J. mar. biol. Ass. India, 1981, **23** (1 & 2) : 55 - 61

MATURITY AND SPAWNING OF *MUGIL CEPHALUS* LINNAEUS IN PORTO NOVO WATERS

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ABSTRACT

Mugil cephalus Linnaeus is a grey mullet of commercial importance in Porto Novo. Maturity and spawning of this mullet was studied by observations on the gonads collected from December 1977 to November 1978. Males were found to mature earlier than females. High G.S.I. values were noted from September to April. Different stages of maturity were noted from ova diameter studies as also the spawning season and the breeding periodicity. Fishes were found to spawn only once during the breeding season which seems to be an extended period from September to April, with a peak during October to January.

INTRODUCTION

GREY MULLET *Mugil cephalus* Linnaeus is commercially important occurring in seas, estuarine and brackishwater systems world over. In Porto Novo coastal waters *M. cephalus* is the most common grey mullet and occurs throughout the year with a peak between November to March. In view of the significance of this fish as a cultivable species, several workers have studied its biology earlier (Breeder, 1940; Kesteven, 1942; Jacob and Krishnamurthy, 1947; Devasundaram, 1952; Dekhnik, 1953; Bromhall, 1954; John, 1955; Sarojini, 1951; Erman, 1959; Ndoc, 1959; Patnaik, 1962; Luther, 1963; Thomson, 1963; Shetty *et al.*, 1965; Hickling, 1970; Rangaswamy, 1972; Brulhet, 1975; Dos, 1978). The maturity and spawning of this species has been studied in Porto Novo coastal waters for a period of one year (December, 1977 to November, 1978) as we had no knowledge previously on its biology from this region.

We are thankful to the University Grants Commission, New Delhi for financial support.

MATERIAL AND METHODS

Mateiral for the present study was obtained between December, 1977 and November, 1978. Fishes were collected from landing centres and local fish markets and were also caught by operating cast nets of various mesh sizes in the Vellar estuary and Pitchavaram mangrove areas. A total of 1221 fishes was collected ranging from 84 mm to 520 mm in total length. Specimens were brought to the laboratory for study in fresh condition. They were first cleaned, measured, weighed and were cut open to note the sex before the gonads were dissected out for maturation studies. Weight, colour and condition of the gonads were noted and ovaries were preserved in 5% neutral formalin for ova diameter studies.

Results and Discussion

a. *Maturation and spawning*

1. Development of ova to maturity and frequency of spawning.

A total of 524 ovaries of different maturity stages was examined for ova diameter studies. Ova diameter measurements were made with ocular micrometer at a magnification which

