Replicative Biology of Indian Mackerel, Rastrelliger Kanagurta (Cuvier, 1817) Off Ratnagiri Coast, Maharashtra, India

Bhendarkar MP¹, Naik SD², Mohite SA³, Kulkarni GN⁴

1. Research Scholar, Fisheries Resource Management (Dept. of Fisheries Biology), College of Fisheries, Ratnagiri, Maharashtra, India
2. Associate Professor, Dept. of Fisheries Biology, College of Fisheries, Ratnagiri, Maharashtra, India
3. Assistant Professor, Dept. of Fisheries Biology, College of Fisheries, Ratnagiri, Maharashtra, India
4. Associate Professor, Dept. of Fisheries Hydrography, College of Fisheries, Ratnagiri, Maharashtra, India

*Corresponding author: Research Scholar, Fisheries Resource Management (Dept. of Fisheries Biology), College of Fisheries, Ratnagiri, Maharashtra, India, Mail: mukeshcofsn@gmail.com

Received 03 January; accepted 14 February; published online 01 March; printed 16 March 2013

ABSTRACT

The present study indicated that there is no population synchrony in spawning of Indian mackerel resulting in the availability of spawners throughout the year. But it is clear that from the availability of the various stages of maturity during the various months maximum spawning activity occurs during the month of April and a small minor peak occurs during October & November. The average GSI value in females was 3.5373 while maximum value recorded was in the month of April (6.0607) and minimum in the month of January (1.1473). The average GSI value of males was 2.7549 and maximum GSI value (4.0717) was recorded in the month of April, while and minimum (0.8220) value was recorded in the month of January. The size at first maturity was estimated to be 19.6 cm for male while the female, at 20.6 cm LT. Sex ratio showed deviation from 1:1 in certain months. The fecundity of fish ranged from 55,264 to 3,14,568 eggs with an average of 1,08,266 eggs.

Keywords: Reproductive biology, Indian mackerel, Rastrelliger sp., Maharashtra, India.

Abbreviation: GSI- Gonado-somatic Index

1. INTRODUCTION

The Indian mackerel, Rastrelliger kanagurta (Cuvier, 1817) is one of the important pelagic, schooling marine fish that is widely distributed in the Indo-West Pacific region (Pradhan, 1956). India contributes 90% of the world mackerel production, out of which 77% is from west coast and 23% is from east coast of India. Its fishery is second in importance to that of oil sardine in the multispecies structure of Indian marine fishery (Yohannan & Sivadas, 2003). Indian mackerel is also called as ‘Rake gilled mackerel’ and locally known as Bangda in Maharashtra.

A species can comprise of a single stock or a number of stocks with a fixed spawning ground and specific spawning season (Begg and Waldman, 1999). From the point of fisheries management, it is observed that there is localized variation in fishing intensity along the Indian coast and therefore the stocks have to be effectively decline. Therefore to overcome of such problem adopts management strategies on local/ regional scales a holistic knowledge base on biology, life history and behaviour of species in the region is crucial (Adams, 1980; Begg et al., 1999; Pratibha et al., 2004). An understanding of the reproductive biology of a species is an important prerequisite for providing scientific advice for fisheries management to achieve optimum exploitation of the concerned species in tune with its reproductive characteristics. Each fish species has a unique set of reproductive characters (pattern of gamete development, duration of spawning season and associated endocrine changes) which can be used in formulating capture fisheries management policies. As the reproductive potential of individual fishes within the spawning stock affects recruitment most fish biomass assessment programmes require inputs on reproductive parameters such as the age/length at maturity, proportion of mature fishes in the population, fecundity and spawning frequency (Nikolskii, 1969). Estimates of reproductive parameters have been widely applied to formulate capture fisheries management strategies such as enforcement of minimum catch at size restrictions, closed fishing seasons during peak breeding periods. The Indian mackerel forms a major fishery resource by itself in the Indian marine fisheries sector. A characteristic of the mackerel fishery is the highly fluctuating nature of the catches over interannual / decadal scales, which has been attributed to fishery as well as non-fishery factors.

2. MATERIAL AND METHODS

Coastal water of Maharashtra along the west coast of India were selected as study area. Mirkarwada (16° 59' 42" North and 73° 16' 14" East) a minor fishing harbour on the west coast of India was the sampling station selected for collecting sample of R. kanagurta. Linear measurement like total length, fork length and standard length were recorded with the help of fish measuring board to accuracy of 0.5 mm. Electric balance with precision of 0.1 mg was used to record the total weight and gonad weight of fish from Mirkarwada landing center. The length, weight, gonad condition and stage of maturity of individual fish in each sample were noted. Individual fish was examined as per the measurement scale: Total length (mm), total weight (gm), maturity stages (immature, maturing, ripe and spent) were recorded which was based on observations of the gonad such as the size of ovary/testes in relation to abdominal cavity and its appearance (whether bulging, half shrunk or flaccid; the presence of blood vessels on the ovary and colouration of the gonads) which were followed with the maturity scale developed for mackerel by Pradhan and

Specimens of different sizes, collected at random, were dissected to examine the sex by examining the gonads since no external character are known to distinguish males and females. All maturity stages were observed with the help of colour and shape of ovary. In the present studies fecundity of fish was determined for 30 specimens ranging from 20 to 29.9 cm in TL and 120 to 304 gm in total weight by gravimetric method. The fecundity was determined by the formula Garg et al. (2002). 

\[ F = \text{Total weight of the ovary} / \text{Sub-sample weight X 100} \]

Relation between fecundity and other parameters such as total length, total weight and ovary weight were obtained by fitting data as a scatter plot and fitting linear regressions. The size at first maturity was estimated using the distribution of cumulative percentages of stages V and VI (a) and VI (b).

