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Some Aspects of the Biology of Cod from the Newfoundland Fishing Grounds in 1964

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The data studied in this paper were collected on board the Spanish commercial trawler "Virazon", which belongs to the PYSBE Company, during the last week of June, July and August, 1964, and mainly in ICNAF Divisions 3L and 3N; some data from Division 3K are also available. Figure 1 shows the location of areas investigated.

Length frequencies

The largest samples were obtained in Division 3L, where 4863 codfish were measured. Length distribution is practically identical through June, July and August, though in the latter it varies slightly. Length group 57-59 cm is the most abundant in June and July, and the groups 51-53 and 54-56 cm in August with the group 57-59 almost as abundant (Fig. 2).

Figure 3 shows the length distributions for cod from Divisions 3K and 3N. The number sampled (155 specimens) in Division 3K was not large enough to be able to draw any reliable conclusions. The "Virazon" spent only one day in the Division and fishing was very poor.

It is worth noting that cod bigger than 100 cm were found fairly often in Division 3L. The largest specimen measured 118 cm.

Age frequencies

Division 3K. Age-group 8 (year-class 1956) seems to be the most important of this population, but again the small number of fish aged (25) does not permit accurate conclusions.

Division 3N. A total of 180 fish were aged, and the results show age-group 5 (year-class 1959) to be the largest in the stock. The 1960 year-class (age-group 4) is also an important part of the exploited population.

Division 3L. Otoliths of 514 cod were aged for study purposes. The fish aged 5 and 6 years (year-classes 1959 and 1958) constitute about one half of the stock. Fish of the age-group 7 (year-class 1957) are also a significant part of this stock. Spanish research carried out in this Division in 1962 (FIGUERAS, 1963; CENDRERO, 1963) showed year-classes 1958 and 1957 as the most abundant, especially the former. According to present results, the 1957 year-class can be considered to be a very strong one, for it still holds an important part of the stock after having been fished for two years. The same assumption can apply to the year-class 1958, that is now the most abundant and was the second most important in 1962 according to our own observations (loc. cit.) and the third according to FIGUERAS (loc. cit.).

The results are shown in Fig. 4.

Total length/girth relationship

The relationship between total length of fish and the girth taken at the level of the first ray of the first dorsal fin has been studied.

The regression lines for Divisions 3L and 3N are given in Fig. 5 and 6. Both lines fit the equation: $y = a + bx$.

In Division 3L the equation has been calculated from 200 specimens, and it has the following values:

$$y = 0,506401x + 0,968762$$

The equation calculated for Division 3N fits the straight line:

$$y = 0,560234x + 0,28329$$

whose values were obtained from 179 cod.

The correlation coefficients are:

Division 3L .... $r = 0,97$
Division 3N .... $r = 0,95$

The strong positive correlations make it possible to think that both equations are right; therefore the differences found must be due to local variations in the biological characteristics of the stocks.

Sex ratio and maturity stages

Females were more abundant than males both in Divisions 3L and 3N, though the difference is not great. There are slight variations in the percentage of females from one month to the other. Table 1 shows that in Division 3L, in July, females are 63% of the sample, and in August this figure drops to 48%. The opposite is true for Division 3N, where females are more abundant in July (57%) than in August (43%).

Sexual maturity has been studied according to five established stages: 1) virgin, 2) resting, 3) developing, 4) spawning and 5) post-spawning. Table 1 shows that a big majority of the specimens examined were in the first two stages and that only in August were males seen developing in a significant number. Cod in spawning or post-spawning stages were either scarce of absent (Division 3N, August) from the samples.

Spawning marks were looked for in the otoliths studied, as an indication of age of first maturity with little success. However, the few spawning marks found indicated that no fish under the age of 6 years should be expected to have ever spawned.

Feeding

Stomach contents were examined and the frequency of full stomachs recorded. Stomach contents of the small cod were mainly small copepods and amphipods and of the large cod were many kinds of food items, including the guts and heads of cod split on board our and other fishing vessels. Sometimes the stomachs of both large and small cod were full of sand-eels (Ammodytes americanus) or caplin (Mallotus villosus).

Table 2 shows the frequency with which stomachs were found with the various amounts of food: 1) stomach empty, 2) 1/3 or less full, 3) 1/3 to 2/3 full, and 4) totally full. Most stomachs examined varied from empty to one-third full.

