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Reproductive Biology of *Gerres Oyena* (Pisces: Gerreidae) Along the Bagamoyo Coast, Tanzania

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***Abstract*—** The reproductive biology of *Gerres oyena* (Forskal, 1775) (Gerreidae) along the Bagamoyo coast was studied from January to December 1999 using samples from monthly commercial catches. Size at first maturity was 12.8 and 13.9 cm TL for males and females respectively. The sex ratio was found to be 0.98:1 (m:f) and was not significantly different from 1:1. *G. oyena* spawns throughout the year with two peaks: one in March and the other between October and December, which coincide with the northeast monsoon. Ova-diameter frequency distributions indicated that *G. oyena* is a multiple spawner. They may spawn in three successive batches within the same prolonged spawning season. On an average, the numbers of mature ova produced were 148,138 per fish. For management purposes, a focus should be on the size of maturation relative to length-body depth or capture size. This would reduce harvesting of pre-reproductive individuals.

INTRODUCTION

Members of the family Gerreidae (also known as mojarras, silver-biddies or purse mouths) inhabit warm seas, are marine and estuarine, although they occasionally occur in freshwater (Cyrus & Blaber, 1982; Blaber *et al*., 1995; Ndaro & Ólafsson, 1995). The reproductive biology of the Gerreidae has been studied by Rao (1970), Kurup & Samuel (1991) in Indian waters; Austin (1971), Etchevers (1978) in South America and Albaret & Desfossez (1988), Cyrus & Blaber (1984) in Africa. Many tropical and subtropical fish species have been found to retain a protracted spawning period (Johannes, 1978). Multiple spawning over a protracted period or even a full year is associated typically with less seasonal environments, smaller body size and relatively smaller ovary size (Burt *et al*., 1988).

Gerres oyena is common in the inshore waters of Tanzania, but there is no detailed information on its biology. The *Gerres oyena* fishery is important in Bagamoyo coastal waters and the fish is esteemed as food, with the major portion of the landings consumed locally (Lamtane, 2001). This study was undertaken to ascertain spawning periodicity, spawning season, minimum size at first maturity, fecundity and sex ratio from fish caught at Bagamoyo.

MATERIALS AND METHODS

Specimens of *Gerres oyena*, caught be beach seining, were collected monthly, between January and December 1999, from two fishing landing stations along the Bagamoyo coast (Fig. 1). Their maturity stage was estimated by visual inspection of fresh gonads. A five-point scale based on the

