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An investigation of the squid Loligo forbesi Steenstrup on Faroe Bank.

by

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Abstract

In October - November 1986 and in March 1987, the squid *Loligo forbesi* Steenstrup was caught by bottom trawl on Faroe Bank. The dorsal mantle length of the females was 5 - 29 cm and of the males 5 - 48 cm. Based on counts of the statolith growth rings, the growth rates of both sexes were calculated to 2 mm/day in 10 - 40 cm DML. Therefore the differences in mantle length between the two sexes, were not because of difference in growth rates, but because some of the males caught by the bottom trawl were older than the females. Development of the gonads started, when the squids reached a dorsal mantle lenght of 12 - 14 cm, corresponding to an age of about 5 months. The main spawning period is found to be in April - May, although a spawning in somewhat smaller scale seems to continue all through the year. Investigations on stomach filling and digestion showed that the squids eat during the day.

Introduction

The Faroe Bank is southwest of the Faroe Islands, on about 61°N and 8°30´ W. It is about 150 m deep, although the shallowest part is less than 100 m. Towards the east it is separated from the Faroe Plateau by a narrow (20 km) and deep (850 m) channel (Fig. 1).

The tidal current on the Bank causes an effective mixing of the water, and the temperatures therefore are very similar down through the water, with temperatures from around 7.5°C in March to around 11°C in September. It has been shown, that there is a closed circulation system on the Faroe bank, which probably keeps the watermasses fairly well isolated from the surrounding water (Hansen *et al., 1986*). It has also been indicated both by phytoplankton observations (Paulsen, 1909) and by fish research (Taaning, 1943; Jones, 1966; Jamieson and Jones, 1967) that the plants and animals on the Faroe Bank do not mix with those on the Faroe Plateau, but are kept more or less isolated on the Bank.

The squid *Loligo forbesi* Steenstrup is common as by-catch by the trawlers on the Faroe Bank with the highest catches in the autumn and early winter and the lowest in March (Howard, 1979).

This paper describes some investigations on squids, caught by bottom trawl on the Faroe Bank in November-December 1986 and in March 1987.