Temperature and fishing

This item was studied mainly in Division 3N in July. In addition to the temperature of water, the condition of the sky and whether it was daylight or not was recorded, on the assumption that cloudy or foggy weather or the lack of daylight could help the catch of fish because of the optical conditions of water.

Again we have not found a clear relationship between the temperature of water and the amount of fish caught. From the results given in Table 3, it can be concluded that the small variations in temperature are not enough to define the so-called cod temperature. In fact, temperatures recorded were normally between 4.5°C and 4.9°C. Only in a few cases were temperatures below that range. Although it seems that temperatures between 4° and 5°C could be the best for cod, the scarcity of data does not allow to reach definite conclusions.

Conclusions

1) Length-groups 51-53, 54-56 and 57-59 cm are the most abundant in Division 3L, and 45-47 cm (July) and 39-41 cm (August) in Division 3N.

2) Year-classes 1959, 1958 and 1957 (fish which are 5, 6 and 7 years old) form the main part of the stock fished in Division 3L; in Division 4N, fish of age-groups 4 and 5 (year-classes 1960 and 1959) make up more than a half of the total number sampled.

3) A high correlation has been found between total length and girth of cod. The correlation coefficient is $r = 0,97$ in Division 3L and $r = 0,95$ in Division 3N. The regression line fits the equation: $y = a + bx$.

4) The majority of codfish studied had no sign of sexual maturity.

5) Cod feed on everything they found. The majority of specimens sampled had their stomachs empty or less than 1/3 full.

6) No cod temperature can be defined, although good catches were made in waters from 4,5 to 4,9°C.

Acknowledgements

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Table 1. Cod. Sexual maturity, Div. 3L and 3N, July-August, 1964

	Total no. cod sampled	No. of females sampled	Percentage of females in maturity stages				
			virgin	resting	developing	spawning	post-spawning
3L							
Jul	137	86(63%)	19	76	-	3	2
Aug	353	169(48%)	18	80	1	1	1
3N							
Jul	126	72(57%)	56	43	-	-	1
Aug	53	23(43%)	65	35	-	-	-

Table 2. Cod. Stomach contents. Div. 3L and 3N, July and August 1964.

	Division 3L				Division 3N			
	July		August		July		August	
	No.	%	No.	%	No.	%	No.	%
Empty	54	39,7	135	38,2	14	11,1	41	77,3
1/3 or less	43	31,6	169	47,9	46	36,5	11	20,7
1/3 to 2/3	22	16,1	39	11,0	48	38,1	1	2,0
More than 2/3	17	12,6	10	2,8	18	14,3	—	
	136	99,9	353	99,9	126	100,0	53	100,0

Table 3. Cod. Temperature and fishing (catch in kg of round fresh cod per hour).
Div. 3L and 3N, July, 1964.

Division	Date	Time	Depth (m)	Temp. °C	Catch Kg/h
3L	July 7	9. 00-14. 40	250-270	2,5	978
3L	July 10	8. 10-12:30	233-252	1,0	2252
3L	July 13	8. 15-15. 05	210-224	2,0	1203
3L	" "	15. 50-22. 15	220	0,7	1701
3L	July 15	6. 55-15. 55	212-220	2,2	1135
3N	July 18	17. 50-22. 50	52-58	4,6	3903
3N	July 19	19. 15-20. 45	50-55	4,6	6414
3N	July 20	7. 10-13. 15	" "	4,6	5517
3N	July 21	3. 40-6. 50	51-57	4,9	2329
3N	July 22	7. 50-11. 45	48-55	4,7	12769
3N	July 23	19. 00-0. 25	50-54	4,7	4001
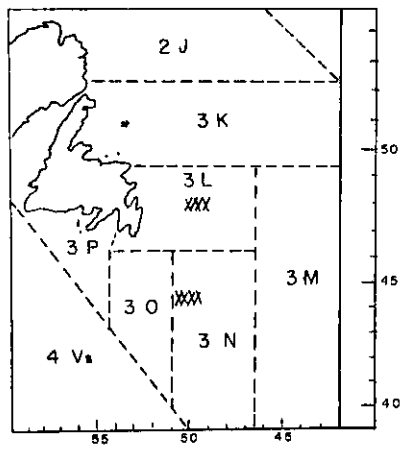
Fig. 1.—Areas of cod investigated during the summer of 1964

AUG.

n = 2800   mean = 55·97 cm.

JUNE n = 363   mean = 51·7 cm.

JULY n = 1300   mean = 55·28 cm.

