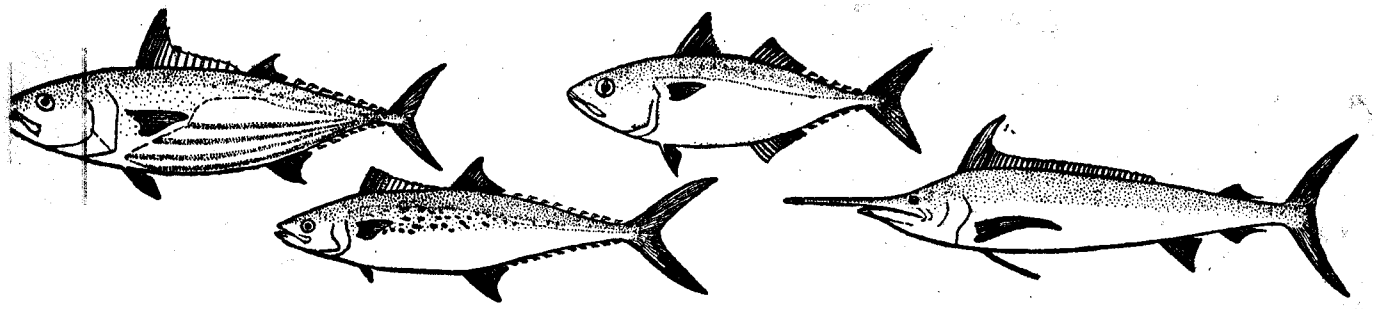
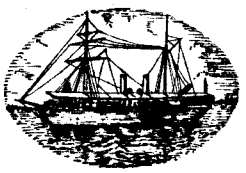


SYMPOSIUM ON SCOMBROID FISHES

PART II



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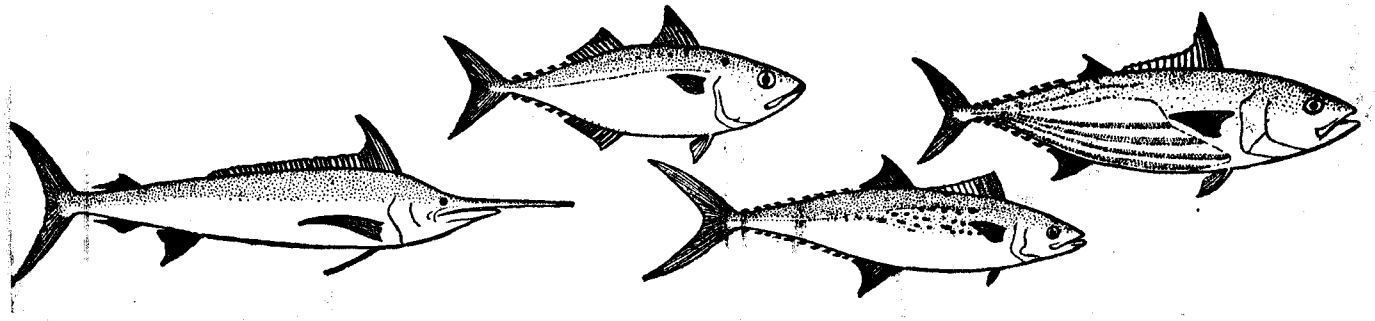

PROCEEDINGS OF THE

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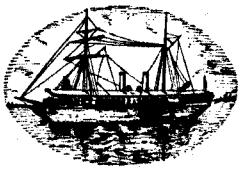
ON
SCOMBROID FISHES

