

## NOTES ON EGGS, LARVAE AND JUVENILES OF FISHES FROM INDIAN WATERS

VIII. *Scomberomorus guttatus* (Bloch and Schneider), IX. *Scomberomorus commerson* (Lacépède) and X. *Scomberomorus lineolatus* (Cuvier)

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### VIII. *Scomberomorus guttatus* (Bloch and Schneider)

THIS is the commonest seerfish in Indian waters and is fairly widely distributed in the Indo-Pacific from the Persian Gulf in the east to the Western Pacific from Taiwan to Indonesia. It attains a length of about  $\frac{3}{4}$  of a metre. According to Munro (1943) *S. guttatus* does not occur in Australian waters and the specimens formerly identified as *S. guttatus* were most likely either *S. queenslandicus* or *S. semifasciatus*. Some may even refer to *S. niphonius*.

The only information we have on the developmental stages of *S. guttatus* is by Delsman (1931) and Vijayaraghavan (1955). The former had collected three sets of eggs from three places, viz., Kumai in Borneo, Amphitrite Bay in Sumatra and Cheribon in Java and had adduced reasons for considering them as those of *Cybium* (= *Scomberomorus*) and at least one of them as those of *Cybium guttatum* (= *S. guttatus*). Though descriptions and figures of the three types of eggs and the larvae that hatched out from them have been given by Delsman (*op. cit.*) there has been no attempt subsequently on the part of anyone to check or confirm his provisional identification and unfortunately it would appear that the tendency has been to consider his inference as final though he never wanted them to be taken so. None of the eggs could be of *S. commerson* since their characters do not agree with the eggs of this species given by Munro (1942) who had artificially fertilized them and studied their development up to the prolarval stage. In view of the difference in the alignment of the chromatophores in the embryos and larvae described by Delsman it is almost certain that the eggs collected by him from Indonesian waters belong to three different species. If it is presumed that the general appearance of the early larvae of *S. commerson* and *S. guttatus* could be more or less similar, the chances are that none of the eggs referred to by Delsman could be considered as belonging to the latter also.

Large numbers of late larval and juvenile specimens of *Scomberomorus guttatus* are caught along with *S. commerson* in shore seines during February to May along the South Kerala coast and the specimens described in this account are mostly from Vizhingam near Trivandrum. Juvenile specimens from Madras and Waltair were also examined in the course of this study and no significant differences were noticed between them. The smallest specimen in the collection was about 16 mm. in total length and a connected series consisting of hundreds of specimens up to a length of about 75 mm. were available for examination. Detailed measurements of a selected number of specimens are given in Table I. Alizarin preparations were made to study the vertebral counts and other skeletal characters for the confirmation of the species and to distinguish it from *S. commerson*. While *S. guttatus* has 48-49 vertebrae + urostyle, *S. commerson* has 43-44 + urostyle. The former has a comparatively shorter head, a less pointed snout and a deeper body than the latter. The head length to standard length relationship in the early juveniles of the two species is given in Fig. 1. Further the teeth are comparatively small in *S. guttatus* whereas they are larger in *S. commerson*. In the younger specimens studied the size of the pre-opercular spines get progressively reduced from above to below and none extends beyond the operculum in *S. guttatus*, whereas in the corresponding stages in *S. commerson* the second spine situated at the angle of the pre-opercle is conspicuously larger than the rest and extend beyond the operculum. In older specimens with the distinct adult characters there is hardly any difficulty in distinguishing the species. The only possibility is that stages of *S. guttatus* could be confused with *S. lineolatus* between which there is some superficial resemblance. The latter has 49 or 50 vertebrae.

14.8 mm.\* Stage (Fig. 2).—The head is 2.7 and height 4.3 in standard length. Most of the larval characters are lost except the pre-opercular spines of which the uppermost is the largest. Teeth are present and these are comparatively smaller-sized than those in the corresponding stage in *S. commerson*. All the fins have their full complement of rays and spines but the membranous connection between the finlets still persists. The general colouration is white in formalin and chromatophores are distributed as shown in the figure. On the head they are present in patches at the tip of the snout, above and below the orbitals, above the region of the hind brain and on the posterior region of the opercle. On the body they are present close to the base of the dorsal fin, and along the mid-lateral line and a few

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\* Unless otherwise mentioned all lengths given are standard length.

