory examination was geographically extensive only in January-Febraury of 1978 and 1980 (Trips 5 and 30; Table 1). Since the number of sets were relatively high and the number of juvenile redfish was low, information is provided only for those sets yielding juveniles. In 1978 most juvenile redfish were recovered from the NW region (Table 2). The depth range was 216-391 m. In 1980 the distribution was more even, the majority coming from the NE (Table 3). Three individuals were taken from near the shallowest part of the bank at 128 m, but all others came from 208-332 m.

In 1979 the number of sets from which stomachs were collected was small, so the data from all sets that year can be presented in detail (Table 4). Since cod must be almost 30 cm in length to ingest redfish juveniles 6 cm in length (Lilly 1979, and Fig. 2), the percentage of cod greater than 30 cm with juvenile redfish in their stomachs may be an indication of the availability of this prey. This information complements the data on total number of juveniles recovered. Juvenile redfish were most abundant in 244-277 m on Trip 17, in 230-333 m on Trip 19, and 169-252 m on Trip 20. No conclusions on geographic distribution are possible since most collections were in the NW region on Trip 17 and in the SW region on Trips 19 and 20.

In summary, the depth distribution was wide, varying from 128 m to 391 m, but the majority appeared to be in 200-300 m. More extensive sampling in 1979 might have been rewarding.

RELATIVE ABUNDANCE

As shown in Table 1-4, far more juvenile redfish were recovered during detailed examination in 1979 than in 1978 and 1980. However, data from the three January-February trips are not comparable since few stomachs were collected in 1979. An indication of relative abundance was therefore obtained from the examinations at sea, which were extensive in all three years (Table 1).

The percentage of cod in which redfish occurred as primary prey was 6% in 1978, 32% in 1979, and just 2% in 1980 (Table 5). However, these data encompass predation on all sizes of redfish, and comparison should be restricted to those sizes of cod preying on redfish under 10 cm. Redfish length-frequencies from surveys by the Gadus Atlantica were distinctly bimodal, the length range of the smaller mode being 17-24 cm in 1978 and 21-28 cm in 1980 (Gavaris 1980). A cod would have to be at least 60 cm to prey on these individuals (Lilly 1979). Since there appear to be relatively very few redfish between 10 cm and the smaller mode seen in research surveys (Lilly 1979), the majority of redfish consumed by cod under 60 cm must be juveniles under 10 cm. The occurrence of redfish as major prey in cod under 60 cm was low in 1978, very high in 1979, and very low in 1980 (Fig. 1).

CONSUMPTION OF REDFISH

An estimate of the rate of consumption of juvenile redfish by cod in 1979 was not attempted because of inadequate sampling coverage, both spatially and seasonally, and because of uncertainties regarding the gastric evacuation rate in cod at temperatures experienced on the Flemish Cap. However, the number of juvenile redfish in cod stomachs was high, the maximum recorded being 65 in a cod 80 cm in length (Fig. 2).

The numbers shown in Fig. 2 could be somewhat midleading, since the

redfish were often in various stages of digestion. In calculating a feeding rate one could not assume that the cod emptied their stomachs before taking more food.

DISCUSSION

The stomach contents of carnivorous fish can provide useful indications of the distribution and rough estimates of the abundance of a prey species, but such information can be biased by distribution, abundance, size and feeding habits of the predator (Saville 1977). Since cod appear to overlap the distribution of juvenile redfish on the Flemish Cap, and the redfish appear to be a major and possibly preferred prey of cod (Lilly 1979), routine annual examinations of cod stomachs may give fairly accurate information on the relative success of redfish year-classes as 1- and 2-yr-olds. The sampling must include measurement of redfish prey. Some lengths of juvenile redfish from cod stomachs are available for the 1978-80 sampling, and will be presented later.

A major concern in using cod stomachs as a sampling tool is that the juvenile redfish may often be far from the bottom and thus inaccessible to the cod. Accessibility might vary regionally and temporally, possibly in response to differences in physical parameters such as temperature. More knowledge of the behaviour of both the juvenile redfish and the cod are required before this method can be considered reliable.