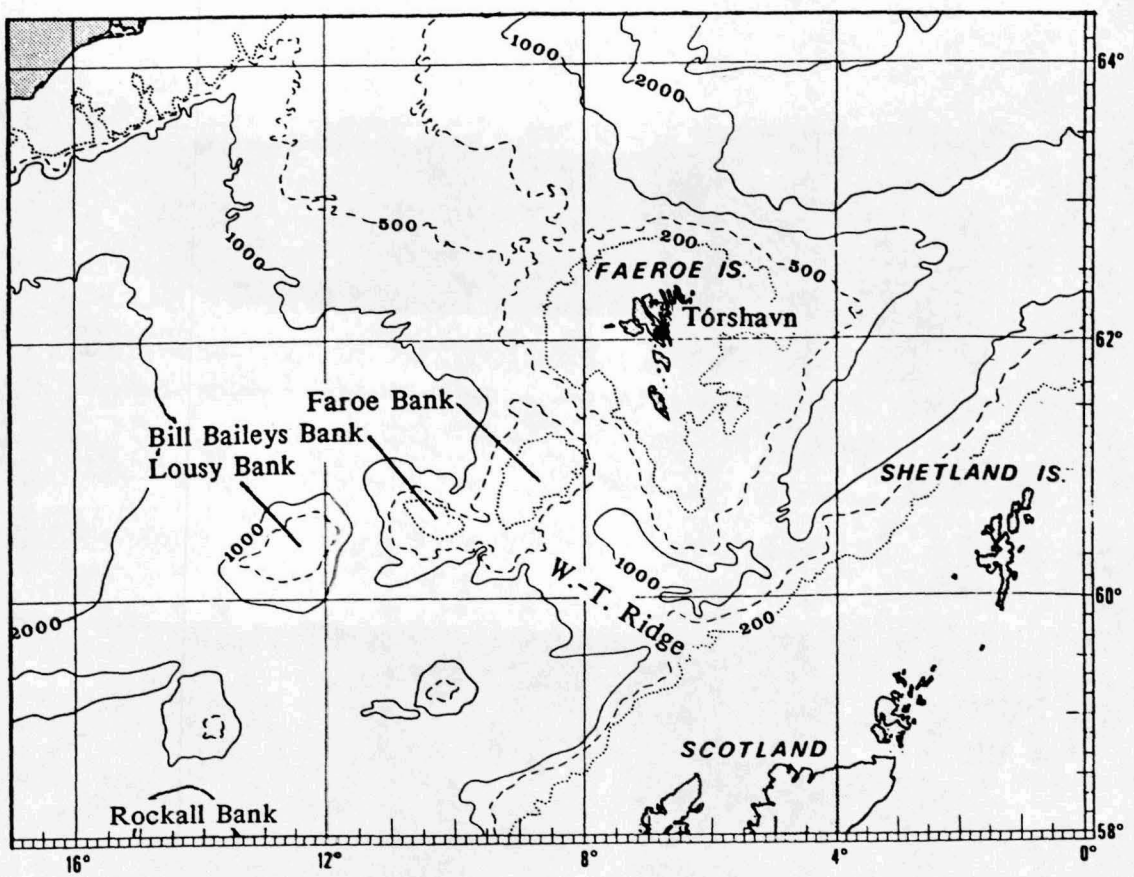

Fig. 1. The Faroe Bank and surrounding area.

Materials and methods.

The squids were caught by a 116 feet bottom trawl, having a mesh size of 40 mm in the codend. The cruices were made 17/10 - 11/11 1986 and 10/3 and 29/3 1987.

The dorsal mantle length (DML) was measured to the nearest millimeter and the weight to the nearest gram. The gonads were removed and the weigth was measured to the nearest 0.1 gram. The statoliths were removed and kept in 96% ethanol and the growth rings were counted by Inger Marie Beck, Institute of Marine Research, Bergen, Norway according to the method of Rosenberg *et al.* (1981).

The stomach filling was determined according to the following scale:

0 = Empty stomach
1 = Up to $^1/_4$ filled
2 = From $^1/_4$ to $^1/_2$ filled
3 = From $^1/_2$ to full, but not distended
4 = Distended stomach

The food digestion was determined according to the following scale:

0 = Empty stomach
1 = Not digested
2 = A little digested
3 = Half digested. Remnant of flesh on bones or shells
4 = Well digested. Many clear structures of bones or shells
5 = Very much digested. Only few structures of bones or shells

Results and discussion

Length and sex

The length distributions of the two sexes are shown on figure 2. In November - December 1986 the females had a peak at 14 - 20 cm DML, while the males had two groups present, one having a peak at 12 - 16 cm DML and one at 30 - 34 cm DML. In March 1987 the females had two groups, one having a peak at 12 - 14 cm and one at 20 - 24 cm DML while the males had one peak at 14 - 20 cm and one at 30 - 38 cm.

In both cases therefore we had different length distributions for males and females, where the largest males reached a length of 48 cm DML, while the females only reached a maximum length of 29 cm.

These differences in the length distributions between the two sexes are equal to what Howard (1979) found on squids, caught by Scottish trawlers on Faroe Bank. It is also similar to what Holme (1974) found in the English Channel and Howard (1979) around the Scottish coast.

More males than females were caught. In October-November 1986, 54% of the investigated squids were males and 46% females, while in March 1987 65% were males and 35% females.