TABLE I

*Measurements of Scomberomorus guttatus (Bloch and Schneider) in mm.*

Sl. No.	Place and date of collection	Standard length	Head	Snout	Eye	Maxilla	Sn. to 1st D.	Sn. to Anal	1st dorsal spine	Depth at 1st dorsal origin	Gill rakers
1*	V. 16-3-1959	14.76	4.50	2.15	1.52	3.14	5.50	8.73	0.96	2.93	..
2	do.	15.04	5.40	2.19	1.57	3.45	6.21	10.15	1.15	3.62	..
3	do.	16.64	5.64	2.19	1.62	3.56	6.24	10.37	1.10	3.92	..
4	do.	17.85	6.19	2.40	1.68	3.61	6.80	11.42	1.20	3.80	..
5	do.	18.74	6.75	2.56	1.83	4.01	7.17	12.13	1.41	4.10	..
6	do.	19.23	6.91	2.77	1.88	4.02	7.32	12.46	1.36	4.18	..
7	V. 11-3-1959	19.84	6.85	2.56	1.88	4.13	7.29	12.64	1.41	4.18	..
8	do.	20.06	7.17	2.82	1.95	4.50	7.64	13.19	1.41	4.56	..
9	do.	21.20	7.20	2.66	1.89	4.38	7.75	13.61	1.41	4.49	..
10	do.	22.72	7.70	2.93	2.04	4.71	7.68	14.07	1.57	5.18	..
11*	V. 27-2-1959	22.90	7.70	2.85	1.94	4.71	8.10	14.28	1.80	5.10	0+3
12	do.	25.00	8.40	3.00	2.20	5.00	9.20	16.50	2.10	5.50	0+4
13	do.	28.00	8.70	3.00	2.20	5.30	9.50	19.00	2.30	6.00	1+5
14	do.	30.70	9.60	3.60	2.20	5.60	10.50	19.50	2.50	6.40	0+6
15	V. 1-5-1959	35.00	10.70	4.00	2.40	6.10	12.00	21.20	2.90	7.10	2+5
16	do.	38.50	12.20	4.20	2.80	6.20	13.00	24.50	2.80	7.70	1+5
17*	do.	41.20	12.60	5.20	2.90	6.50	13.30	26.50	3.00	8.20	1+4
18	do.	45.00	12.40	5.10	3.00	6.80	13.70	28.10	3.00	8.90	2+5
19	W. 28-2-1958	49.00	14.00	5.00	3.00	7.70	14.90	30.50	3.90	10.30	1+4
20	do.	51.50	13.40	5.00	3.20	7.70	15.80	31.80	3.90	10.60	2+6
21*	W. 25-2-1959	66.80	16.90	5.80	3.60	9.40	18.80	38.30	5.00	14.60	2+5
22	do.	75.50	19.50	6.80	4.20	10.70	21.20	44.20	5.80	16.80	2+7
23	do.	83.50	21.20	7.00	4.50	11.20	23.70	49.50	6.00	19.00	2+6
24	V. 4-8-1959	228.80	48.00	17.00	8.40	26.70	57.40	125.00	12.60	44.00	3+7
25*	do.	239.00	48.80	17.20	8.90	26.80	58.20	127.00	12.80	44.50	3+8

\* Denotes specimens described and figured. V. = Vizhingam. W. = Waltair (collected by Mr. K. Srinivasa Rao).

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at the base of the caudal and anal fins. The anterior region of the first dorsal is slightly pigmented.

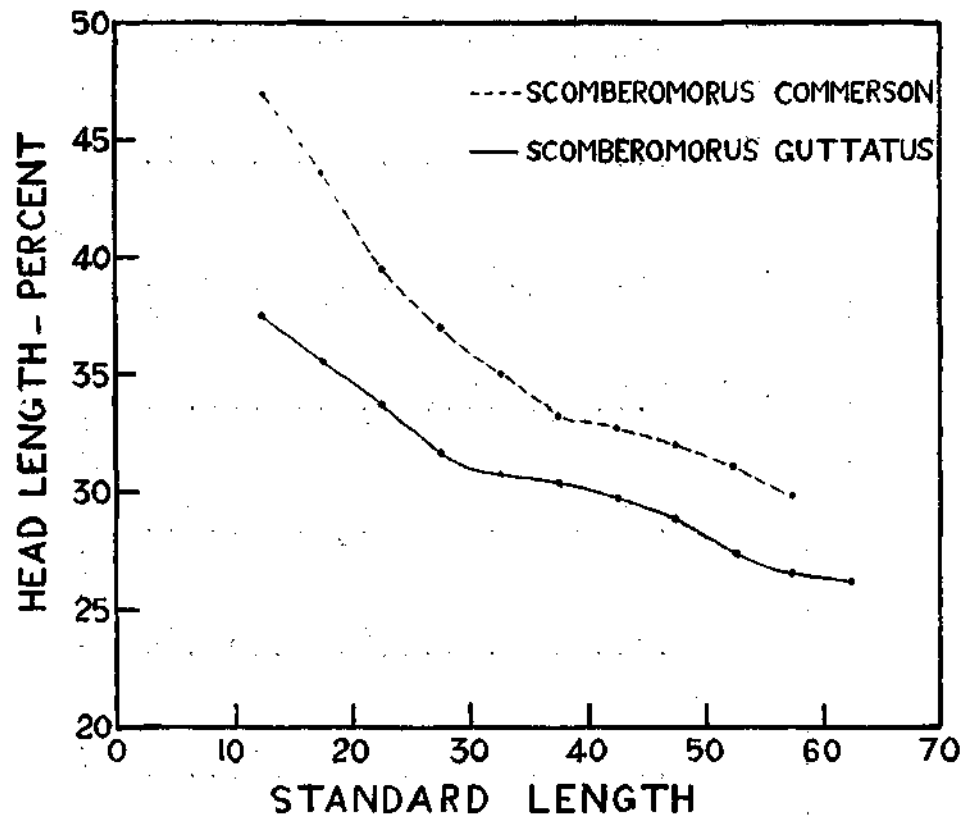


FIG. 1. Percentage of head length against standard length in mm.