### 3. RESULTS AND DISCUSSION

#### 3.1. Maturity and Spawning Season

A perusal of data on the temporal distribution of maturing stage shows that most of the stages were present throughout the year except in November and January, where only four stages of maturity were recorded (Table 1, Fig. 1). However, the main spawning period is during April as indicated by the consistently higher percentage of mature ones, ELEFAN-II analysis and GSI values. Earlier studies have also indicated high abundance of advanced spawning stages of Indian mackerel during March to May (Sekharan, 1958; Gopakumar et al., 1991 and Abdussamad et al., 2010). This study indicates that apparently there has been no major change in the spawning and maturation schedules of Indian mackerel along the southwest coast of India. Moreover some workers observed that spawning season of mackerel from west coast extends from June to September (Devanesan & John, 1940; Devanesan and Chidambaram, 1948 and Hulkoti, 2005). The spent stage specimens were not recorded throughout the year.

#### 3.2. Ova diameter

Typical ovaries belonging to the seven stages of maturity described above were selected and the ova diameter frequency polygons were drawn. The data are presented in Table 1. Vijayaraghavan (1962) who reported it to ripe ova with modal group between 0.67 – 0.74 mm. Radhakrishnan (1965) classified the ova into four categories, immature, maturing, mature and ripe the respective diameter ranges being 0.017 to 0.170 mm, 0.255 to 0.272 mm 0.332 to 0.612 mm and 0.62 to 0.75 mm. It thus appears that egg size in mackerel does not show many variations over temporal scales and thus oocyte diameter measurements can be used for making rapid estimates of potential fecundity in mackerel.

#### 3.3. Size at First Maturity

The occurrence of male and female R. kanagurta in different stages of maturity in relation to size indicates that the first maturity for male is at 19.8 cm and for female at 20.6. Radhakrishnan (1965) observed that the mackerel matured for the first time when it measured 21.0 – 22.0 cm which is in agreement with the present observation using cumulative percentage method (Table 2). Rao (1962) have indicated that mackerel below 20.0 cm are immature. Thus this study indicates the Indian mackerel attain at first sexual maturity at its first year at 19.8 cm and 20.6 cm male and female respectively.

#### 3.4. Gonado Somatic Index

GSI were calculated month wise which showed high and low value in either sex (Fig. 1). High value in April suggested maturity of gonads during these months. Therefore, it can be inferred that the spawning of R. kanagurta occurred only once in a year. The value of GSI was high at 29.9 cm in total length for either sex.

#### 3.5. Sex ratio

Indeterminate stages were recorded separately.

For ova diameter studies of intra-ovarian eggs, small pieces of ovaries from the anterior, middle and posterior region were cut and then ova were teased out on to a glass slide. The process of growth of ova from one stage of maturity to another was studied using Motic Images Plus 2.0 is a Digital Microscopy Software. For ova diameter study a total of 300 - 400 ova were measured in mm from mature wise individual fish. For GSI estimation, the two lobes of gonads fused at their base where they are connected to the body cavity were separated by a horizontal cut. The weight and total body weight was then taken with help of electronic balance. The commonly followed method (Bal and Rao, 1984) is expressed as GSI = gonad weight / body weight X 100.
Sex composition of the random samples examined during each month from March 2011 to February 2012 has been represented. Females were almost more in number with an average ratio of male to female 1:1.29. Males dominate in the month of June and November whereas females dominate over the rest of the period. The Chi square test applied for monthly samples indicate the significant difference at 0.05% probability level, in the months of July and August (Table 3).

### 3.6. Fecundity

The fecundity range in female *R. kanagurta* was recorded as 55,264 (22.7 cm, 120 gm) to 3,14,568 eggs (29.9 cm, 304 gm) with an average of 1,08,266 and relative fecundity ranges from 407 to 419. The results of the present study also suggest that ovarian weight and total length are most important in determining fecundity of Indian mackerel. In the present study, the logarithmic relations between fecundity and length of fish, fecundity and weight of fish and fecundity and gonad weight were found to be linear indicating that the fecundity generally increased with increasing length, weight and gonad weight. These observations are in agreement with the observations of Yohannan and Abdurahiman (1998). In the present investigation, 'r' value indicated strongest relationship with total length followed by ovary weight. Thus the observations in the present study are pertinent for the implementation of length-based fishery management measures. Presently more emphasis is placed on conservation of juveniles and a minimum legal size (MLS) of around 20 cm to ensure that mackerel can spawn at least once (Yohannan and Nair, 2002; Pillai et al., 2009).

### 4. CONCLUSION

The macroscopic gonad staging method is the most simple and rapid method in obtaining data on maturity and spawning which are inputs in routine fish stock assessment studies. This study indicates that apparently there has been no major change in the spawning /maturation schedules of Indian mackerel along the southwest coast of India unlike in some other resources where deviations attributed to recent shifts in climate are reported. This may perhaps be due to the fact that the mackerel is already placed in a favorable environmental niche and therefore such "shifts" are not evident. In the context of an expanding mackerel fishery attributed to increasing seawater temperature due to climate-change, the study indicates that an evaluation of the historic database on the maturation/spawning of mackerel may be interesting to evaluate the same with regards to the fishery biology of mackerel. The study also indicated that the fecundity levels being related to the total length of the fish, the effects of recruitment overfishing (large scale capture of mature spawners) are likely to be a significant factor in determining recruitment variations. At present, capture of juvenile fishes only is discouraged and hence management advisories may also consider conservation of spawners, especially during monsoon period.

### REFERENCES