It remains unknown whether the apparent decline in numbers of juvenile redfish from 1979 to 1980 was due primarily to predation by cod and possibly other predators, including adult redfish (Kashintsev 1962), or due to other factors including inadequate food supply and physical environmental effects (Akenhead 1978, Anon. 1980). It is clear, however, that monitoring of early juvenile stages is essential if factors contributing to year-class strength of redfish are to be elucidated.

ACKNOWLEDGEMENT

I wish to thank Conrad Mullins for drafting the figures.

REFERENCES

Akenhead, S. A. 1978. Report of the Canadian planning group of the Flemish Cap International Experiment meeting, St. John's, Newfoundland, 12-14 September 1977. ICNAF Res. Doc. 78/VI/80, Ser. No. 5267.

Anon, 1980. Report of ad hoc working group on the Flemish Cap Project, January 1980. NAFO SCR Doc. 80/VI/9, Ser. No. N109.

Gavaris, C. A. 1980. An update of the Flemish Cap redfish assessment. NAFO SCR Doc. 80/VI/88, Ser. No. N142.

Kashintsev, M. L. 1962. Some notes on rosefish feeding in the Newfoundland area. In: Soviet Fisheries Investigations in the Northwest Atlantic, VINRO-PINRO, Moscow. (Israel Program for Scientific Translation, 1963).

Lilly, G. R. 1979. Observations on the food of cod (Gadus morhua L.) on the Flemish Cap in winter. INCAF Res. Doc. 79/VI/70, Ser. No. 5412.

Saville, A. [ed.]. 1977. Survey methods of appraising fishery resources. FAO Fisheries Technical Paper No. 171.

Table 1. Details of cod stomach examinations and collections on the Flemish Cap during research cruises of the Gadus Atlantica, 1978-1980.

Trip	Date	Sets	Stomachs examined at sea	Stomachs examined in lab.	Juvenile[1] redfish
5	1-2/78	134	1398	403	42
17	1-2/79	95	858	95	250
19	3/79	6		154	367
20	4-5/79	4		206	956
30	1/80	130	650	457	19
35	4/80	9		72	3
37	5/80	8		136	1

[1]Number of juvenile redfish recovered during examination of preserved stomachs in the laboratory.

Table 2. Number and distribution of juvenile redfish recovered from cod stomachs collected on the Flemish Cap in January-February 1978 (Gadus Atlantica 5) (J.R. = juvenile redfish).

Region	Set	Depth(m)	Cod with J.R.	J.R.
NE	109	265	1	1
Total			1	1
SE	17	221	1	1
	10	305	3	3
Total			4	4
SW	63	221	1	1
	25	232	1	1
	40	287	1	1
Total			3	3
NW	103	216	1	2
	79	243	2	7
	78	262	1	1
	69	263	2	4
	77	294	1	1
	56	305	3	4
	75	391	3	15
Total			13	34

Table 3. Number and distribution of juvenile redfish recovered from cod stomachs collected on the Flemish Cap in January 1980 (Gadus Atlantica 30) (J.R. = juvenile redfish).

Region	Set	Depth(m)	Cod with J.R.	J.R.
NE	117	208	2	5
	90	242	1	1
	114	295	1	2
	131	332	1	1
Total			5	9
SE	16	128	1	1
	17	128	1	2
	3	264	1	1
Total			3	4
SW	40	222	1	1
	48	286	1	1
	46	318	1	1
Total			3	3
NW	37	222	1	1
	78	318	1	2
			2	3

Table 4. Details of cod stomach collections in 1979, showing for each set the number of cod longer than 29 cm, the percentage (P.C.) of these with juvenile redfish (J.R.) in their stomachs, and the number of juvenile redfish recovered.

Set	Depth	Region	Cod > 29 cm		
			No.	P.C. with J.R.	J.R.
January-February (Trip 17)					
75	132	SE	1	0	0
77	155	NE	1	0	0
56	244	NW	24	35	37
64	248	SW	3	100	45
55	260	NW	14	57	25
60	264	NW	5	100	70
54	277	NW	18	39	72
91	292	NE	3	33	1
100	306	NE	1	0	0
62	332	NW	3	0	0
101	368	NW	3	0	0
82	383	SE	1	0	0
68	480	SW	1	0	0
March (Trip 19)					
88	160	NE	25	4	1
91	200	NE	15	27	9
100	230	SW	6	83	26
99	270	SW	29	76	299
84	333	SW	26	38	31
75	495	SW	19	0	0
April-May (Trip 20)					
64	167	NE	22	18	10
63	169	SW	27	56	53
141	250	SW	63	90	610
142	252	SW	51	84	269

Table 5. The food of cod on the Flemish Cap in January-February 1978-1980, expressed as percentage occurrence as the dominant food item. Stomachs were examined at sea.