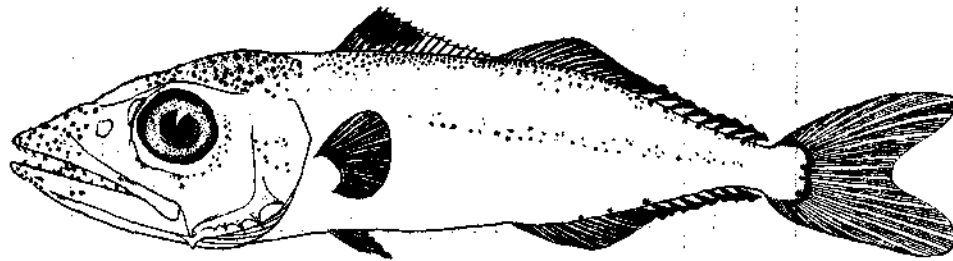
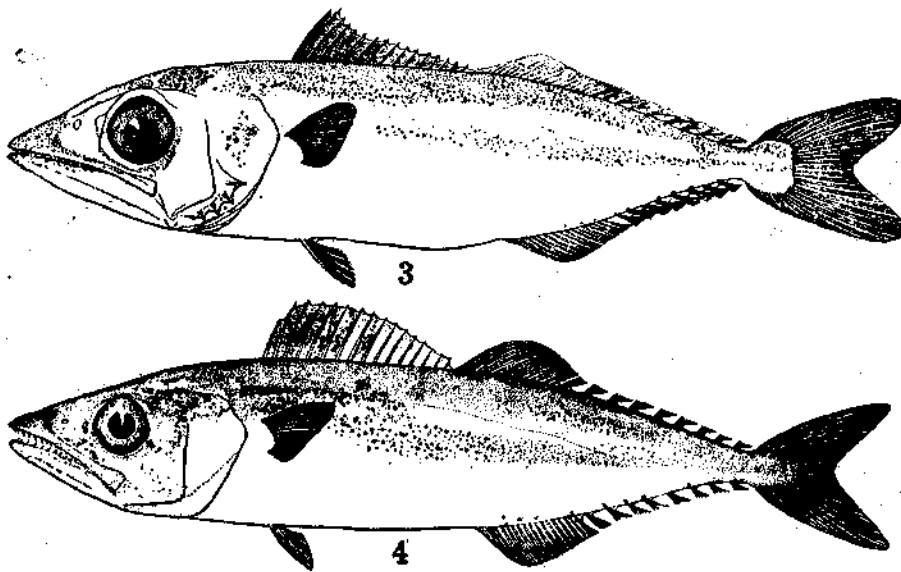


FIG. 2. *Scomberomorus guttatus*, 14.8 mm. long.

22.9 mm. Stage (Fig. 3).—The head is 3 and height 4.5 in standard length. Except for the slight increase in the depth and length of the body

there is very little difference from the earlier stage. Chromatophores have slightly increased in number.



FIGS. 3-4. *Scomberomorus guttatus*. Fig. 3. 22.9 mm.; Fig. 4. 41.2 mm.

41.2 mm. Stage (Fig. 4).—The head is 3.3 and height 4.7 in standard length. The pre-opercular spines have become smaller and inconspicuous. The lateral line could be made out up to the vertical below the third dorsal finlet. The chromatophores have appreciably increased in number and appear as a continuous band, but not quite uniform, from the head to the caudal base. While the lateral band of chromatophores has merged with the dorsal band on each side of the body, those at the base of the anal fin and finlets have disappeared.