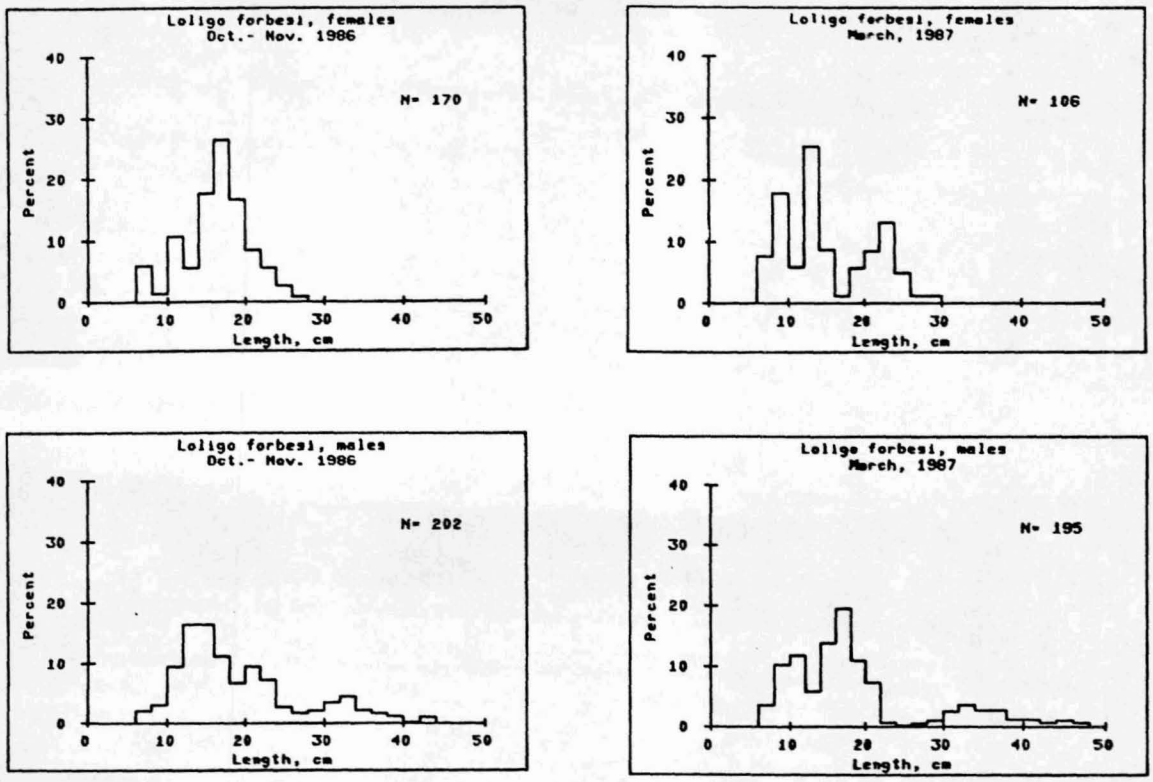

Fig. 2. Length distributions from Loligo forbesi caught on Faroe Bank in October-November 1986 and in March 1987.

Growth

The differences in the length distributions, shown in fig. 2 may lead to the thought, that the males grow faster than the females. However, the statolith growth rings do not support this, as shown in fig. 3. Providing that these rings really represent the age of the

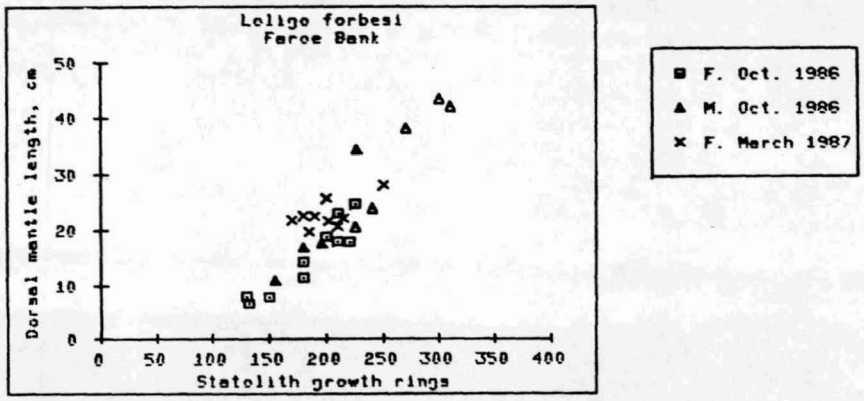

Fig. 3. Relationship between statolith growth rings and dorsal mantle length in cm in Loligo forbesi from October-November 1986 and March 1987.

squids, we are not able to find any such difference in the growth rate between the two sexes. Since the number of squids counted is only 30, the result has to be taken with some reservation. However, the difference in the maximum lenght between the two sexes is so big, that the largest males clearly must be several months older than the largest females, even when the reservation of the statolith number is taken into consideration. With the reservations mentioned before we can estimate the growth rate to be around 2 mm/day for both sexes in the interval 10 - 40 cm DML. Furthermore the statolith growth rings indicate, that the squids smaller than ca. 10 cm DML have a much lower growth rate.

Length and Weight

The relationships between mantle length and weight are shown in fig. 4 and table 1. The slope is always higher for females than for males. This is also shown by Holme (1974) in the British Channel, by Howard (1979) near the Scottish westcoast and by Martins (1981) in the Azores. But investigations of *Illex illecebrosus* (Dave, 1984) and *Todarodes sagittatus* (Sundet, 1985) have shown, that in these two species the males have higher slopes than the females.

Table 1. The length-weight regression expressed by the equation $W = aL^b$. W = total weigth in grams; L = dorsal mantle length in centimeters; M = males F = females; N = number of specimens; r = correlations factors and a and b are constants.

		a	b	r	N
Oct.- Nov. 1986	M	0.133	2.452	0.994	202
Oct.- Nov. 1986	F	0.088	2.609	0.993	170
March, 1987	M	0.180	2.304	0.992	195
	F	0.074	2.664	0.996	106