	Occurrence (%)		
	1978	1979	1980
Amphipods	15.8	1.4	17.4
Shrimp	6.9	10.3	7.5
Invertebrates (misc.)	4.5	2.0	11.4
Redfish	5.5	32.3	2.0
Cod	0.2	0.0	0.3
Myctophidae	0.1	4.8	4.0
Fish (misc.)	0.7	0.2	0.5
Fish (unidentified)	17.4	13.5	9.9
Unidentified material	8.5	4.3	16.0
Miscellaneous	0.2	0.1	0.2
Empty	40.1	31.1	30.9
Average fullness	2.76	3.83	2.77
No. of stomachs	1398	858	650

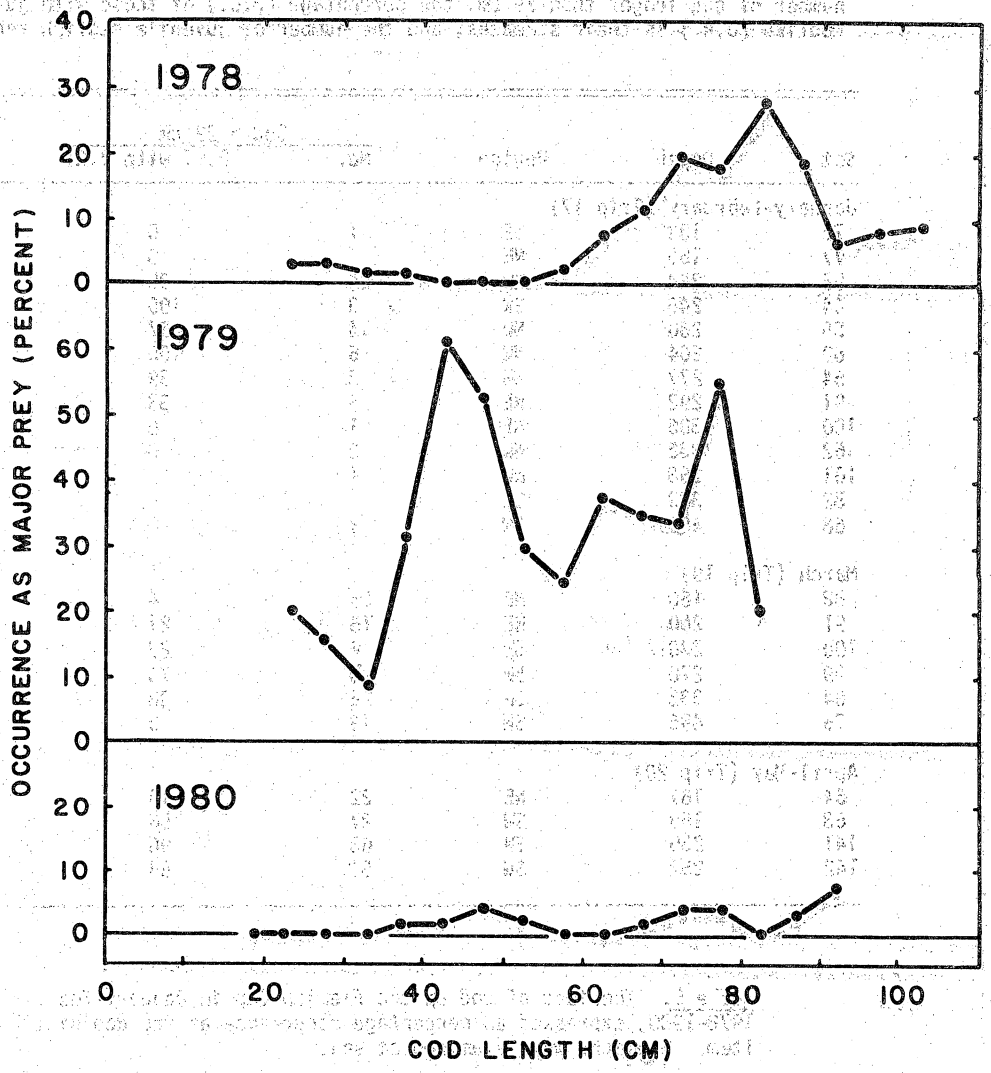

Fig. 1. Relationship between length of cod and percentage occurrence of redfish as major prey in stomachs examined at sea in January-February 1978-1980. Data for any size-classes with fewer than 10 cod were not plotted.

