SOME OBSERVATIONS ON THE SPAWNING BEHAVIOUR OF MACKEREL

By P. Vijayaraghavan

(*Central Marine Fisheries Research Institute*)

Past investigations have shown that the Indian mackerel has a prolonged spawning season which extends approximately to four or five months (Devanesan and Chidambaram, 1948; Chidambaram *et al.*, 1952; Bhimachar and George, 1952; Sekharan, 1958). During this period it is believed that the eggs are spawned in a number of successive batches though, so far, there has been no definite proof of it. From the patchiness of distribution of the transparent ova in the ovary Pradhan (1956) had suggested, that only a small percentage of the ova mature each time. Subsequently, more information was brought forth by Sekharan (1958) which indicated the possibility that the ova are ripened and released in batches. The following is a discussion of the observations on the ovaries of mackerel collected from Portonovo which lend further support to this inference though, however, in regard to certain details Sekharan's observations appear to be somewhat different.

For the purpose of the present study, female fish with their gonads in V–VI *a* stages of maturity* were selected at the commencement of the spawning season. Special care was taken to exclude ovaries in VI *b* stage, *i.e.*, those with transparent ova in the lumen, in order to avoid the possibility of including, in the enumerations, individuals which may have shed any egg. Frequency polygons of the distribution of ova in twenty fishes thus selected showed three prominent modes—the immature ova measuring less than 0·160 mm., another around 0·288 mm. which were maturing and a third around 0·672 mm. representing the mature ones the size of which is somewhat small, considering the range given by Pradhan (*op. cit.*) for mature ova, since stage VI *b* ovaries were excluded from calculations in the present work. These modes did not vary much between different fishes and therefore, in Fig. 1, it is their combined values that are depicted. Ova less than 0·160 mm. in diameter were not measured. Following Sekharan's (*op. cit.*) example, samples (about 200 ova each) from the anterior, middle and

* Maturity stages as defined by Pradhan and Palekar (Pradhan, *op. cit.*).