Length in cm.
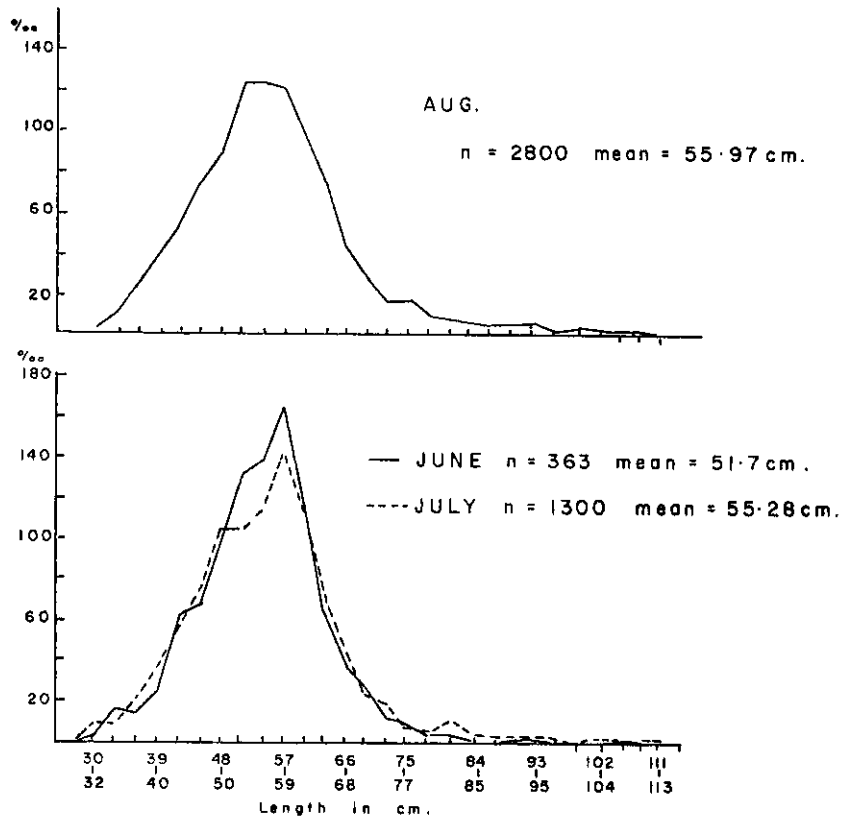
Fig. 2.— Length distribution of cod from division 3L.

3 K

n = 155   mean = 57·09 cm.

3 N

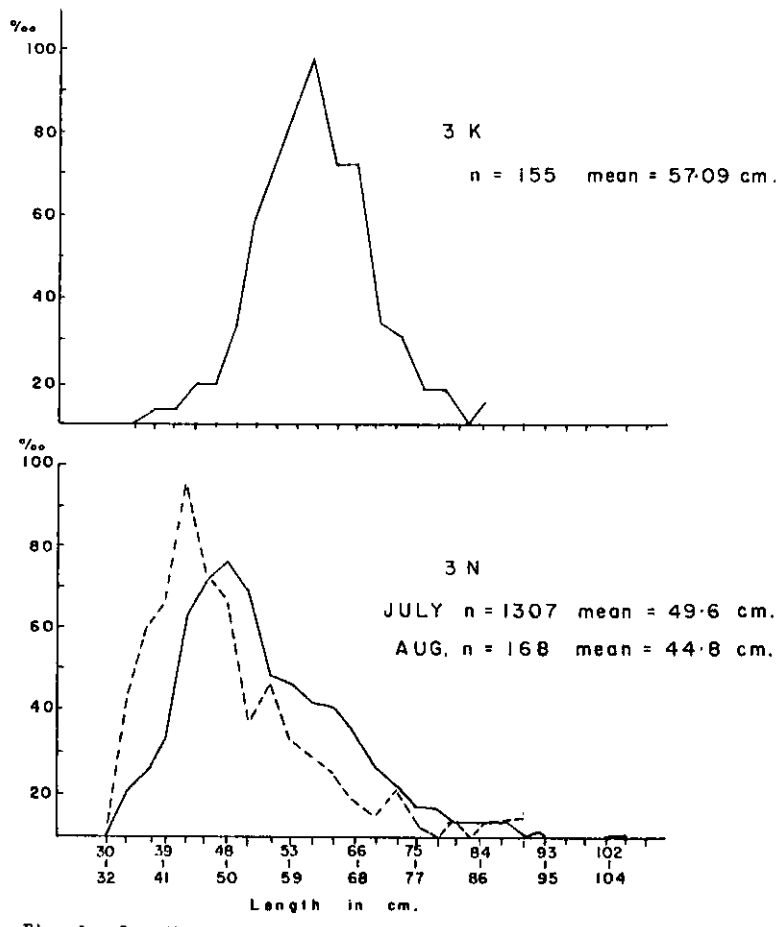JULY n = 1307 mean = 49·6 cm.