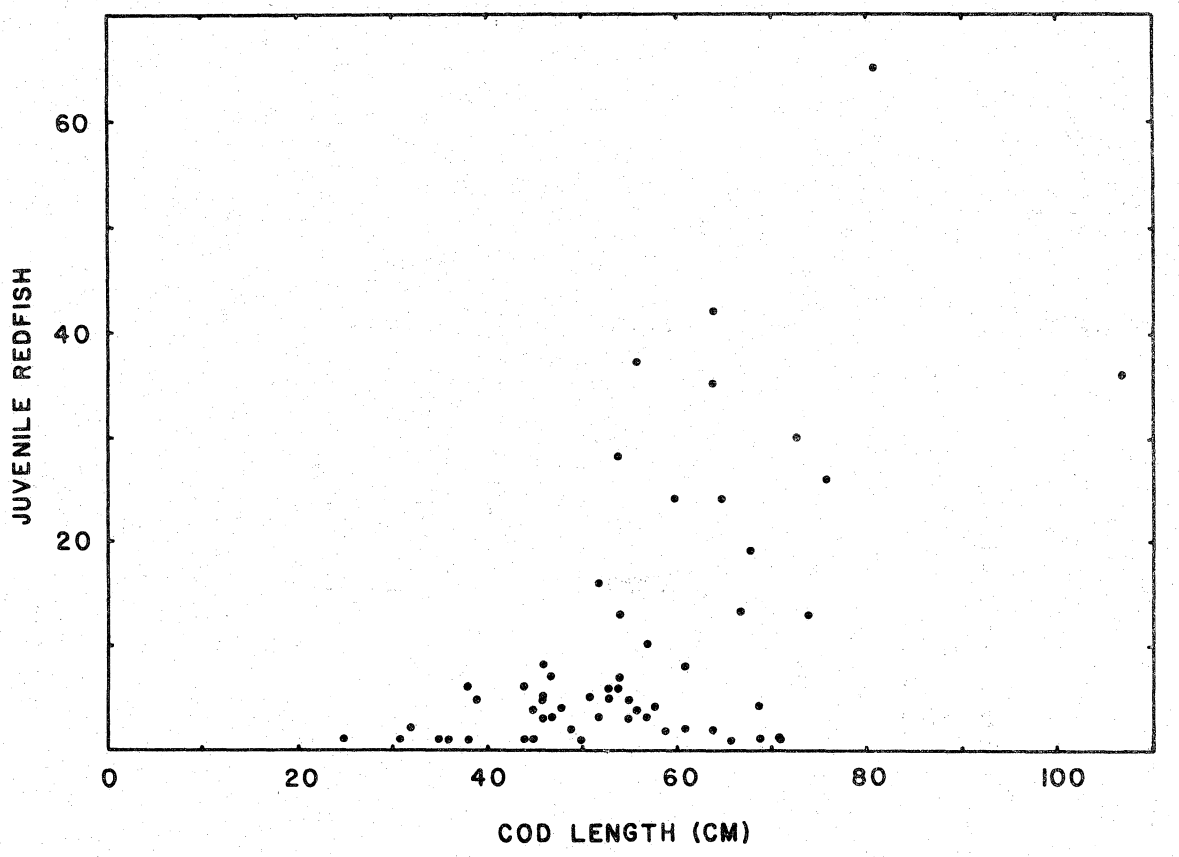

Fig. 2. Relationship between length of cod and number of juvenile redfish recovered from stomachs. Data are combined from Gadus Atlantica Trip 17 (Sets 54, 55, 56, 60, 64) and Trip 19 (Sets 99, 100). Zero values are not plotted.