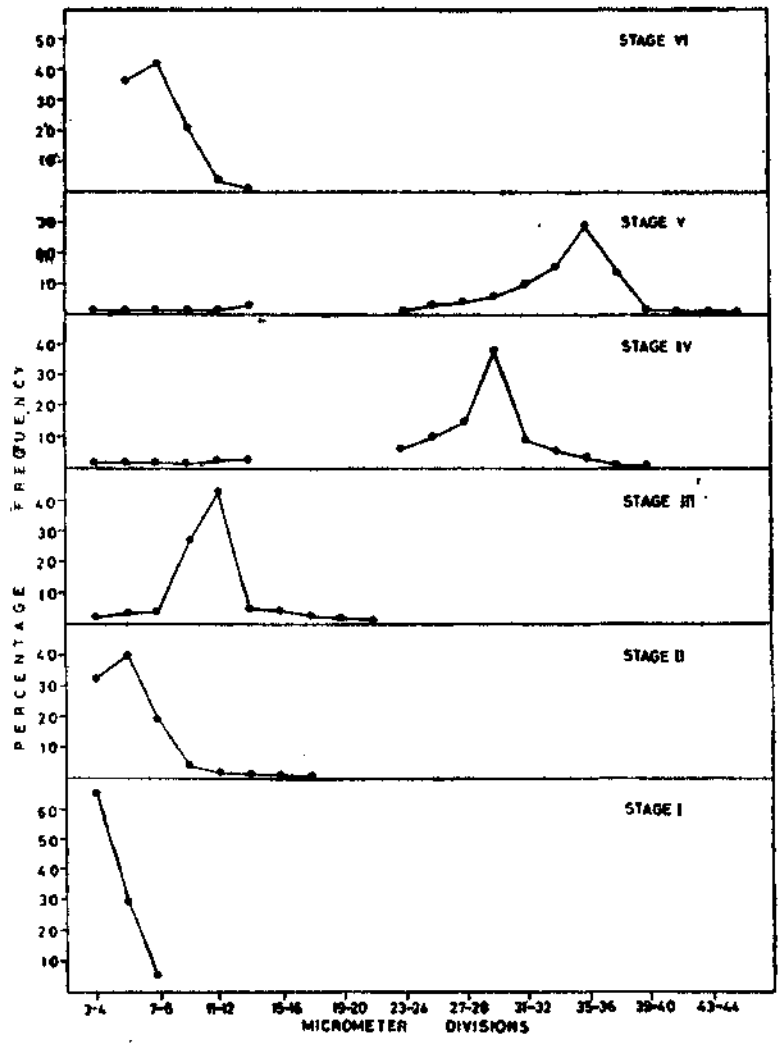

Fig. 1. Ova diameter percentage frequency of different maturity stages of *M. cephalus*.

The maturity stages adopted in the present study are given below along with the corresponding maturity scale of the I. C. E. S. (Wood, 1930) for comparison.

gave a value of 18.2 μ to each micrometer division. The diameters of 200 ova were measured as suggested by Clark (1934) and Dejong (1940). Ova measuring 3 micro

TABLE 1. M. cephalus - *Gonadial condition*

Stage	Female (Ovary)	Male (Testis)	Maturity scale of I. C. E. S.
I Immature	Pinkish occupying ¼ to ½ body cavity. Ova irregular and transparent.	Whitish, ribbon shaped occupying ½ body cavity.	I - II
II Maturing I	Yellowish occupying ½ to ¾ body cavity. Ova round, partially yolk laden.	Whitish, occupying III ½ body cavity.	III
III Maturing II	Yellowish, occupying ½ to ¾ body cavity; ova round, and fully laden with yolk.	Whitish occupying ½ to ¾ body cavity.	IV
IV Mature	Yellowish, occupying nearly the entire body cavity with some ova visible to the exterior; yolk vacuolated, perivitelline space present.	Creamy white occupying the entire body cavity.	V
V Oozing	In the oozing stage.	Fish in the oozing stage.	VI
VI Spent	Flacid with blood vessels prominent over the surface occupying not more than ¼ the body cavity.	Flacid occupying about ¼ body cavity.	VII

divisions (micro. div.) and above were taken into consideration while drawing percentage frequencies. The diameter frequencies were grouped into 2 micro. div. groups i.e. 3-4, 5-6, 7-8 etc. Fig. 1 shows different stages of development of ova in the ovaries. In the I stage, majority of the ova measured between 3-4 micro. div. A few larger ova measuring 5-6 and 7-8 micro. div. were also recorded but withdrawal of this batch of larger ova from the general stock was not indicated. In the II stage, though majority of the ova measured were between 5-6 micro. div., a few larger ova measuring 17-18 micro. div. were also recorded. Further, in the III stage, a distinct stock of ova measuring 11-12 micro. div. was quite apparent. This batch, possibly was derived from the batch of ova 5-6 micro. div. of the II stage, with further accumulation of yolk. After the III stage, the development of these ova seems to be very rapid and separation of these mature ova from the immature stock (3-5 micro. div.) is quite apparent. In the IV stage, the mature group of ova with its mode at 29-30 micro. div. is further well separated from the immature group. Stage V, is the most advanced stage observed in this study. Since the ova diameter percentage frequency polygon of these ovaries present only a single well differentiated batch of ova with a mode at 35-36 micro. div., it is inferred that the individual fish breeds only once a season. This is further supported by the ova diameter percentage frequency polygon of the spent ovary (Stage VI) which is left with an immature stock of ova and with or without few degenerating ova.

2. *Gonado-Somatic Index (GSI)*

Applying the method of June (1953) and Yuen (1955), the relative weight or gonado-

somatic index of *M. cephalus* was calculated by using the formula:

$$\text{Gonado-Somatic Index} = \frac{\text{Weight of ovary}}{\text{Weight of fish}} \times 100$$

This index was calculated for both males and females for each individual and the monthly average was found. Monthly average GSI values of males and females are graphically represented in Fig. 2. From