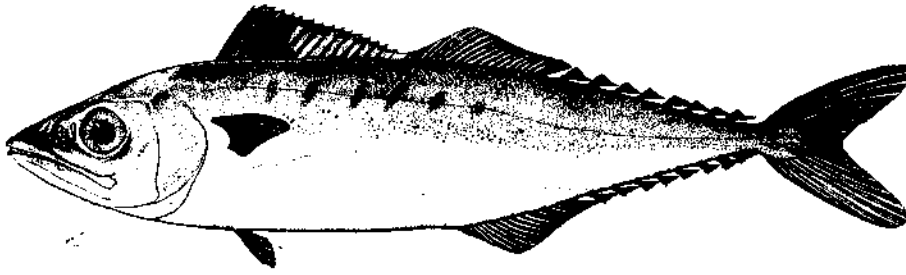
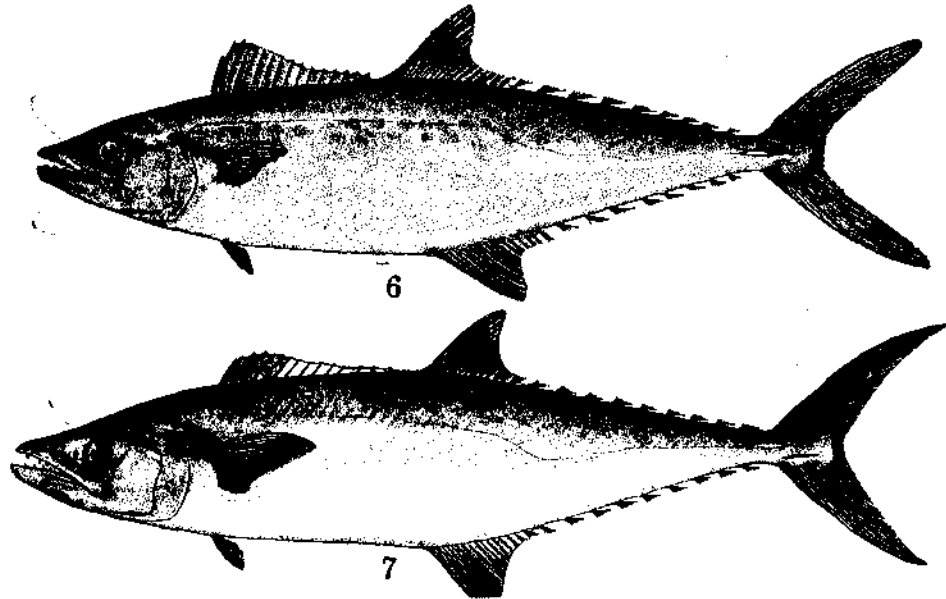


FIG. 5. *Scomberomorus guttatus*, 66.8 mm.

66.8 mm. Stage (Fig. 5).—The head is 4 and height 4.6 in standard length. The pre-opercular spines have almost disappeared completely. The

lateral line is complete. The chromatophores on the upper half of the head and body are more dense with five dense patches indicating the beginning of the characteristic colouration of the adult.



FIGS. 6-7. Fig. 6. *Scomberomorus guttatus*, 239 mm.; Fig. 7. *Scomberomorus lineolatus*, 295 mm.

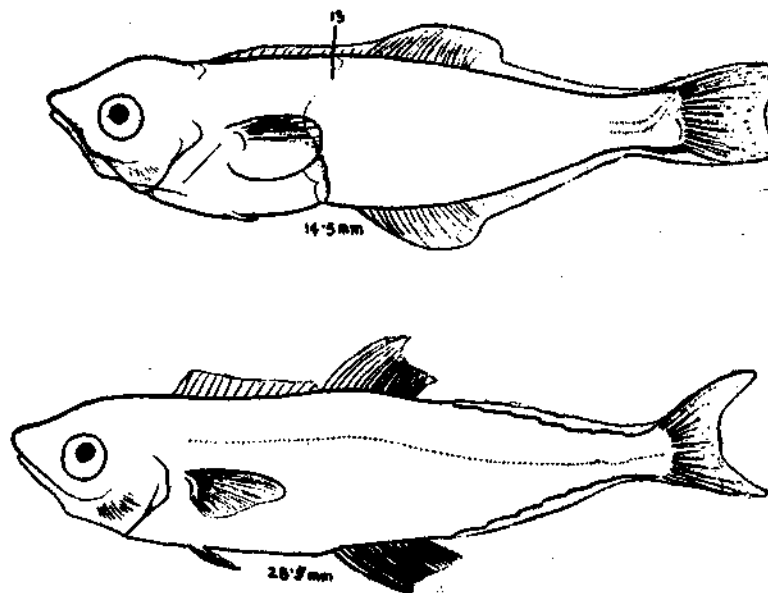


FIG. 8. *Scomberomorus guttatus*, 14.5 mm., and 28.5 mm. Reproduced from Vijayaraghavan (1955).

A juvenile specimen 239 mm. in standard length is shown in Fig. 6. It has all the unmistakable features of the adult. The head is 4.8 and height 4.4 in the body, whereas in mature adult they are about 4.1-4.5 and 3.7-4.4 respectively. The characteristic spots found on the body becomes more distinct as the fish grows in size.