HELD AT MANDAPAM CAMP FROM JAN. 12-15, 1962

PART II



SYMPOSIUM SERIES I

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GONADIAL ABNORMALITIES IN SCOMBROID FISHES*

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INTRODUCTION

THE most familiar case of 'Teratology' in fishes is the incidence of hermaphroditism, the occurrence of both ovarian and testicular tissues in the same individual. A number of teleosts have been known from the time of Aristotle, to be functional hermaphrodites in which there is the production and the expulsion of ova and spermatozoa, simultaneously or at different times. Hermaphroditism is reported as an occasional abnormality in mackerels and tunas among Scombroid fishes. It is interesting to note that instances of this phenomenon have not so far been observed in the other two groups of Scombroid fishes, namely, billfishes and seerfishes. Though extensive work is being done in Scombroid fishes in different parts of the world, the paucity of records on the incidence of this phenomenon indicates that this is rather rare in occurrence in the natural populations of these fishes. The arrangement of the component parts of the gonads in the abnormal hermaphrodites among Scombroids so far observed shows a wide range of variation. In addition to hermaphroditism, certain other abnormalities in the ovaries have been observed in the oceanic skipjack *Katsuwonus pelamis*. A review of the instances of abnormalities in gonads of Scombroid fishes is presented herein.

HERMAPHRODITISM IN MACKERELS

Among mackerels, hermaphroditism has been recorded only in two species—the Atlantic mackerel *Scomber scomber* and the Indian mackerel *Rastrelliger kanagurta*. Five instances have been recorded in *Scomber scomber* ; Malm (1873, 1874, 1877a and 1877b) and Stewart (1891).

In the hermaphroditic specimen of *Scomber scomber* reported by Stewart (Fig. 3), both the gonads were ovo-testes. Along the whole length of the right lobe of ovary on the dorsal side extended testicular tissue which somewhat exceeded the ovary in bulk. It slightly overlapped the outer surface of the ovary and still more so the inner. The posterior portion of the inner surface of the ovary for a distance of 15 mm. had the testicular structure and was generally continuous with the general body of the testis above. In front, the testis projected beyond the ovary and had to its inner side a bilobed mass of testis in contact but apparently not continuous with the main body.

The right lobe of ovary had a rounded commencement from which point it gradually tapered to the posterior extremity. The left lobe of ovary was slightly shorter than the right one and had the same diameter as the right lobe of ovary at the anterior end. The anterior two-thirds of the left lobe of ovary retained this diameter after which it tapered to the posterior extremity. The natural bulk of the left lobe of ovary somewhat exceeded the right one.

The whole length of the dorsal border of the left lobe of ovary with the exception of 15 mm. at its posterior extremity, gave attachment to testicular tissue which overlapped the outer surface of the ovary for about half its diameter. The extreme tip of the ovary was capped with a cocked-hat-shaped testis mass. Dorsally half way between the main body of the testis and the abovementioned lobe was a patch of testicular tissue flush with the general surface of the ovary.

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The ovary was full of well developed ova and spermatozoa were perfectly developed in the testicular regions. The ovary and testis were of approximately equal size.

Two instances of hermaphroditism have been observed in *Rastrelliger kanagurta*. The first has been recorded by Prabhu and Antony Raja (1959) in a specimen obtained from Karwar on the west coast of India (Fig. 1), and the second instance is from Mangalore by Ramamohana Rao (1961). In the first instance the left gonad had the characters of an ovary with yolky yellowish ova ranging in diameter from .15 mm. to .31 mm., mixed with a large number of transparent immature ova in it, while the right gonad had the characters of a normal testis. They differed in their positions, the left gonad being anterior to the right one. Both had ducts emerging from them which united to open outside by a common opening. The ovary which was in stage III was longer than the testis and the oviduct longer than the vas deferens.

In the second instance (Fig. 2), the right gonad was an ovo-testis and the left one had the characters of a normal ovary. A lobulated mass of testicular tissue was found to be appended to the right gonad with loose connective tissue. The left gonad was slightly longer than the right. The testicular portion was equal in length to that of the right gonad. The ovary was in stage III with the ova ranging from .15 mm. to .38 mm. in diameter, mixed with immature, transparent ova of smaller size.