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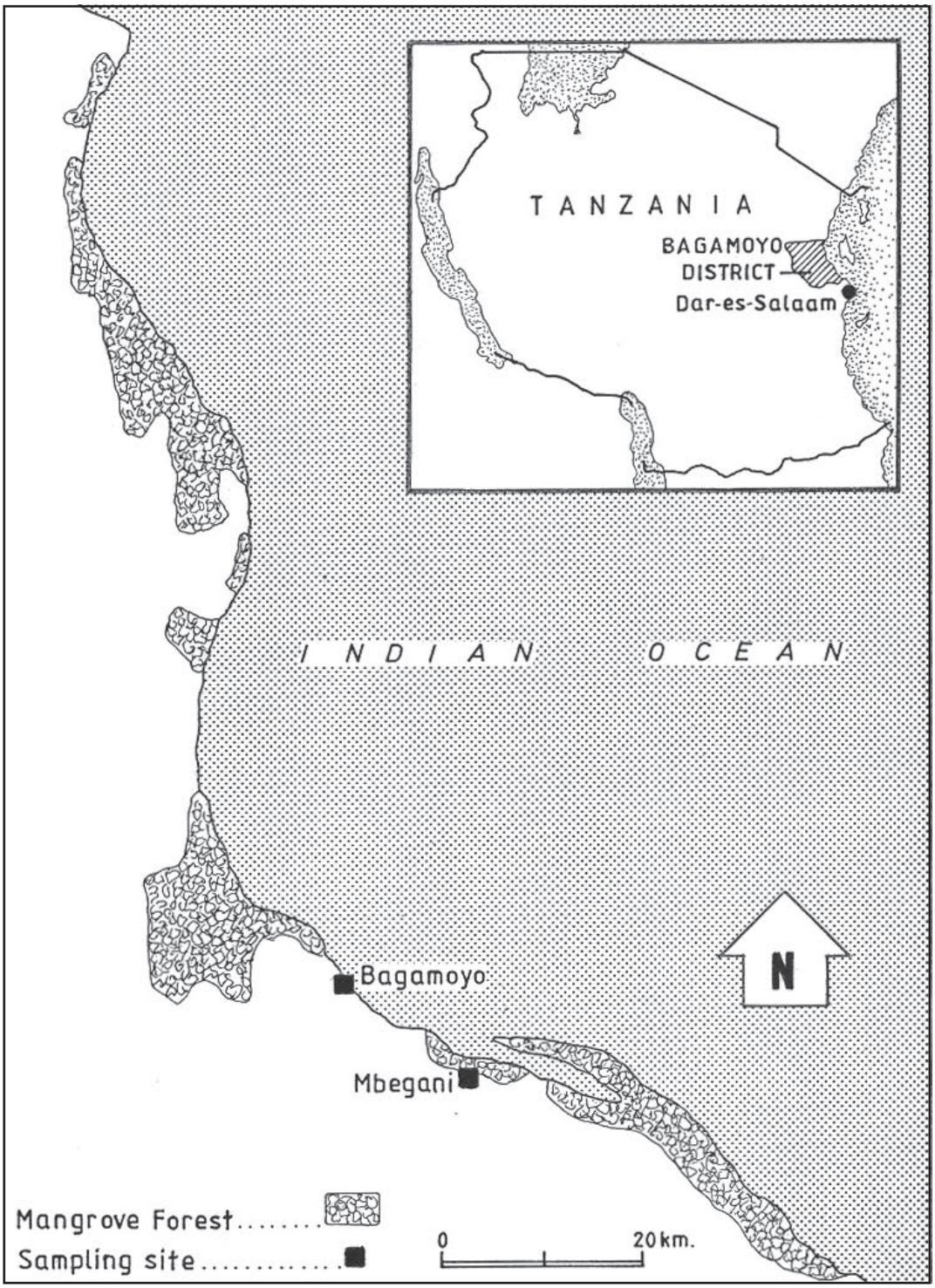

Fig. 1. A map of Bagamoyo coast showing sampling sites

colour, shape, size and microscopic structure of the gonads, as suggested by Nikolsky (1963), was used to classify maturity stage. The gonadosomatic index was estimated for each fish by expressing the gonad weight (g), as a percentage of the total bodyweight (G) using the formula:

$$I_G = \frac{g}{G} x\, 100$$

The frequency of spawning was determined by measuring the diameter of intraovarian eggs. Fecundity was enumerated by the volumetric subsample method as described by Bagenal & Braum (1978) and Macer (1974).

RESULTS

A total of 1,328 specimens were sexed and 656 fish were found to be males giving a sex ratio of 0.98:1 ($\chi^2 = 0.169$; P = 0.6806; df = 1). The size at which 50% of the fish are mature was taken as the size at which fish reach maturity for the first time. The percentage of sexually mature males in 11.1-13.0 cm size class is significantly greater than that of females (t = 12.029, df = 190, P< 0.0001). The L_{50} for length at first maturity was 12.8 cm and 13.9 cm for males and females respectively (Fig. 2).

the females. This corresponds to the period of low occurrence of mature and ripe fish (Figs. 3a & b). Two reproductive peaks were observed, one in March, and the second between October and December indicating the intense gonadal activity during this period and confirmed that the major spawning season of this species was from October to December.

Fig. 5 shows frequencies of ova diameter of the maturity stage IV. In this stage three modes are marked, the mode 'a' has grown to 0.47 and mode 'b' has attained 0.29 mm and third mode 'c' at 0.11 mm is discernible. Modes at 'a' and 'b' ensure progressive development of ova which ultimately take part in the spawning activity. The ova at mode 'a' are larger than those of 'b' and 'c' and two batches of ova are not likely to be shed simultaneously. They are shed in batches one after another with an interval of time. The multiplicity of modes in the mature ovary of *G. oyena* denotes its repeated spawning. Fecundity was studied in 56 fish with ripe gonads from October to Deecember. Size of fish examined range from 13.2 to 20.1 cm TL and the number of ripe ova per fish (stage IV) varied from 22,600 to 367,200.