With regard to the account of Vijayaraghavan (*op. cit.*) on the life-history and feeding habits of *S. guttatus*, it is quite obvious that there is some mistake in the identity of the material he had worked out. The two oldest stages figured are reproduced here for comparison (Fig. 8). To mention a few points regarding post larvae and juveniles (i) the short length of head, (ii) the obtuse-angled or blunt snout, (iii) the absence of any teeth, (iv) the absence of any preopercular spines, (v) the pre-anal length being shorter than the post-anal length, (vi) the shape of the dorsal and anal fins, (vii) the finlets not getting differentiated even in the 28.5 mm. stage and (viii) the almost total absence of chromatophores all go to show that the stages described cannot be of any *Scomberomorus* known from Indian waters. It therefore follows that the feeding habits attributed to the larvae and juveniles of *S. guttatus* do not also relate to the above species.

#### IX. *Scomberomorus commerson* (Lacépède)

This is the most widely distributed seerfish in the Indo-Pacific and is known from the east coast of South Africa and along the entire range of the Indian Ocean to Japan and the east coast of Australia as far as Fiji, New Caledonia and Solomon Islands. It grows to a length of over 1½ metres.

The only information we have about the development of *S. commerson* is the account by Munro *op. cit.* on the embryonic and early larval stages of the fish. He succeeded in artificially fertilizing the eggs of the fish at Watt Reef near Townsville, North Queensland and was also able to collect naturally spawned eggs from the sea. The breeding season of the fish in Queensland waters is from October to December which in the southern hemisphere corresponds more or less to the spring season. Natural spawning takes place in the early hours of the evening. A few important points from the observations of Munro (*op. cit.*) are given below as it might help the workers in the Indian region in the identification of the eggs and early larvae of this species. According to him the embryonic and larval stages resembled very much the corresponding stages of *Cybium maculatus* (= *S. maculatus*) described by Ryder (1882)\*.

\* It may incidentally be stated here that stages corresponding to Figs. 2-6 measuring from 2.75-5.75 mm. doubtfully referred to by Hildebrand and Cable (1938) as of *S. maculatus* do not appear to be on any species of *Scomberomorus*.

Clear ova from mature roes collected by him from Palm Islands had a diameter of 1.13–1.28 mm. whereas those from the Watt Reef area measured 1.23–1.38 mm. Eggs from the latter place were artificially fertilized and these had a diameter of 1.23 mm. The oil globule in all the above were of a uniform size of 0.31 mm. Naturally spawned ova collected from the same area had 1.05–1.12 mm. diameter with 0.31–0.39 mm. oil globule. The temperature of the water was 25.7° C. and salinity 36.5‰ in the sea when naturally spawned eggs were collected and the same conditions were maintained in the hatching vessels at the time of artificial fertilization.

The egg floats with the oil globule at the top and the blastodisc is formed at the opposite pole where ultimately the embryo gets differentiated. The 4-celled stage is reached nearly an hour after fertilization and subsequently cell divisions take place at intervals of about 10 minutes each. At 13½ hours after fertilization the embryo has 8–9 somites and pigments begin to appear about an hour-and-a-half later. Complete investiture of the yolk by the blastoderm takes place at about 16½ hours after fertilization by which time 17 somites are discernible. At about 20 hours after fertilization the embryo shows movement and pigmentation shows a definite pattern. Hatching takes place 3–4 hours later by which time the tail portion gets appreciably elongated. The newly hatched larva is 2.5 mm. in total length with an oil globule of 0.26 mm. in diameter and floats with the yolk sac up. It grows to 3.5 mm. in another 16 or 17 hours.

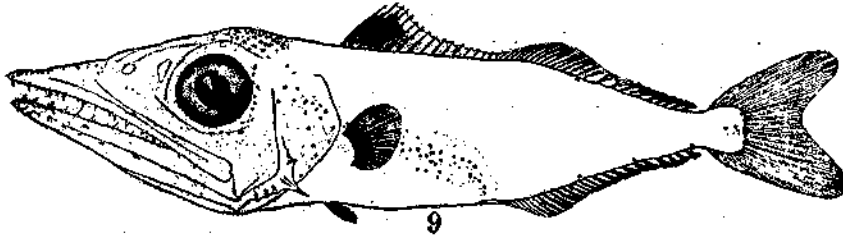
The late post larvae and juveniles described in this account were collected from shore seines from Vizhingam during the months of February to June. A large number of specimens up to about 75 mm. were available for examination. Some young specimens were examined from Madras and Waltair also. The measurements of some of these are given in Table II and some of the typical stages are described below.

14.4 mm. Stage (Fig. 9).—The head is 2.3 and height 4.2 in standard length. When compared to the same stage of *S. guttatus* the snout is very long, pointed and the teeth larger and more prominent. The second spine from above on the preopercule is the longest and it projects beyond the operculum. Chromatophores are much fewer than in the corresponding stage of its congener and the dorsal and lateral bands are absent. The pigmentation in the wall of the abdominal cavity can be seen through.