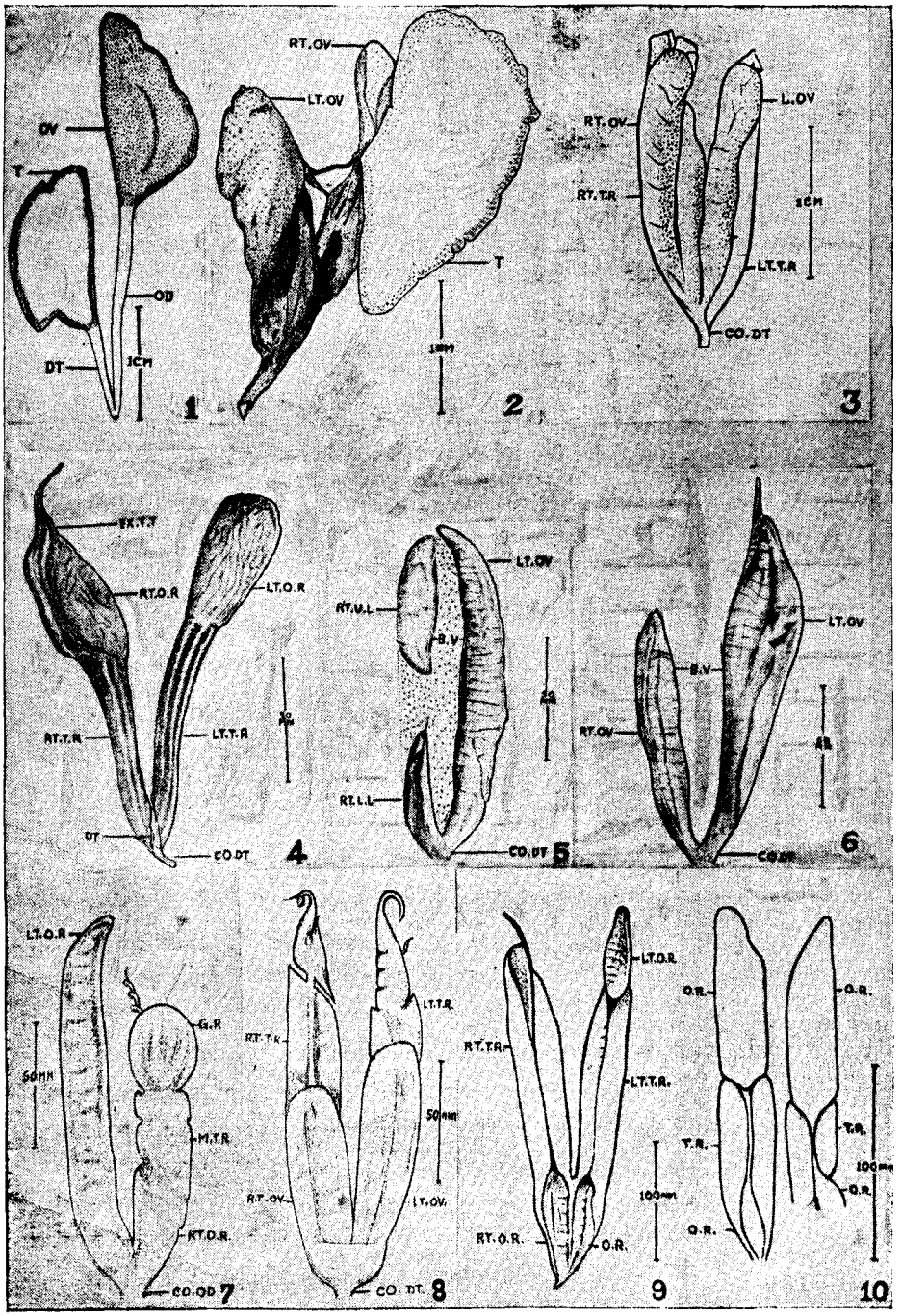
Hermaphroditism in Tunas

Though a larger number of tunas such as *Neothunnus macropterus*, *Kishinoella tonggol*, *Euthynnus affinis* and *Katsuwonus pelamis* have been examined, hermaphroditism as an abnormal feature has been observed only in the oceanic skipjack *Katsuwonus pelamis*. The first record is that of Nakamura (1935) from the Pacific ocean.

