Fecundity, Gonadosomatic index and breeding cycle of the Clupeid Ilisha Africana (Bloch) occurring in the coastal waters of Cape Coast (Ghana)

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ABSTRACT

The fecundity of Ilisha africana ranged from 1,013 to 10,600 (mean, 3,985) for fish measuring 13.4 cm to 19.3cm total length with body weights 17.1g to 64.8g and gonad weight of 0.33g to 2.21g.
The gonadosomatic index (GSI) was higher in the female than in the males. This was attributed to yolk and fat probably needed for nourishment in the developing eggs. The GSI was also found generally to increase with the stage of maturity of the fish.

Information based on the ripe and ripe running stages of both males and females, the gonad weight, the condition factor, and oocyte diameter indicates that Ilisha africana breeds probably throughout the year, spawns more than once during a breeding season and that, possibly, the peak spawning periods are June-July, November and March.

Key words: Fecundity, gonadosomatic index, gonad, oocyte, condition factor, Ilisha africana

INTRODUCTION

Ilisha africana, is an important fish food in Cape Coast and many other towns in Ghana. Little or no attention has been given to it by way of scientific research and therefore very little literature is available on the species.

Ilisha africana is known locally (in and around Cape Coast) as 'Kanfla'. It belongs to the family 'Clupeidae' and like all other members of the family, it is silvery in appearance. The scales are easily shed and the lateral line is almost completely invisible. The body is compressed laterally and has a sharp edge. It has minute teeth in the mouth. In addition, it has an upturned mouth suggestive of planktivorous diet. The species is available throughout the year (1).

In this paper, certain aspects of the reproductive biology of Ilisha africana are discussed.

MATERIALS AND METHODS

Monthly samples of Ilisha africana were purchased from fishermen at Duakor near the University of Cape Coast (Ghana). Occasionally, they were obtained from the OLA Estate beach where the fishermen sometimes landed their catch. The whole sample of Ilisha africana for each month was taken to the laboratory for analysis. In the laboratory, they were washed to remove sand particles and blotted dry with blotting paper prior to further analysis.

The lengths were measured to 0.1cm using a measuring board, and weighed to 0.1g using Oertling Model TP46 electric balance.

Eggs for fecundity studies were preserved in modified Gilson's fluid until needed. The ripe ovaries (stage III) were weighed and then split longitudinally and turned inside out to assist penetration of the preservative. Large ovaries were cut into separate portions. They were kept in labelled bottles and then shaken constantly to free the eggs from the ovarian tissues. The liquid was changed 2 or 3 times before washing in 70% alcohol.

The preserved and washed eggs were poured through a filter paper in a funnel. When the liquid drained away, the paper and the eggs were spread onto blotting paper to remove excess water. It was left to air-dry until the eggs could be moved by hand.

The gravimetric method was used for counting the eggs (2). All the eggs of each gonad were weighed to obtain the total weight of the eggs of each gonad. Two sub-samples of 200 eggs each were selected at random, weighed, and their mean noted. The number of eggs was then calculated by proportions as described by Lagler (3), Blay (4), Bagenal (2) and Olatunde (5).

Histological preparations of the ovaries in the various stages were selected for oocyte measurement. Five slides of each stage were used for the measurement with the aid of a calibrated micrometer eye-piece fitted into a microscope.

RESULTS AND DISCUSSIONS

Fecundity of a fish is the number of ripe eggs in the female prior to the next spawning season (2,3,4). Nikolskii (6) defined fecundity as the number of

eggs for the generation of that year present in the ovaries.

Egg counts on 22 ripe ovaries of Ilisha africana revealed the fecundity to range from 1,013 for a fish measuring 13.4 cm total length and weighing 17.1g, to 10,600 for a fish 19.3cm total length and weighing 64.8g. The fecundity increases with the total length and weight of the fish and with the ovary weight.

The relationship between fecundity and total length, fecundity and weight, and fecundity and ovary weight are given by the equations:

$$\log F = 1059.5853 \log L - 4.1129 \quad (r=0.85)$$
$$\log F = 166.5929 \log W - 3.1938 \quad (r=0.90)$$
$$\text{and } \log F = 3472.4208 \log Wo - 2.1678 \quad (r=0.82)$$

These are illustrated in Figs 1,2 and 3 respectively.

There is a positive correlation between fecundity and the variables as judged by the values of the correlation coefficient (r). The correlation was highest between fecundity and weight and least between fecundity and ovary weight. According to Lagler et al (7), factors that influence the fecundity of a fish are: age, condition, species and size of the female. These factors, plus food and physiology of the species, could singly or in combination influence the fecundity of the species.

