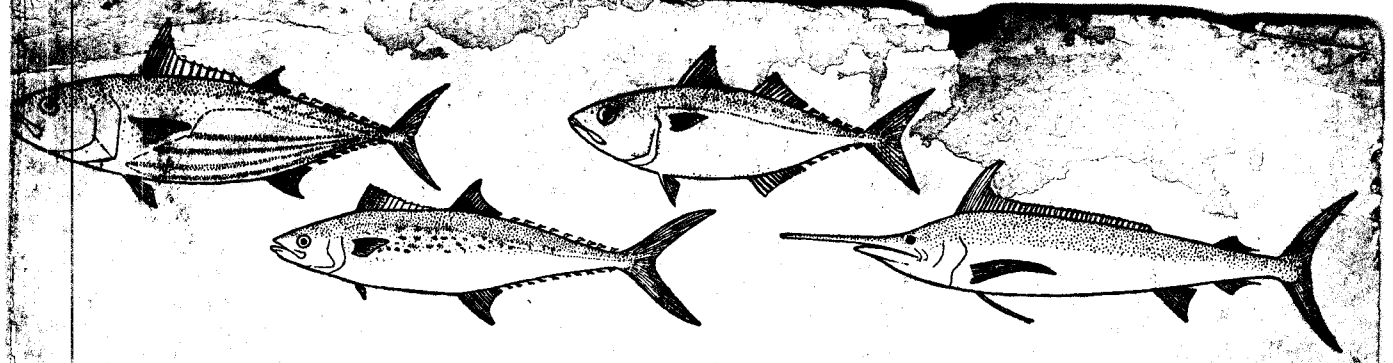
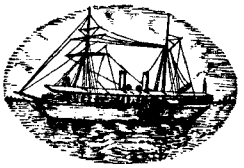


SYMPOSIUM ON SCOMBROID FISHES

PART I



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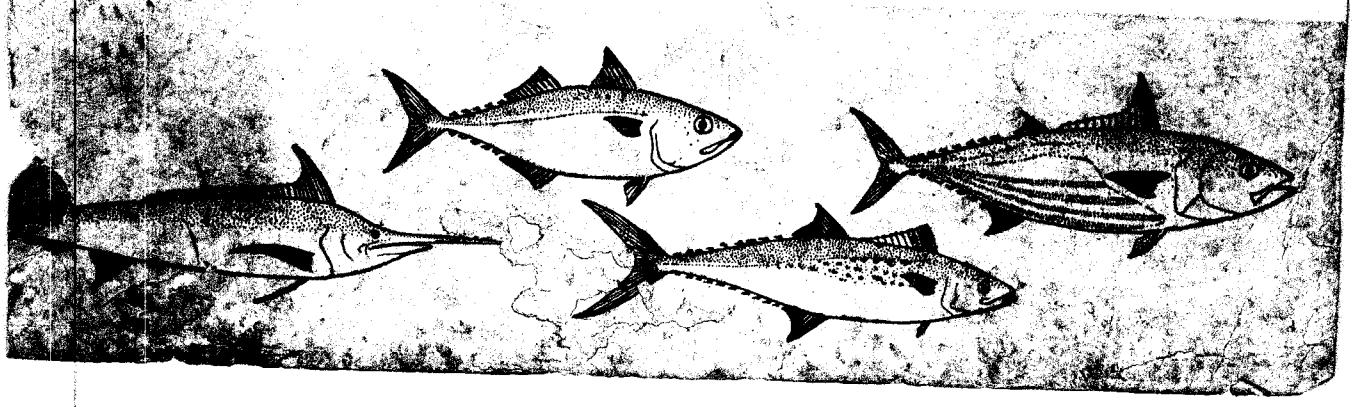
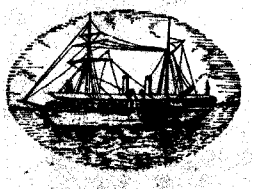


PROCEEDINGS OF THE

SYMPOSIUM
ON
SCOMBROID FISHES

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

PART I



SYMPOSIUM SERIES 1
MARINE BIOLOGICAL ASSOCIATION OF INDIA
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CYBIUM CROOCKEWITII BLEEKER (1850) AND *C.KOREANUM* KISHINOUYE (1915) CONSIDERED SYNONYMS OF *SCOMBEROMORUS GUTTATUS* (BLOCH AND SCHNEIDER) WITH A REDESCRIPTION AND ANNOTATED BIBLIOGRAPHY OF *S.GUTTATUS**