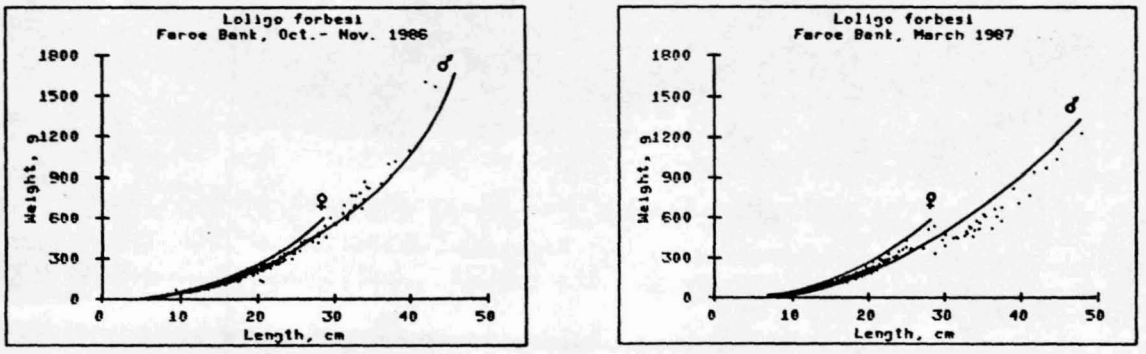

Fig. 4. Length-weight relationship of Loligo forbesi from October-November 1986 and March 1987.

Maturity

In the autumn 1986 some of the largest males (20 - 25 cm DML and upwards) were mature. Between ca. 10 and 20 - 25 cm DML the gonads were developing and below ca. 10 cm the gonads had not started to develope The females smaller than 10 - 12 cm DML had not started to develop the gonads while in the larger females the gonads were developing. No females were mature.

But in March 1987 most of the large females above 18 - 20 cm were mature while some were maturing. E.g. a male of 25 cm DML in Oct.- Nov. 1986, had an average gonad weight of around 8 g while a female at same length had an average gonad weight of 1.9 g. But in March 1987 a male of 25 cm DML had an average gonad weight of around 6 g while a female at the same length had a gonad weight of around 27 g (Fig. 5).

Comparing the gonad weights and the length distributions it can be seen that while the squids from Oct.- Nov. 1986 had gonads growing continuously with the length, the squids in march 1987 were represented by two different groups, both in length distributions and gonad growth. In the squids from March 1987 the gonads of the group smaller than 18 - 20 cm DML had not started to develop perceptibly, while the larger group, 18 - 20 to 28 cm DML for the females and 18 - 20 to 48 cm DML for the males were mature or maturing.