Gonadosomatic Index (GSI)

The gonadosomatic index (GSI) or maturity coefficient is a measure of the ratio between the

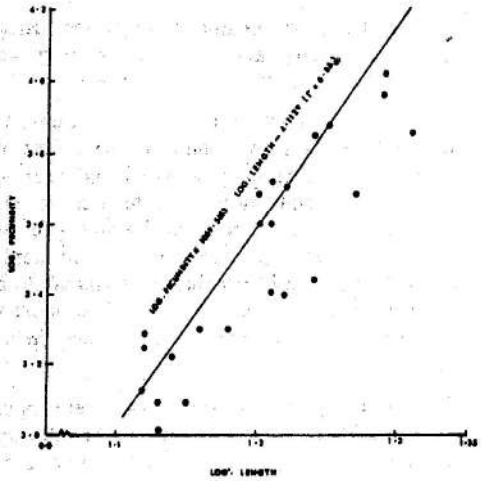

FIG. 1 - SCATTER PLOT OF LOG. FECUNDITY AGAINST LOG. TOTAL LENGTH IN I. AFRICANA

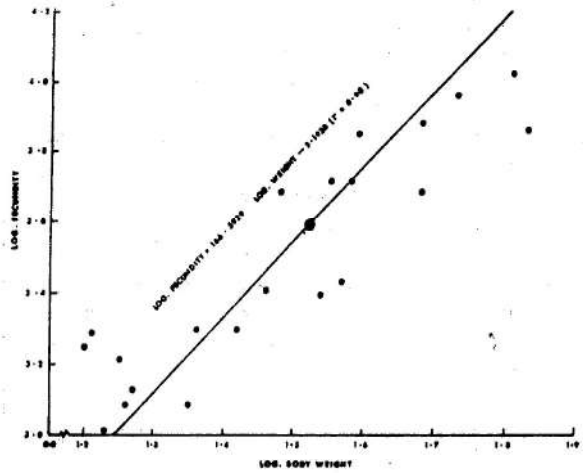

FIG. 2 - SCATTER PLOT OF LOG. FECUNDITY AGAINST LOG. BODY WEIGHT IN I. AFRICANA

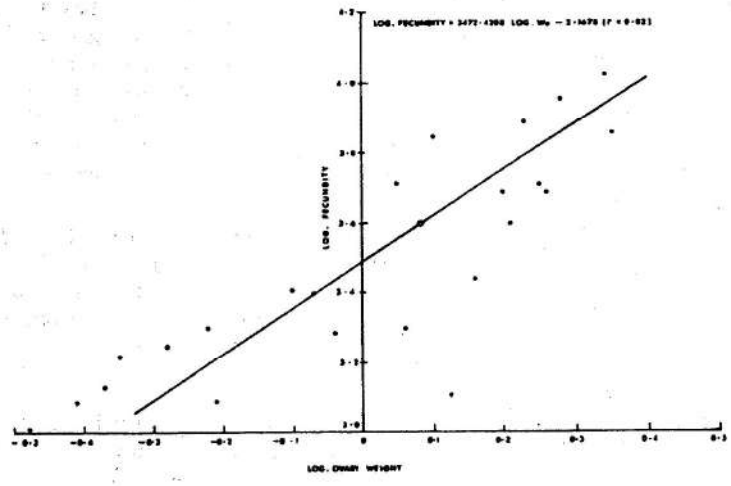

FIG. 3 - SCATTER PLOT OF LOG. FECUNDITY AGAINST LOG. OVARY WEIGHT IN I. AFRICANA

gonad weight and the body weight of the fish. It was calculated from the formula:

$$GSI = \frac{Gwt}{(Twt - Gwt)} \times 100$$

where GSI = gonadosomatic index, Gwt = gonad weight in grams and Twt = total weight of the fish in grams (4;5). Gonads weighing less than 0.01g were not used in the calculations. The GSI was determined for each fish. The averages for each month were calculated for the males and females and the figures represented in Fig 4. The mean GSI ranged between 0.45 - 2.94% for the females and 0.40 - 1.69% for the males. There was a sharp

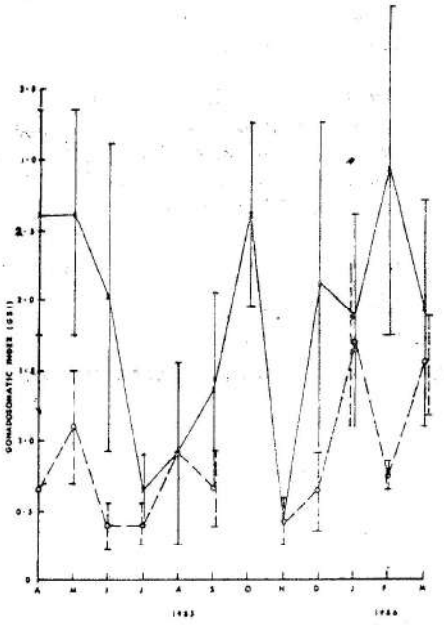

FIG. 4. MEAN GONADOSOMATIC INDEX (GSI) OF MALE (o- - -o) AND FEMALE (x——x) I. AFRICANA LANDED AT OLA – DUAKOR BEACH (APRIL, 1985 – MARCH, 1986)