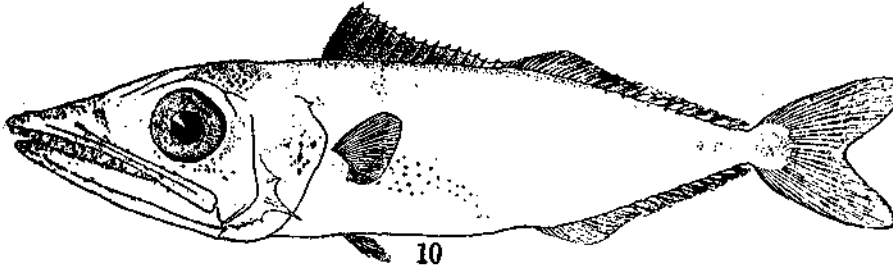
24 mm. Stage (Fig. 10).—The head is 2.6 and height 4.5 in standard length. There is little difference from the previous stage except in the slight elongation and broadening of the body and increase in chromatophores.



A very narrow band of chromatophores is present close to the base of the spinous and soft dorsals and a chromatophore each below the first few dorsal finlets. There is a small cluster at the base of the caudal fin extending to the caudal peduncle.

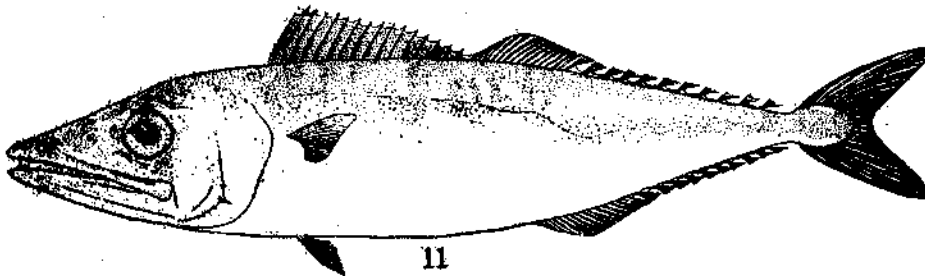


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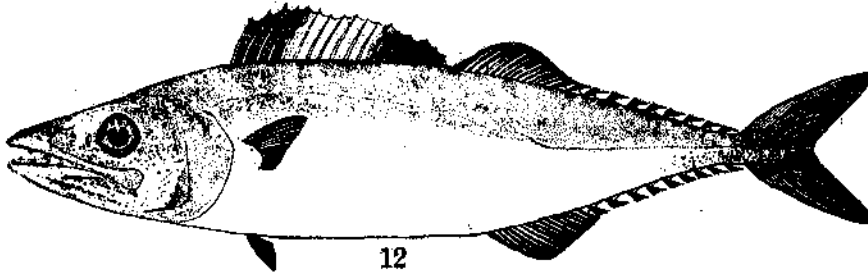


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FIGS. 9-10. *Scomberomorus commerson*. Fig. 9. 14.4 mm., Fig. 10. 24 mm.



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FIGS. 11-12. *Scomberomorus commerson*. Fig. 11. 42.4 mm., Fig. 12. 54.5 mm.

42.4 mm. Stage (Fig. 11).—The head is 3.2 and height 4.7 in standard length. The preopercular spines are considerably reduced in size and appear

TABLE II

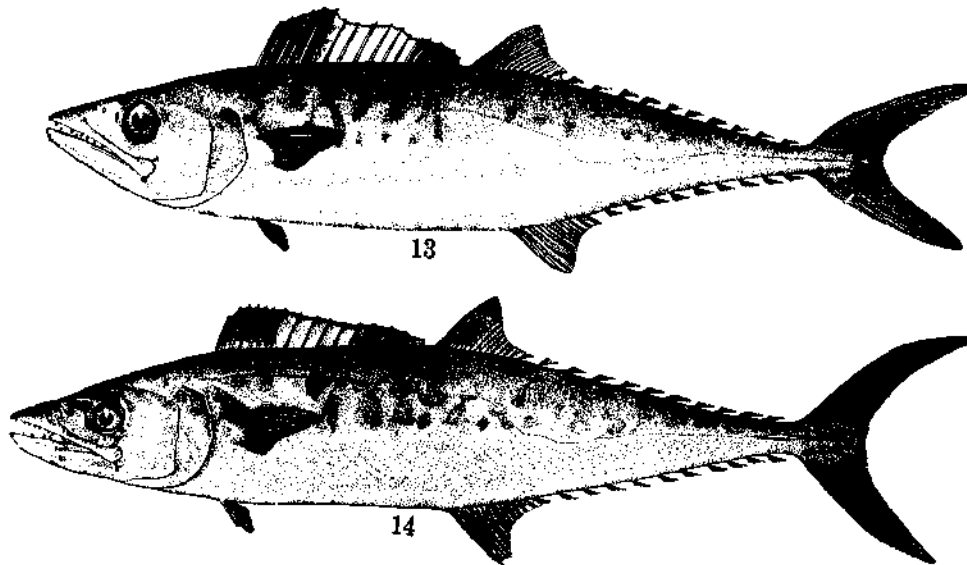
Measurements of *Scomberomorus commerson* (Lacépède) in mm. (All specimens from Vizhingam)

