

OBSERVATIONS ON THE GONAD MATURITY STAGES OF  
FEMALE *RASTRELLIGER KANAGURTA* CUVIER

by

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ABSTRACT

The sequence of gonad maturation and spawning in female *Rastrelliger kanagurta* Cuvier is described. The results of classifications of gonads based on the *Rastrelliger* Field and Laboratory Keys are compared and the inadequacy of using ovary weights for such classification is discussed. Some observations are also made on the number of batches of ova that could be spawned in one reproductive season and on fecundity.

INTRODUCTION

In an earlier paper (Pathansali, 1961) the breeding season and the number of batches of ova that could be spawned by female *R. kanagurta* were described and discussed. The number of batches of ova that could be spawned were determined by comparing the ratio of the numbers of ripe ova to all maturing yolked ova in the ripe ovary. No attempt was then made to describe the ova diameter frequencies of mature and spent ovaries. Further collections of ovaries were made since the earlier investigation and the observations are recorded here.

A further object of this study is to verify the Field Key and especially the Provisional Laboratory Key of the gonad maturity stages of female *R. kanagurta* drawn up at the International Training Centre on the Methodology and Techniques of Research on Mackerel (*Rastrelliger*) held in Bangkok in 1958.

MATERIAL AND METHODS

Ninety ovaries were collected at the Pangkor Island purse seine fishery landing in December 1960. The stage of maturity of each ovary, its weight and the length of the fish were recorded. Selected ovaries

were immersed in Gilson's solution while the rest were preserved in 5% formalin. In the laboratory every ovary was re-examined, a representative selection of the various stages removed and sub-sampled to measure the ova diameters and to calculate the numbers of ova in mature and spent ovaries. Not less than 500 ova were measured from each ovary.

The maturity stages of the gonad referred to throughout this note are those embodied in the two keys mentioned above. Reference to "reports" and "observations" are those contained in the "Report of the International Training Centre on the Methodology and Techniques of Research on Mackerel (*Rastrelliger*)" by Holt (1959), unless otherwise stated.

## RESULTS AND DISCUSSION

From the superficial examination of the fresh ovaries in the field the following maturity stages, based on the Field Key, and the numbers in each maturity stage were recorded, Table IA. The results of the detailed re-examination of the same ovaries in the laboratory with the maturity stages based on the Provisional Laboratory Key and the numbers in each maturity stage are given in Table IB.

TABLE IA

### Field Key Stages

<u>State of Maturity</u>	<u>No. of Ovaries</u>
II	6 (1 recovering/spent)
III	71
IV	13

TABLE IB

### Provisional Laboratory Key Stages

<u>Stage of Maturity</u>	<u>No. of Ovaries</u>	<u>Mean Weight (g.)</u>
II	6	0.97 (0.86 recovering/spent)
IIIb	35	3.15
IIIb'	19	3.39
IVa	11	6.15
IVb	19	3.95
@ v	8	1.27

@ Taken at other times.

A comparison of the two tables show that important details are missed in the superficial examination. Partially spent ovaries cannot be detected with certainty unless the ova diameters are measured and their numbers estimated. Almost completely recovering/spent ovaries cannot be detected as the residual and degenerating ova following spawning are to be found free in the lumen of the ovaries. A comparison of the weights of the ovaries, Table 1B, in the various maturity stages show that it would be impossible to distinguish between maturity Stage II mature virgins and recovering/spent ovaries, and between Maturity Stage III mature and recovering/spent ovaries. Where the weights of ovaries are used to determine the reproductive cycle it would be necessary to carry out a careful internal examination of each ovary simultaneously. The opening up of ovaries is important for some countries reported that they had not observed mature, spawning and spent ovaries. The lengths of the mature fish recorded here, 17.5-19.8 cms, are comparable to the lengths of mature fish reported in the Philippines but are smaller than fish in the same condition reported by Indian Workers (also personal communication).

#### Ova diameter frequency distribution

The histograms in Figs. 1A to 1H illustrate the ova diameter frequency distributions of mature and spent ovaries. The equivalent maturity stages in the Provisional Laboratory Key are recorded in each histogram. The stages of maturity of the ovaries in Fig. 1, A-H, may be explained as follows:-

- Fig. 1, A and H - a mature virgin ovary and a recovering/spent ovary in Maturity Stage II.
- Fig. 1, B and C - ripening ovaries in Maturity Stages IIIa and IIIb respectively.
- Fig. 1, D and E - ripe ovaries in Maturity Stages IVa and IVb respectively. It would appear that the ripe ovary in Maturity Stage IVb is already spawning. A comparison of the numbers of ripe ova in Maturity Stage IVa as they progress to Maturity Stage IVb shows in the ovaries examined a decrease in numbers. The ripe ova are still visible externally. Maturity Stage IVb should then represent a spawning or a partially spent ovary.
- Fig. 1, F - an almost completely spent ovary in Maturity Stage IVc. But it could also represent a recovering/spent ovary, Maturity Stage IIIb', which has spawned one batch of ova. Ripe ova are not visible externally.
- Fig. 1, G - a spent ovary with degenerating opaque ova in Maturity Stage V that has spawned two or more batches of ova. Ovaries in Maturity Stage V would revert to Maturity Stage II.