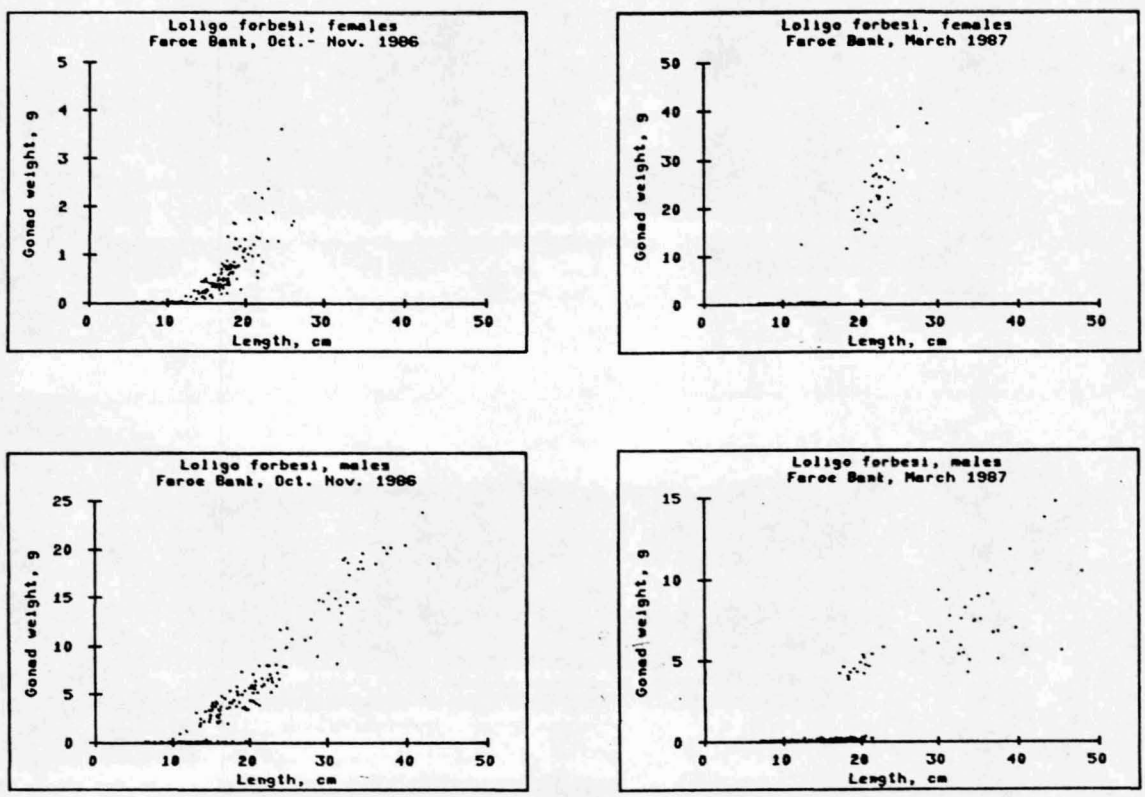

Fig. 5. Gonad weight against dorsal mantle length on Loligo forbesi from the Faroe Bank

The oldest group of females from 1987 were 7 - 8 months old, while the oldest males were 7 - 11 months old. No gonads of squids younger than around 5 months had started to develop perceptibly.

Food intake

Investigations of stomach filling and digestion have shown, that the squids do not eat as much during the night as during the days. On fig. 6 it can be seen that the stomach filling was highest in the evening and lowest in the morning, while the food digestion was lowest in the evening and highest in the morning. One exception is where the the stomachs were empty in the early afternoon (the dot-and-dash line), showing than these squids have not found much food that particular day. The results show that the squids eat most during the day, and eat only very little during the night. This may be due to the fact, that the squids catch their food visually, and therefore need dayligth to see the prey.

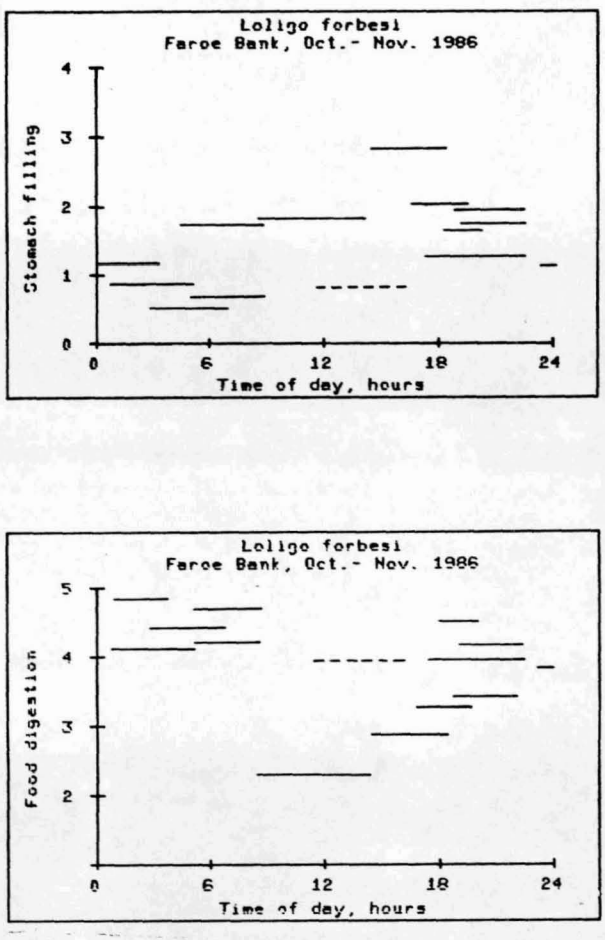

Fig. 6. Stomach filling (upper figure) and food digestion (lower figure) at day and night in Loligo forbesi from October-November 1986.

Conclusion

Based on countings of the statolith growth rings the growth rate of *Loligo forbesi* from Faroe Bank is around 2 mm/day in the length interval between 10 and 40 mm DML, and is equal for both sexes. The difference in the maximum mantle length of two sexes, caught by the bottom trawl, which was 48 cm for males and 28 cm for females, therefore was not because the males had a higher growth rate than the females, but the males were older than the females. The oldest males were about 11 months old, while the females were about 7 months.

Providing that the stock of *Loligo forbesi* on the Faroe Bank is permanent on the Bank and isolated from the one on the Rockall plateau, a possible explanation of these differences in age of the two sexes is that the oldest females swim clear of the bottom and therefore get free of the bottom trawl. The fact that more males than females were caught might support this suggestion.

In October-November 1986 the squids were not mature, but in March 1987 the squids were mature and close to spawning. This supports the results from Howard (1979) who found, that the main spawning period is in the spring. But by comparing the growth rate and length distribution, it can be seen that a spawning in somewhat smaller scale continues all through the year.

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