Sl. No.	Date of collection	Standard length	Head	Snout	Eye	Maxilla	Sn. to 1st D.	Sn. to Anal	1st dorsal spine	Depth of 1st dorsal origin	Gill rakers
1*	26-2-1959	14.4	7.01	3.35	1.62	4.86	6.81	10.04	1.36	3.87	..
2	do.	15.60	7.11	3.20	1.72	4.85	6.84	10.41	1.36	4.03	..
3	do.	16.10	7.11	3.14	1.72	4.81	7.07	11.15	1.36	4.03	..
4	do.	16.50	7.74	3.71	1.78	4.97	7.39	11.41	1.41	4.24	..
5	2-1-1959	18.80	8.04	3.61	1.88	5.23	7.80	12.92	1.46	4.45	..
6	do.	19.50	8.20	3.60	1.90	5.50	8.60	14.20	1.60	5.00	..
7	21-3-1959	20.80	8.40	3.70	1.90	5.60	8.80	14.70	1.70	5.30	..
8	2-3-1959	22.30	9.00	3.80	1.90	6.00	9.20	15.20	1.80	5.30	..
9*	do.	24.00	9.40	4.00	2.00	6.30	9.70	16.20	2.00	5.90	..
10	do.	26.50	9.80	4.30	2.10	6.60	10.10	16.80	2.00	6.10	..
11	do.	28.50	10.30	4.50	2.10	7.00	10.90	18.50	2.10	6.90	..
12	11-3-1959	37.80	13.00	5.20	2.70	8.00	12.90	24.20	2.40	8.50	..
13	do.	40.50	13.20	5.30	2.80	8.10	13.30	26.00	2.40	9.00	..
14	4-3-1959	41.70	13.80	5.70	2.90	8.60	14.00	28.20	2.70	9.30	..
15*	do.	42.40	13.90	5.80	2.90	8.60	14.20	27.90	2.80	9.20	..
16	do.	46.50	14.70	5.90	3.00	9.00	15.10	30.30	3.10	10.60	0+2
17*	11-3-1959	54.50	16.00	6.30	3.10	9.90	16.30	35.00	3.00	11.70	0+3
18	do.	60.20	17.50	7.00	3.30	10.70	18.70	38.00	4.00	13.00	0+3
19	1-3-1958	63.00	19.00	7.10	3.70	11.00	18.80	40.00	4.60	13.00	0+3
20	16-4-1960	91.50	25.10	9.10	4.70	14.60	26.70	57.70	6.80	19.10	1+4
21	do.	102.50	28.00	10.20	5.00	16.80	29.60	61.30	8.40	21.60	1+4
22	5-5-1959	130.50	33.00	11.90	6.10	19.30	35.20	75.60	8.70	24.60	0+3
23*	do.	137.00	35.00	12.50	6.30	20.20	37.00	80.50	8.80	26.20	1+3
24	16-5-1959	157.00	41.30	15.30	7.00	24.50	43.50	95.50	9.90	31.20	1+4
25	24-5-1959	171.00	43.90	16.00	7.10	25.20	46.70	100.00	10.30	31.50	1+4
26	do.	196.00	50.80	19.00	7.80	29.00	53.30	115.00	10.80	35.70	1+3
27	16-4-1959	213.00	53.30	19.80	7.80	30.30	57.80	122.80	11.20	38.20	1+4
28*	do.	278.00	68.50	26.00	10.00	38.50	71.00	154.00	13.20	48.50	1+4

\* Denotes specimens described and figured.

only as tiny projections. The lateral line is present and is discernible up to the vertical below the 7th dorsal finlet. Only traces of the membranous interconnections between the finlets persist. Chromatophores have increased and the vertical bands are faintly indicated.

54.5 mm. Stage (Fig. 12).—The head is 3.5 and height 4.5 in standard length. The lateral line is complete and the opercular spines have almost completely atrophied. Membranous interconnections between the finlets persist only at their bases. The spinous dorsal has dark pigmentation anteriorly. Rudiments of the transverse bands could be seen as diffused patches along the dorsal aspect of the anterior portion of the body.



FIGS. 13-14. *Scomberomorus commerson*. Fig. 13. 137 mm., Fig. 14. 278 mm.

137 mm. Stage (Fig. 13).—This has all the unmistakable features of the adult. The head is 4 and height 5 in standard length. The characteristic bands on the sides of the body have begun to take shape.

A young fish 278 mm. in standard length is shown in Fig. 14. The head is 4.2 and height 5 in standard length, whereas in mature adult of over 1 metre the head is 3.7-4.4 and height 4.2-5.9 in standard length.