Two pairs of hermaphroditic gonads of *Katsuwonus pelamis* have been described by Uchida (1961) from Hawaii. In the first instance (Fig. 9) the left gonad was divided into three segments, the anterior one-sixth and the posterior one-third being ovarian and the remainder testicular, while the right gonad was divided into two segments, about two-thirds of the anterior portion being testicular and the remainder ovarian. In the second instance (Fig. 10) both the gonads were distinctly divided into three parts, an anterior ovarian section, a middle testicular portion and an ovarian segment posteriorly. The testicular portions contained no running milt, but their size suggested that they were in a rather advanced stage of maturity. The lumen of the anterior ovarian region was filled with a compact mass of resorbing ova, while the peripheral portion contained ova ranging from small transparent stages to larger opaque ova. The average diameter of the larger opaque ova was 0.504 mm. The posterior ovarian regions contained similar small and larger ova, but no resorbing ova were found. The anterior ovarian region of one gonad in the second instance contained in its lumen a loose mass of large, ripe, resorbing ova together with a few completely degenerated ova. The ova in the posterior ovarian sections in the second instance had an average diameter of 0.479 mm.

The presence of residual ova indicated that the fishes had been functional females. Assuming that the ova in each of the ovarian regions ripened simultaneously, it is possible that ova were extruded from the posterior regions at spawning time, while the extrusion of ova from the anterior sections was impossible owing to the absence of adequate ducts. This could account for the presence of the resorbing ova in the lumen of these regions.

From Indian waters Raju (1960) recorded a hermaphroditic gonad in the same species, from the Laccadive sea (Fig. 4). In this instance, in both the gonads the anterior regions were differentiated into ovarian tissue, the posterior regions remaining typically testicular in nature. The ovarian region contained translucent and yellow ripe ova varying from 0.63 mm. to 0.81 mm. in diameter. One of us (P.T.T.) collected two more hermaphroditic specimens of the same species



Figs. 1-10. Abnormal gonads of scombroid fishes.

For explanation see p. 724

from the Laccadive sea. In one instance (Fig. 7) the left gonad was normal while the other showed hermaphroditic features. In this gonad, three regions could be clearly distinguished, a thin-walled bulbous anterior region filled with a watery fluid, a middle testicular region overlapped on the ventral side by a portion of the ovarian tissue at the posterior margin, and a posterior ovarian region. A small duct on the posterior midventral side of the testicular region, was continued along the margin of the ovarian region and united with the common duct of the two gonads which in turn opened into the cloaca.

In the other instance, (Fig. 8), each gonad was distinctly demarcated into an anterior testicular, and a posterior ovarian region. Both the testicular portions of the gonads tapered towards their anterior ends into thread like structures. The ovarian regions in both the gonads were folded along the lateral margin on the ventral side, giving them a groved appearance.

Other Gonadial Abnormalities in Tunas

Two instances of other abnormalities in the gonads of *Katsuwonus pelamis* have been reported by Raju (1960). In one instance (Fig. 5), the left ovary was normal while the right ovary had an anterior lobe completely cut off from the lower portion which was connected to the normal left ovary. In the second instance (Fig. 6), the abnormality was apparently caused by the infection of larval nematode worms in large numbers. The enormous development and hardening of the left lobe, with the complete destruction of the mature ova in it, was the result.

General Remarks

In all the instances of hermaphroditism so far recorded in Scombroid fishes, the gonads were either in the maturing, mature or ripe stages. This indicates that the gonads undergo normal development from the immature to the ripe stage, though the degrees of maturity of the ovarian and testicular tissues of the same gonad were observed to be varying.

Now the question arises whether there is the actual expulsion of the sperm and the ova from the same individual. Though this has not been actually observed, the possibility existed in certain cases. In the gonad reported by one of us (Raju 1960), the ovarian region contained translucent fully ripe ova. Though the testicular region had a normal vas deferens, it abruptly ended at the margin of the ovarian part, leaving the latter as a closed sac having no communication with the exterior. Therefore the only possibility for the liberation of the ova was by the rupture of the ovarian wall. In one of the other two cases, the vas deferens of the anteriorly placed testicular region running along the margin of the ovarian part was found to open into the common duct, whereas in the second case, (Fig. 8), the vasa deferentia of the anteriorly located testicular parts were found to open into the lumen of the ovarian regions in both the gonads. In both the above cases there is every chance for the spermatozoa to be shed into the ovarian region and to self fertilize the ova, if conditions were congenial.