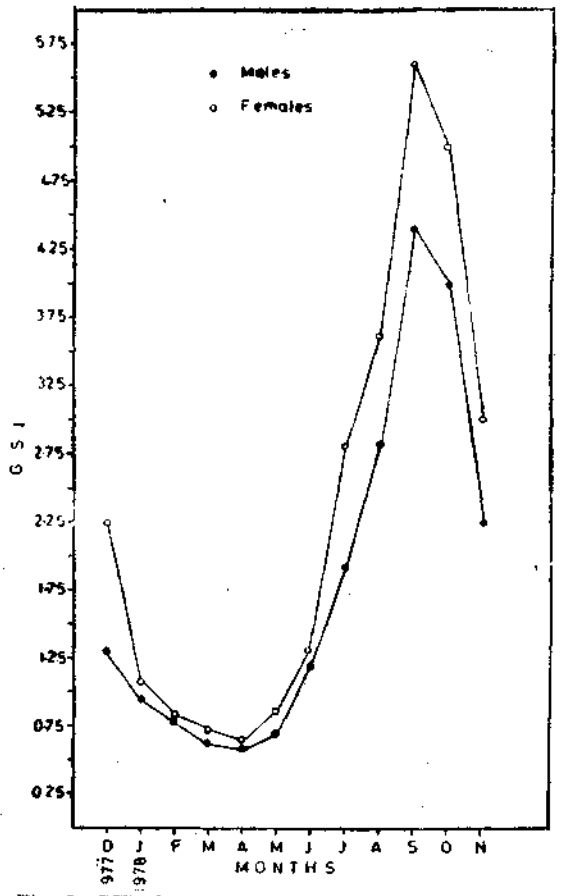

Fig. 2. GSI of males and females of *M. cephalus*.

the figure it is evident that in females and males GSI values were found to increase from May onwards reaching a peak in September followed by a gradual decrease upto April after which a gradual increase is evident leading to the maximum values in September. Increase in GSI values of males and females indicate development of the gonads during May to September months and a sudden drop in values from September to April is due to spawning. The monthly variation in the GSI offer not only additional proof for the spawning season but also are indicative of the major phases of the reproductive cycles. Further, GSI clearly shows that *M. cephalus* has a prolonged spawning season (September to April) in Porto Novo waters.

3. *Spawning season*

The percentage occurrence of various stages of maturity in different months is given in Fig. 3. Evidence of spawning is offered by the occurrence of Stage V (oozing) gonads. From the figure it can be seen that the V stage gonads were recorded from September to April which obviously was the spawning period (8 months). Occurrence of spent females from September to May further confirmed this. However, peak spawning season was from October to January as 84.12% of specimens had ripe gonads during this period. Almost an identical pattern could be observed in both sexes.

Jacob and Krishnamurthy (1942) observed *M. cephalus* with mature gonads in the Ennore Creek during October to May. Jhingran and Natarajan (1969) observed a prolonged spawning season for this species in Chilka Lake extending from September to December. John (1955) reported that in Kayamkulam lake, ripe *M. cephalus* was seen from September onwards and the spawning season was from September to December. According to Shetty *et al.* (1965) the spawning season of *M. cephalus* in Mahanadi estuary was from September to December. Luther (1963) opined that the spawning period was short in Mandapam coast. Rangaswamy (1972) reported that, in the Pulicat lake, spawning season is a prolonged one from September to February. Das (1978) observed a prolonged spawning

season from *M. cephalus* in Goan waters from September to February with a peak during October-December. These observations of earlier workers indicate that *M. cephalus* breeds during monsoon and early post-monsoon months on the east coast of India. It is interesting to note that though monsoonal cycles are different on the west coast, spawaing period of *M. cephalus* in Goan waters (Das, 1978) followed the same pattern as that of their counterparts on the east coast. In the present investigation however, *M. cephalus* was found to breed from September to April. This indicates that in Porto Novo, *M. cephalus* not only breeds during monsoon and post-monsoon periods (like in other places of