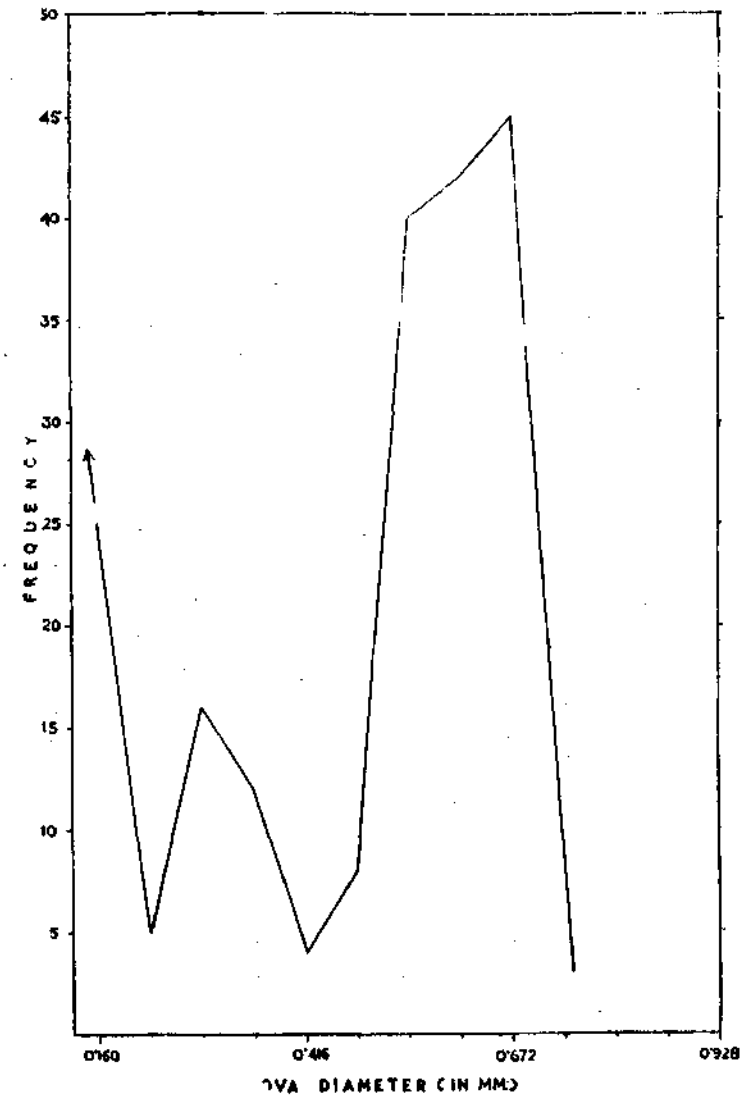

FIG. 1.

posterior parts of the ovary were treated separately and the frequencies pooled while plotting the curve for each fish. But 4–5 random samples of ova taken from each of the three regions and treated separately did not show any appreciable difference in size of the ova among the three regions. This was confirmed by the examination of the ovaries from a random collection of 10 fishes of identical maturity stages. Since these observations pertain to fishes in stages V–VI *a* as mentioned already, it is considered that the observations

in size composition of the ova among the anterior, middle and posterior parts of the ovary observed by Sekharan may be related to ovaries of stages other than V–VI *a*.

It is obvious from Fig. 1 that ova ranging from 0·480 mm. to 0·736 mm. are involved in the spawning, the season for which was to commence shortly. But no further inference can be made from this figure except that a considerable number of ova in various stages of ripeness are arranged in a compact series around the mode 0·672 mm. It was observed that they were comprised of ova which are opaque and a number of those which are in various degrees of transparency. By plotting the sizes of the two groups separately Sekharan found that within the maturing group of ova, those that were opaque and others which were in various degrees of transparency showed different modal sizes. This was interpreted as showing that the eggs are ripened and released in batches. But difficulty was experienced during the present study in assigning the transitional stages either to the opaque or to the transparent groups. However, without resorting to the abovementioned grouping it was possible to recognise the existence of a series of distinct modes by measuring the mature group of ova (all ova larger than 0·525 mm.) under a greater magnification which enable the plotting of values at a much smaller size interval. Thus, measurements were made under a magnification which gave the value of $3 \cdot 5 \mu = 1$ micrometer division and a size interval equal to the smallest measurement that was possible at this magnification, namely, $3 \cdot 5 \mu$.

Eight fishes examined in the above manner gave results which showed variability in the number and position of modes. In five of these the modes were clearly distinguishable whereas in the rest the modes were ill-defined especially towards the smaller size ranges. Typical examples from 4 such specimens are set forth in Fig. 2 *a*, *b*, and *c* representing those where the modes are well defined and *d* where they are less obvious. Further reduction in the size interval may probably help better separation of the modes. But the magnification used at present was the maximum that could be attempted within the microscope's field of vision. However, it should be sufficiently clear from Fig. 2 that the ripening group of ova reach the final stages of maturity in well-defined batches. There is no reason to expect that after the first batch is shed the others undergo degeneration. Because, during the spawning season, especially during its later half, one could always obtain without difficulty samples of fish representing almost a continuous gradation of ovaries ranging from fully ripe but unspawned to fully spent condition. The number of transparent ova that are often seen to linger in the lumen during the gap between the spawning of successive batches of eggs

and which are possibly resorbed would seem too few to affect fecundity assessments significantly. But as pointed out by various authors (Clark, 1934; Sette, 1943, etc.) in other species there is no proof yet in the Indian mackerel