In the Indian mackerel described by Prabhu and Antony Raja (1959) there is the unilateral arrangement of the testis and the ovary with their normal ducts opening to the outside, thereby facilitating the expulsion of the sexual products. Self fertilization can be expected if the gonads mature simultaneously. In the other case, (Ramamohana Rao 1961) in which the testicular tissue is connected to the ovary by loose connective tissue, no connection seems to exist for the passage of the sperms to the ovary. The spermatozoa observed by him in the testicular tissue when mature can only be liberated into the body cavity by the rupture of the wall.

One of the abnormal cases of the gonad in *Katsuwonus pelamis* (Raju 1960) appears to be due to parasitic infection. The presence of such parasites only in the ovary and not in any other part of the body is peculiar. It may be due to the specialised environment provided by these organs.

The occurrence of hermaphroditism in the Scombroid fishes which are normally dioecious indicates that the determination of sex in very rare cases may be upset in such a way as to develop the ovary and testis in the same individual. Brambell (1930) assumes that the factors determining the development of the germinal ridge into an ovary or testis are not co-existent in vertebrates and they are antagonistic and never active simultaneously in the same individual. Whether acting simultaneously or consecutively, they result occasionally, in the production of the ovary and testis in the same individual.

The absence of records of such abnormalities in billfishes and seerfishes does not necessarily mean that the sex determining mechanism is stable in the above groups, but may probably be due to the comparatively small number of specimens examined. However the apparent absence of abnormality in the gonads of the Pacific mackerel *Pneumatophorus deigo* and other species of *Rastrelliger* and tunas does not rule out the possibility of the stability of sex determining mechanism in these fishes that are also examined in large numbers and the instability of such mechanism in *Scomber scomber*, *Rastrelliger kanagurta*, and *Katsuwonus pelamis*.

Summary

A brief review of abnormalities in the gonads of Scombroid fishes has been made. The most common abnormality is the occurrence of hermaphroditism which has been recorded in the Atlantic mackerel *Scomber scomber*, and the Indian mackerel *Rastrelliger kanagurta*. Among tunas hermaphroditism has been recorded only in *Katsuwonus pelamis*. Two new instances of the phenomenon are reported herein, in the oceanic skipjack. Two other types of abnormalities have also been reported in the skipjack.

Acknowledgement

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Explanation to Text-figure

1. Hermaphroditic gonads of *Rastrelliger kanagurta*. 2. Hermaphroditic gonads of *Rastrelliger kanagurta*. 3. Hermaphroditic gonads of *Scomber scomber*. 4. Hermaphroditic gonads of *Katsuwonus pelamis*. 5. Abnormal gonads of *K. pelamis* with divided right lobe. 6. Parasitised gonad of *K. pelamis*. 7. Hermaphroditic gonads of *K. pelamis* (Dorsal view). 8. Hermaphroditic gonads of *K. pelamis* (Ventral view). 9. Hermaphroditic gonads of *K. pelamis*. 10. Hermaphroditic gonads of *K. pelamis* (Diagrammatic).

Legend

B. V.-Blood vessels, CO. DT.-Common duct, DT.-Ducts of the two sides emerging from the testes, Ex. T.T.-Extensions of the testicular tissue, G. R.-Globular region, LT. O. R.-Left ovarian region, LT. OV.-Left ovary, LT. T.R.-Left testicular region, RT. L. L.-Right lower lobe, RT. OV.-Right ovary, RT. O.R.-Right ovarian region, RT.T.R.-Right testicular region, RT. U.L.-Right upper lobe.

Fig. 1. after Prabhu and Antony Raja 1959, Fig. 2. after Ramamohana Rao 1961, Fig. 3. after Stewart 1891, Figs. 9 and 10 after Uchida 1961.