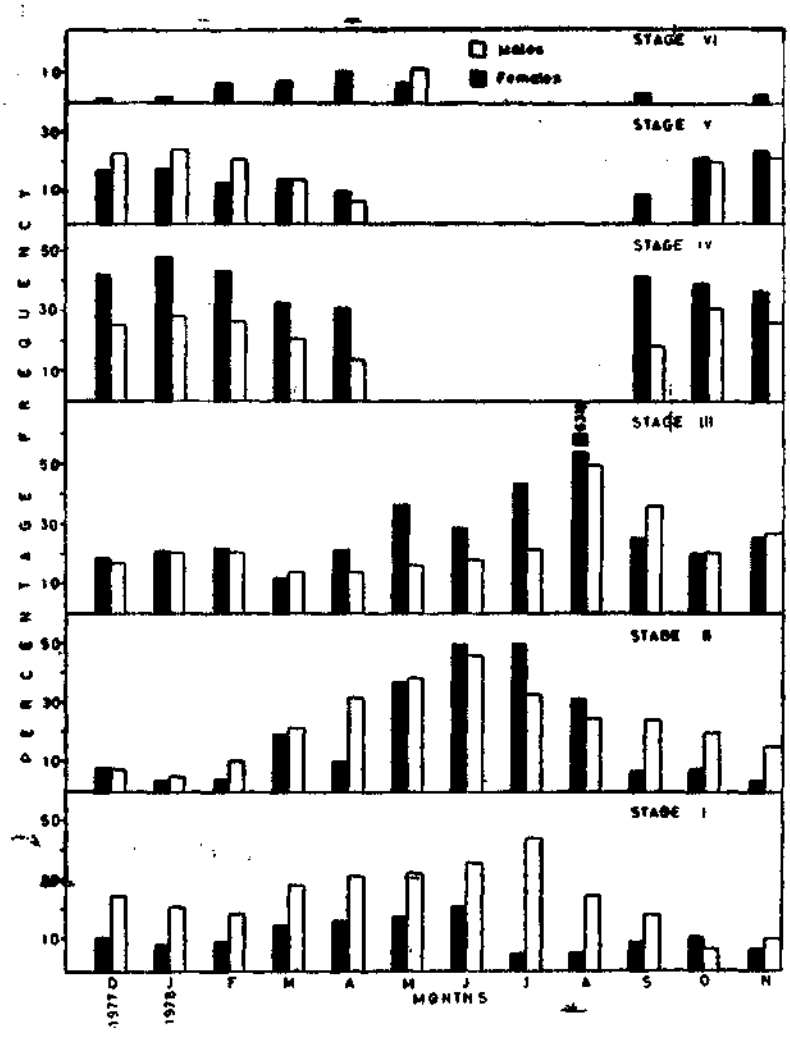

Fig. 3. Percentage distribution of different maturity stages of *M. cephalus*.

the east coast) but also during early summer months.

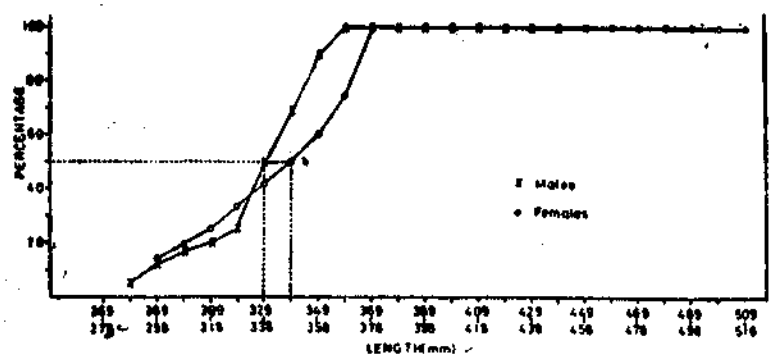

Fig. 4. Length at first maturity of males and females of *M. cephalus*.

b. *Length at first maturity*

Percentages of both the sexes are graphically represented in Fig. 4. It is seen that, in 269-278 mm (total length) groups, all the males were immature and the percentage of mature males increased with length, upto the 359-368 mm length group, wherein all the individuals examined were found to be mature. In 279-288 mm length group all the females were immature and the percentage of mature females increased upto 369-378 mm when all the females were mature. The 50% levels in the maturity curves, which may be taken to represent the mean lengths at which maturity was attained, were 329 mm for males and 339 mm for females. It is evident from the data that males of the species attain maturity earlier than females. In Pulicat lake, Rangaswamy (1972) observed that 50% levels in maturity curves of *M. cephalus* were 376 mm for males and 425 mm for females. These values seem to be very high for females indicating a delay in maturity of *M. cephalus* in Pulicat lake compared to that of Porto Novo waters. From Goan waters Das (1978) reported that at 290 mm and 310 mm, males and females attained maturity respectively indicating that they reach maturity earlier than in Porto Novo waters.

Kesteven (1942) estimated the size at first maturity of *M. cephalus* in Australian waters to be from 300 to 340 mm. Brulhet (1975), on the Mauritian coast, found that first sexual maturation was at about 500 mm for females and at 430 mm for males. Maturity of *M. cephalus* in Australian waters seems to be almost the same as in Indian waters but in the Mauritian Coast the maturity of this species seems to be very much delayed.

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