AUG. n = 168 mean = 44·8 cm.

Length in cm.

Fig. 3.— Length distributions of cod from divisions 3K and 3N.
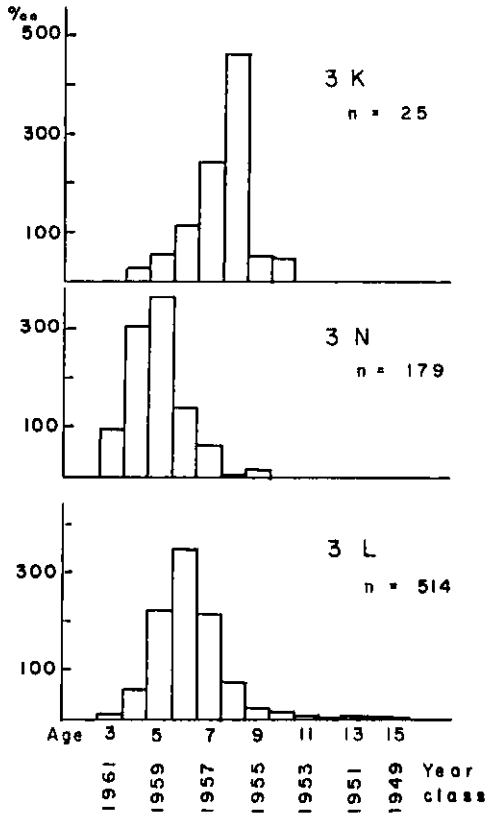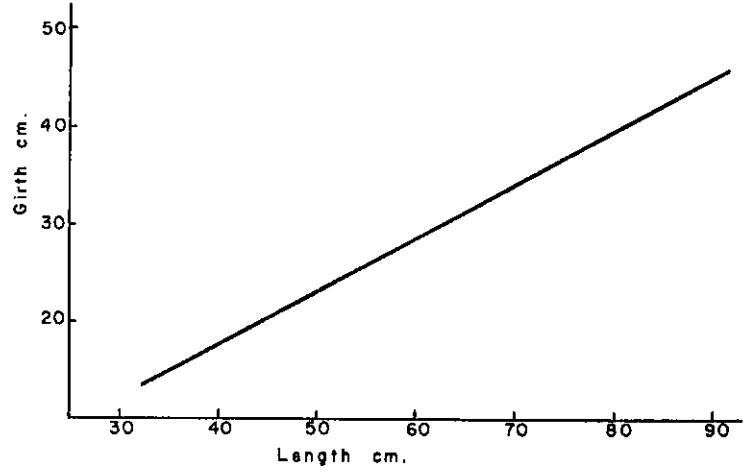
Fig. 4.- Age compositions of cod.
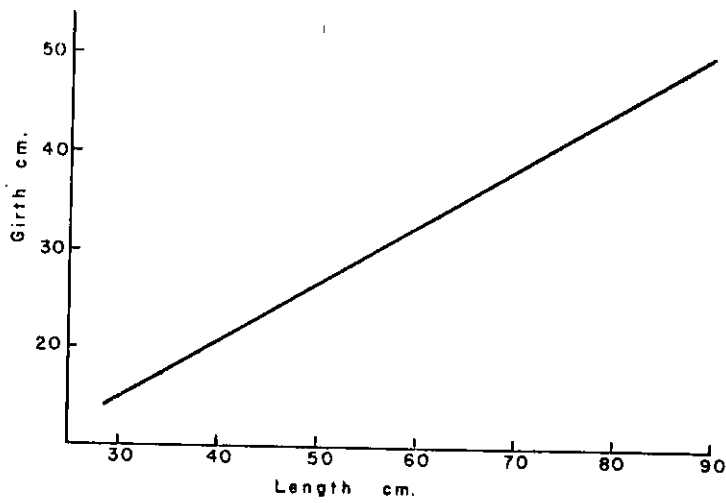

Fig. 5.- Length/girth correlation of cod, divisi⋅

Fig. 6.- Length/girth correlation of cod, division 3N.