In view of these observations the amendments suggested in the Report should be incorporated in the Provisional Laboratory Key. Then Maturity Stages IIIb', IVa' and IVb' would describe the ripening and spawning of a second batch of ova.

The process of ripening and spawning is obviously not continuous throughout the ovary. Comparisons of the ova diameter frequencies of the most advanced mode of opaque ova in Maturity Stages IIIb, IVa, IVb and IVc show no apparent increase in their distributions whilst the most advanced mode of ova separate ripen and are spawned. There appears then a time lapse between spawnings. Indian workers report that *R. kanagurta* may spawn twice, 3-4 months apart, in one reproductive season. During the two years of investigations ripe ovaries were observed for 6 and 7 months respectively in each year and if the observation of Indian workers were correct then the number of batches of ova that could be spawned would be limited - two or at the most three batches of ova within a reproductive season. The presence of spent ovaries in Maturity Stage V, Fig., I, G, indicate that at least two batches of ova must have been spawned to reach this stage. Other studies (Prabhu, 1956 and Dharmamba, 1959) on different species of fish with comparable ova diameter frequency distributions to *Pastrelliger* also indicate, according to these authors, the spawning of two batches of ova within a reproductive season.

#### Fecundity

The estimated numbers of ova in the size ranges 0.32 - 0.58 and 0.58 - 0.81 mm. in diameter in Maturity Stages IVa and Maturity Stage IVb and IVc are given in Table II.

TABLE II

FECUNDITY VALUES

No.	Maturity Stage IVa		Maturity Stage IVb & IVc	
	0.32-0.58 mm	0.58-0.81 mm	0.32-0.58 mm	0.58 & greater
1	12,370	12,960	31,840	160
2	20,195	20,480	37,760	800
3	20,090	14,560	19,680	320
4	20,016	18,080	18,560	1,920
5	19,688	14,873	14,659	107
6	23,840	21,280	14,320	2,880
7	23,168	18,480	16,112	32
8	14,697	13,440	20,865	1,170
9	16,264	11,128	11,760	2,410
10	26,710	15,040	22,320	412
11	21,727	15,920	20,784	81
12			37,450	764
13			25,145	1,814
14			16,080	217
Mean	19,888	15,113	21,933	

There is a considerable variation in the numbers of ova in each size range within and between ovaries in Maturity Stage IVa ovaries while the mean fecundity value obtained from ova 0.58-0.81 mm in diameter is 76.0% of that obtained from ova 0.32-0.58 mm in diameter. This difference could be due to loss of ripe ova during impoundment of the fish and their transfer to the fish hold or to actual differences in fecundity between batches of ova. A comparison of the mean fecundity values obtained from ova 0.32-0.58 mm. in diameter in the Maturity Stage IVa and Maturity Stage IVb and IVc shows them to be remarkably close and would tend to suggest that the difference in fecundity between batches of ova in the Maturity Stage IVa ovaries is more likely due to loss while handling.

The fecundity values obtained here from ova 0.32-0.58 and 0.58-0.81 mm in diameter during the 2nd year of investigation are about two times and one and a half times respectively of the fecundity value obtained from ova 0.58-0.81 mm in diameter during the 1st year of investigation, (Pathansali, 1961). Obviously, frequent estimates of large samples are required to determine the fecundity between batches and between fish in any on reproductive season to give a reliable estimate.

#### CONCLUSION

The reproductive cycle of female *R. kanagurta* compares with that of *Scomber scombrus* described by Stevens (1949, pp. 564-566). There is considerable difference in the maturity stages of ovaries within fish in the same school and in the same size range. This is amply illustrated in the 90 ovaries used in this study and is primarily the result of the peculiar mode of ripening and spawning of the ova in distinct batches over an extended period of time.

This peculiar method of spawning in *Rastrelliger* also creates problems in determining growth through length-frequency distributions. Moreover, as the spawning of any one batch of ova is not simultaneous in all fish, a number of broods are produced during each reproductive season. It is possible that the failure to obtain growth rates of *Rastrelliger* in the Pangkor Island purse seine fishery is due to this. Then one and sometimes two samplings were conducted each month. It might be necessary to carry out more frequent and intensive sampling, at least once a week, and to identify and follow the growth rates of each brood separately.

Where migratory species, such as *Rastrelliger* are concerned, it would be necessary to investigate breeding behaviour not only on one fishing area but over the whole range the species occurs. Recent investigations of the *Rastrelliger* purse seine fishery at Penang show that while maturing and spent ovaries have been recorded in the catches ripe ovaries have not been observed. It is possible that fish with later stages of ripening and ripe ovaries might be found in other fishing areas, for example in this instance, off Pangkor Island to the south or around Langkawi Islands to the north. Then only could the complete breeding behaviour and reproductive cycle be ascertained. This would entail identification of the stocks and migratory habits, which could be done more easily by tagging than by other biological measurements.

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FIGS. IA - H. OVA DIAMETER FREQUENCY DISTRIBUTION OF  
Rastrelliger kanagurta