BY

E. G. SILAS

Central Marine Fisheries Research Institute, Mandapam Camp

INTRODUCTION

In a recent review on fishes of the subfamily Scomberomorinae from Indian seas, Jones and Silas (1961) recorded three species of spanish mackerels or seerfishes, namely, *Scomberomorus commerson* (Lacépède), *S. guttatus* (Bloch and Schneider), and *S. lineolatus* (Cuvier). Two other nominal species, *Cybium kuhlii* Cuvier and *C. interruptum* Cuvier recognised by Day (1878, 1889) and other ichthyologists are now considered synonyms of *S. guttatus* (by de Beaufort, 1951 ; Jones and Silas, 1961), and *S. lineolatus* (by Williams, 1960; Jones and Silas, 1961) respectively.

The examination of several adult and juvenile specimens of *S. guttatus* from various localities along the Indian coast as well as a perusal of the literature dealing with this species has drawn attention to the need for a proper scrutiny of its taxonomy, systematic position, and a redescription. The last said given here based on Indian material may be considered more typical for *S. guttatus* which was first described from Tranquebar on the South East Coast of India, south of Madras. Comparisons of *S. guttatus* with other species of the genus from Indian waters are given along with an annotated bibliography and a subject index at the end.

HISTORICAL RESUME

The original description of *Scomber guttatus* as given by Bloch and Schneider, (1801) is brief and reads as follows :

> "...Sc corpora oblongo, alepidoto, capite acuminato, guttis nigris circa lineam lateralem dorso vicinam, maxilla inferiore longiore, carina caudali, cauda attenuata, pinnulis 8 supra, 7 infra.
>
> B 7, P 18. V 6. A 20. 7. C. 22. D 15/15. 19.8
>
> Habitat ad Tranquebarium pelagicus inter faxa; noctua Januario. Usque ad Martium ad fummum emergeus capitur, 3½ pedes longus; Tamulice *Wantsaran* audit.
>
> Comparatis exemplis donobus ficeis vercor he piscis idem fit cum regali plumeril pictura descripto. In linea laterali in regione pinnae analis deflexa et undulata usque ad candam squamas reliquas vidi parvas; dentes conici maxillam superiorem totam usque ad commissuram ossis labialis occupant."

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The body colouration, the number of dorsal and anal finlets, and the number of dorsal spines (XV) are characteristic.

Russell (1803) defined the *Wingeram* (*Scomber Wingeram*) as:

"Scomber pinnulis octo, seu novum; cauda falcata; corpore lanceolata, alepidoto, maculis ovalibus; eminentia membranacea longitudinalis, as finan lineae lateralis." ('The Scomber with eight or nine pinnulae; the body lanceolate, without scales, and with oval spots; a longitudinal membraneous protuberance at the end of the lateral line.').

Other salient characters given in the description of *Wingeram* are:

"Head small, ovate, sharp, smooth, the front very gently declivous, somewhat flattened.....teeth numerous, close, regular, conical, somewhat larger in the under than in the upper jaw.....lateral line supreme, gently arched to the beginning of the pinnule, then straight to the middle of the caudal fin, carinate to near the end...two dorsal fins.....first spinous consisting of 15 or 16 spines, of which the last six (connected by a very tender membrane lying in a groove) may easily escape notice if not raised.....the pinnae superiae vary from eight to nine..... the anal pinnulae vary from seven to eight.....The *colour*. The upper part of the head a changeable dark green and blue, the ridge of the back of the same colour, but changes to a polish leaden, which, from the lateral line growing gradually lighter, terminates on the belly in a bluish white. Above, but parallel to the line, a row of small round spots, nearly black; and on the sides are several similar spots. The fins are darkish, the ventral and anal excepted which are with the same colour with the belly."

The above description as well as the accompanying figure (Plate I, fig. A) clearly show that Russell's *Wingeram* and *Scomber guttatus* described by Bloch and Schneider, are identical. Shaw's (1803) description of *Scomber leopardus* is based on the *Wingeram* of Russell and consequently becomes a synonym of *S. guttatus*.