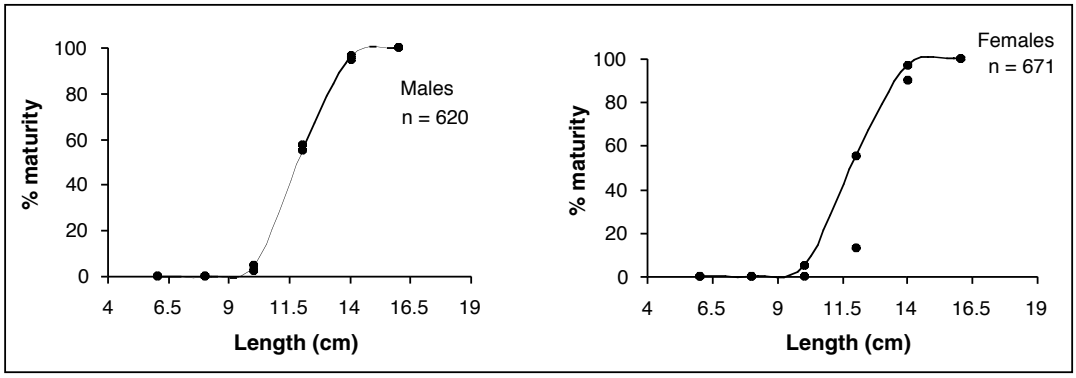

Fig. 2. Size at first maturity of females and males of *G. oyena*

Figs. 3a and b show that both males and females spawn throughout the year as indicated by the presence of mature and ripe gonads throughout the sampling period. The seasonal changes in mean gonad weight are shown in Fig. 4. The lowest value of mean I_G occurs in January and May for males and in January and February for

DISCUSSION

The observed sex ratio in the fishery could be due to gear selectivity, sexual differences in growth rate, partial segregation of mature fish, or to behavioural differences between the two sexes during spawning period (Etchervers, 1978; DeMartin & Fountain,