* VERTICAL LINES REPRESENT TWO STANDARD ERRORS

decline in GSI in females in June and November, 1985. Peaks were observed in April, May, October 1985 and February 1986. These follow the same pattern as the mean gonad weight (1). In the males, the GSI was generally lower than in the females but the same general pattern was observed. Peaks (for the males) were noted in May, and August 1985 and January and March 1986. There was a reduction in June, July and November 1985 and in February 1986. No GSI was calculated for the males in October 1985 because all the gonads weighed less than 0.01g.

Table 1 shows that the GSI in the females increased with the stage of maturity, the highest being attained in the ripe running stage (stage IV). A similar pattern was observed for the males but the

TABLE 1

Mean gonadosomatic index (GSI) of various gonadal stages of male and female Ilisha africana landed at OLA-Duakor beach (April 1985 - March 1986)

SEX	MATURITY STAGE	TOTAL NUMBER OF FISH	RANGE OF GSI (%)	TOTAL GSI (%)	MEAN GSI + 2SE
Females	I (Immature)	80	0.07-2.03	14.83	0.49 ± 0.14
	II (Ripening)	33	0.07-6.93	53.40	1.62 ± 0.50
	III (Ripe)	16	1.22-4.77	39.08	2.44 ± 0.40
	IV (Ripe running)	23	2.35-6.63	94.71	4.12 ± 0.44
Males	I (Immature)	30	0.06-0.84	11.37	0.38 ± 0.08
	II (Ripening)	19	0.09-1.94	15.52	0.82 ± 0.26
	III (Ripe)	25	0.05-2.79	43.08	1.72 ± 0.26
	IV (Ripe running)	11	0.09-3.19	14.37	1.31 ± 0.52

value in stage IV (1.31%) was lower than that of the ripe stage (stage III) (1.72%). This observation could be due to the physiology of the males.

The findings on the GSI suggest that the females have exhibited a peak reproductive activity in April, May and October 1985 and February 1986. For the males the peak reproductive activity appears to be in May and August 1985 and January 1986. The reductions in GSI in June, July, and November 1985 and February 1986 suggest that the species might have spawned during those months.

Figure 5 shows the frequency distribution of oocyte diameter of the four different stages of maturity of Ilisha africana. The smallest oocyte observed measured approximately 0.02 mm in diameter. The maximum oocyte diameters for stages I,II,III and IV (i.e. immature, ripening, ripe and ripe running) were 0.22mm, 0.36mm, 0.51mm and 0.68mm respectively.

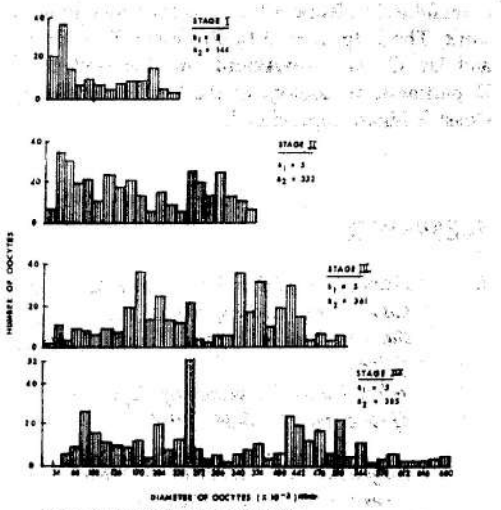

FIG. 5: FREQUENCY DISTRIBUTIONS OF OOCYTE DIAMETERS AT DIFFERENT STAGES OF MATURITY OF I. AFRICANA

n_1 = NUMBER OF SPECIMENS; n_2 = NUMBER OF OOCYTES

The polymodal nature of the oocyte diameter distribution (Fig.5) suggests that the species spawns more than once during a breeding season. In general, the months in which high condition factor was recorded were the same months in which high gonad weight, high percentage of ripe and ripe running stages for males and females and high gonadosomatic index (GSI) were recorded (1). It was further observed that condition was lost between May-August and November 1985 and March 1986. Generally, these were also the months in which the GSI, the gonad weight, the percentage of ripe and ripe running males and females were low (1).

Combining these factors, it is difficult to state precisely the spawning periods but it is possible that the species spawns between June-July, November and March.

CONCLUSION

It is observed that Ilisha africana is available throughout the year and probably breeds throughout the year. Since it is an important fish food and therefore much exploited, there is a tendency of it being over-exploited. It is suggested that its fishery be regulated. Particular attention should be paid to the periods of peak reproductive activity and spawning when the species is being exploited. This is important so that the stock is not depleted.

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