#### X. *Scomberomorus lineolatus* (Cuvier)

*Scomberomorus lineolatus* is the only species other than *S. guttatus* and *S. commerson* known so far from Indian waters (Jones and Silas, 1961),

It attains a length of over a metre and is often confused with the forme along with which it is caught in gill net and hook and line. There is a recent critical account of this species in East African waters by Williams (1960).

Kuthalingam (1959) refers to his collection of post larvae, juveniles and adults of *S. lineolatus* from Madras coast and has given figures of 9.5 mm. and 18.3 mm. stage which are reproduced below (Fig. 15 a and b).

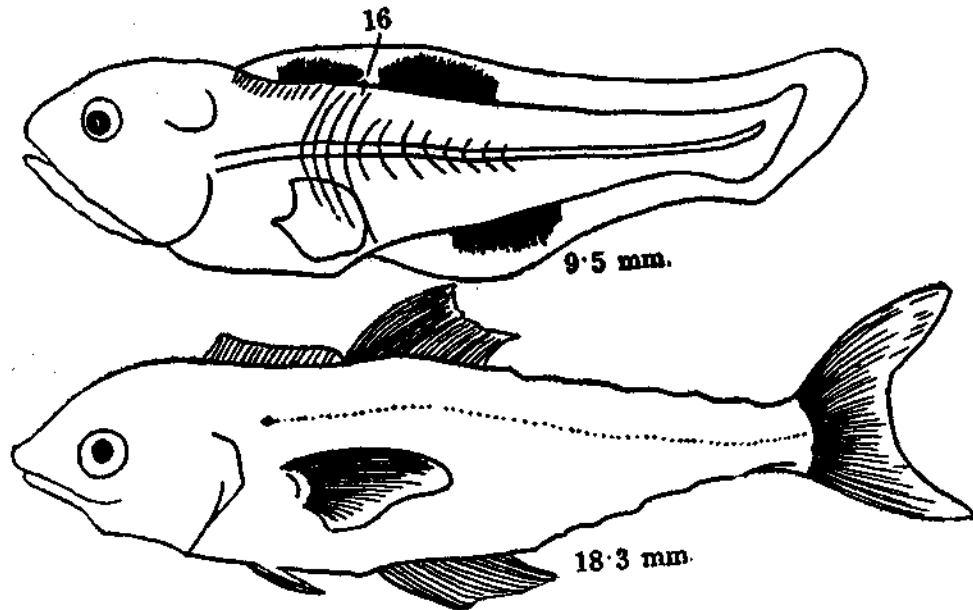


FIG. 15. *Scomberomorus lineolatus*. 9.5 mm. and 18.3 mm. Reproduced from Kuthalingam (1959).

A study of the description as well as the figures would show that they cannot be of any *Scomberomorus*. To mention a few points (i) the short and blunt snout, (ii) the general body proportions, (iii) the pre-anal length being shorter than the post-anal length, (iv) the subventral mouth with the lower jaw shorter than the upper jaw, (v) absence of teeth, (vi) absence of any spines on the pre-opercle (the pre-opercle itself is undefined), (vii) the origin of the dorsal from the occipital region of the head, (viii) the origin of the pectorals far behind the operculum, (ix) the relatively forward position of the second dorsal and anal fins, (x) the absence of finlets, (xi) the lateral line being complete even at the 18.3 mm. stage and (xii) the absence of chromatophores in the body all go to show that the larvæ and juveniles described cannot be of any *Scomberomorus*. According to him there were 31 myotomes (16 pre-anal and 15 post-anal) which itself shows that the

larvae cannot be of *S. lineolatus* which has 49 or 50 vertebræ. It may be stated in this connection that no known species of *Scomberomorus* has less than 43 vertebræ. His reference to adults measuring 100 mm. to 128 mm., a size too small for any scomberomorid to be considered an adult, is also rather puzzling.

Larval or early juvenile specimens of *S. lineolatus* have not been collected in the course of this work. The smallest specimen available in the collection is a juvenile 295 mm. in length from Tuticorin and is shown in Fig. 7 for comparison. Nothing is known about its spawning habits and development.

#### GENERAL REMARKS

In view of the doubts that have risen about specimens described as *Scomberomorus guttatus* and *S. lineolatus* by Vijayaraghavan (*op. cit.*) and Kuthalingam (*op. cit.*) respectively, an attempt was made to re-examine the material but unfortunately this was not possible since specimens were no more available either in the Institution where the work was carried out or with the authors. This has created a rather difficult situation as any view in future about the identity of the material worked out by them could only be a matter of conjecture. It is needless to say how important it is that specimens studied and forming the basis of publications should be deposited safely for future reference. It is hoped that this aspect will receive due attention of all scientific workers and institutions in this country.

#### ACKNOWLEDGEMENTS

My thanks are due to Mr. K. V. Narayana Rao who collected for me most of the material described from Vizhingam and to Mr. M. Kumaran for preparing the tables and the figures of the early juveniles and for the general assistance given in the laboratory. I am indebted to Mr. D. Chakraborty for the preparation of the graph.

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