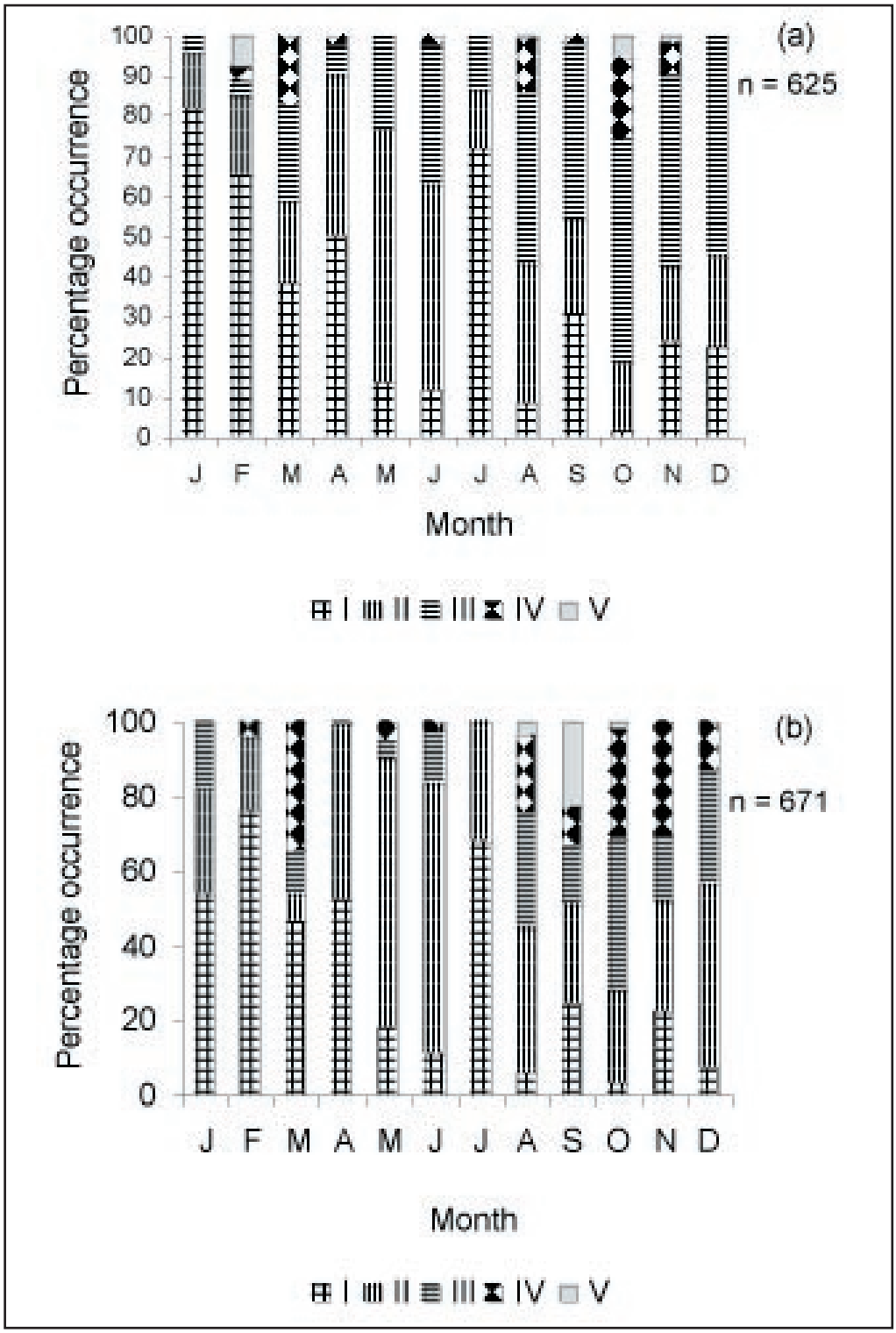

Fig. 3. Percentage composition of maturity stages of (a) males and (b) females of *G. oyena*

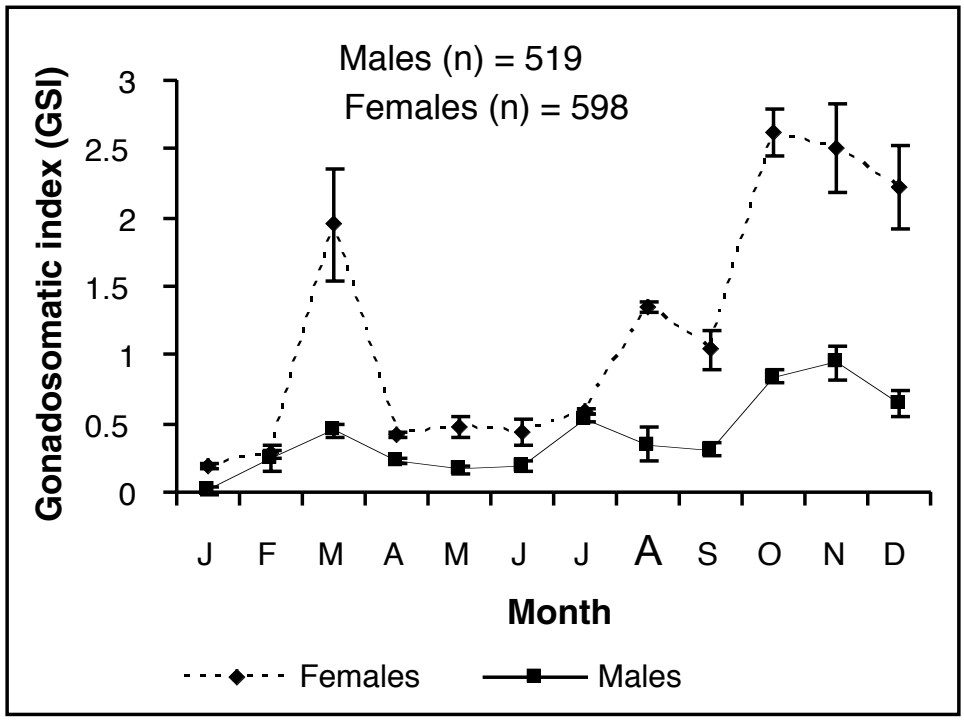

Fig. 4. Monthly variations of Gonadosomatic index (I_G) in males and females of *G. oyena.* Vertical bars show ± S.E.M

1981; Lowerre-Barbieri *et al*., 1996). In this study, male *G. oyena* attained sexual maturity at a smaller size than females. Similar observations and conclusions have been made by Patnaik (1971) on *G.s setifer*, by Etchevers (1978) on *Diapterus rhombeus*, by Albaret & Desfossez (1988) on G. nigri, by Kurup & Samuel (1991) on *G. filamentosus* and Sarre *et al* (1997) on *Parequula. melbournensis*. A variable body size at first sexual maturity is a common feature of serial spawners and fishes in general (DeMartin & Fountain, 1981). For fisheries management a focus could be on the size of maturation relative to capture size so as to reduce harvesting of pre-reproductive individuals and relative to recruitment size to determine the rate at which individuals enter the reproductive population.