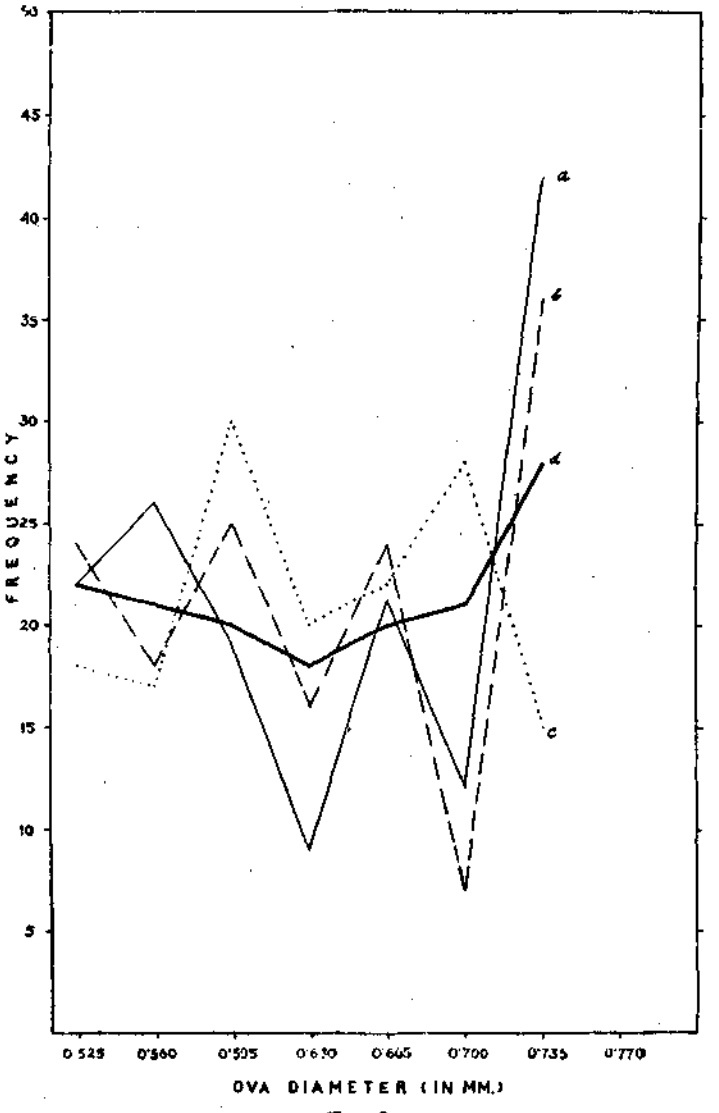

FIG. 2.

whether or not additions take place from smaller size groups of ova to the size range that contributes to the current spawning. It is felt that with the accumulation of more informa ion and with more refined methods, it should be possible to make reliable computations of the quantity and rate of expul-

sion of eggs in mackerel during a spawning season, though the author is well aware of the gaps in our present knowledge in realising this objective. An attempt has been recently made by Pathansali (1961) to find the ratio of the number of maturing to mature ova in *R. canagurta* caught in Malayan waters.

It may be relevant to mention certain observations made at Portonovo regarding the movements of mackerel during the spawning season. In the spawning season there is intense fishing during daytime as well as night. Fishing activity is confined to comparatively shallow waters, generally not beyond 5 miles from shore and depths less than 10–12 fathoms. Examination of samples (about 3,000 fish in each season) from commercial catches in the past four years showed that the day catches did not contain even a single fish with running ovary. They were invariably either in the threshold of spawning or showed signs of having just liberated their stock of truly oozing stages of ova. A handful of specimens with ova actually oozing came from the night catches indicating that the spawning activity is confined to night. The possibility that the fish, at the time of actual spawning, moves out of the range of the intense fishing operations suggests itself from the dearth of such individuals in the commercial catches. Further, regular samples of inshore (same area where the mackerel fishing was intense) plankton analysed during this period did not contain any fish egg that could be attributed as belonging to mackere'.

All the mature and spawning individuals that were landed at Portonovo appeared to have been feeding voraciously though, in the west coast of India the feeding intensity has been observed to be particularly low among mackerel in advanced stages of maturity (Chidambaram *et al.*, 1952; Bhimachar and George, 1952; Pradhan, 1956).

If during the spawning season mackerel feeds intensely in the inshore areas where they are fished and remains offshore to liberate their eggs as indicated by the present observations it may be worthwhile examining the manner in which this behaviour may be linked with the phenomenon of the eggs being spawned in batches during the season.

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