Gerres oyena breeds throughout the year with two peaks, one in March and the other between October and December (Figs.3 and 4). These spawning peaks coincide with the northeast monsoon (NE), which starts from October to March. Observed peaks of spawning during this season concur with most of the findings on reproduction in different fish from East African coastal waters (Talbot 1960; Merret 1971; Okera 1974; Kamukuru & Mgaya, 2004). During the NE monsoon there a larger algal biomass and a high diversity of phytoplankton (Bryceson, 1982), and the greatest abundance of zooplankton (Kimaro, 1986).

Gerres oyena has asychronous ovary development (i.e. oocytes at all stages of development are present). Most species with asynchronous oocytic development have protracted spawning seasons with multiple spawning (West, 1990). The multiple modes (Fig. 5) in the mature ovary provide strong circumstantial evidence that *G. oyena* are multiple spawners. Multiple spawning increases the number of eggs that can be produced in a year (Burt *et al*., 1988). This reduces vulnerability to fishing and time of maturity (Lowerre-Barbieri *et al*., 1998), spreads the risk of predation on eggs and larvae over an extended period (Lambert & Ware, 1984) and acts as a buffer against adverse fluctuations in the amount of food available to the larvae.

The fecundity of *G. oyena* is relatively higher than other *Gerres* species. The fecundity of *Gerres setifer* ranges from 17,293 to 161,505 eggs with

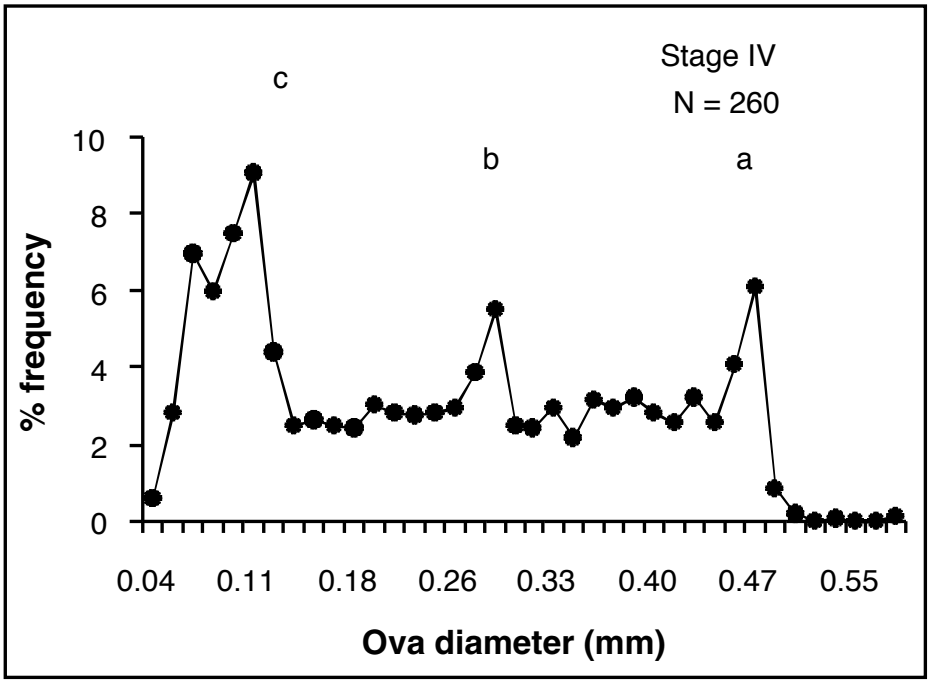

Fig. 5. Frequency distribution of ova diameter of *G. oyena* sampled between October-December

size range 88-193 mm TL (Patnaik, 1971) and *G. filamentosus* from 64,278 to 387,576 with size range 100-148 mm SL (Kurup & Samuel, 1991). This difference may be attributed to differences in habitat and environmental conditions. In conclusion, selecting mesh sizes slightly higher than length at first maturity will allows the fish to reproduce at least once before being recruited to the fishery.

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