De Beaufort (1951) has clearly shown that *Cybium kuhlii* Cuvier is a synonym of *S. guttatus*. Herein it should be mentioned that Munro (1943) proposed a new subgenus *Pseudosawara* with *Cybium kuhlii* as the genotype and characterised the subgenus as :

"A new subgenus is necessary for reception of two species possessing another type of lateral line branching. This is not true ramification but a branching effect produced by the continuation backwards of the area of minutely furrowed skin caused by presence of tracts of cutaneous mucous canals. Such areas are seen on the posterodorsal region of the head of all species of *Scomberomorus*. In the subgenus *Pseudosawara* such canals are branched together along both sides of the lateral line as well as on the head. They all point outwards and backwards and are densest towards the anterior part of the lateral line."

Unfortunately Munro's (1943) selection of the subgenotype (=*C.kuhlii*) for *Pseudosawara* was inopportune as it is a synonym of *S. guttatus* which in turn Munro placed along with *S.lineolatus* (Cuvier) (Syn. *Cybium interruptum* Cuvier) and *S. semifasciatus* (Macleay) (Syn. *Cybium tigris* De Vis) under another new subgenus *Indocybium* (Subgenotype: *Cybium*

semifasciatum Macleay). Consequently, *Pseudosawara* becomes a synonym of *Indocybium*. In case subgenera of *Scomberomorus* are to be recognised, the species thus grouped under *Indocybium* may form a composite lot. Eventually a new name may have to be proposed for species showing the diagnostic characters mentioned for *Pseudosawara*. However, such action should await a detailed revision of the spanish mackerels on a global basis. The nature of the lateral line for *Pseudosawara* given by Munro appears to be a dependable character and among the Indian species of *Scomberomorus*, is seen only in *S. guttatus*. *Cybium koreanum* Kishinouye also shows this type of branching of the lateral line. Interestingly enough the species which possess such pseudobranching of the lateral line also appear to have the following characteristics:

(1) A relatively stumpy head with the dorsal profile slightly decliveous, making the occipital crest appear high.

(2) Relatively deeper body — depth greatest at origin of second dorsal.

(3) Larger second dorsal and anal fins.

(4) Prominently falcate caudal lobes.

(5) Colour pattern on body consisting of ovate or rounded dark spots along sides.

(6) Total number of gill rakers and vertebrae 9–13 and 46–51 respectively.

Regarding variations in vertebral counts in *S. guttatus*, Jones and Silas (1961) remark that: "Munro (1943) gives the vertebral count of this species as 20+26=46, while specimens we have examined from Tuticorin and Vizhingam coasts show a total number of 48 or 49 vertebrae. Kishinouye (1923) mentions 51 as the count for *Cybium guttatum* from Formosan waters. Thus it would appear that of the three Indian species of *Scomberomorus*, the range of variation of vertebral counts is greatest in *S. guttatus*. The significance of this is not apparent as stray observations hitherto made do not lead to any conclusions except draw attention to the likelihood of there being geographical races or distinct populations in different geographical locations along the range of distribution of this species." Available data indicate that *S. guttatus* has a fairly wide spread distribution in the Indo-Pacific, second only to that of *S. commerson*.

It should be mentioned here that de Beaufort's (1951) statement regarding the nature of the lateral line in *S. guttatus* is partly correct. According to him "I do not think that this structure is of any use even to distinguish species" as he found this character to be present "not only in specimens of *kuhli* in the Leiden Museum, but in many specimens of *guttatus* as well, especially in the larger ones and other species." *C. kuhli* is a synonym of *S. guttatus* as already mentioned. The last part of the above statement, namely, "and other species," will certainly not include *S.commerson*, *S. lineolatus* etc. On the other hand, as recognised by Munro (1943) such branching of the lateral line occurs only in *S. koreanus* (Kishinouye), which as shall presently be shown may be considered a subspecies of *S. guttatus*.

CYBIUM CROOCKEWITII BLEEKER, A SYNONYM OF *S.GUTTATUS* (BLOCH AND SCHNEIDER)

The nominal species *Cybium croockewitii* Bleeker (1850) Plate I, fig. D was tentatively recognised by de Beaufort (1951). In doing so, he drew attention to the considerable similarities between *C.croockewitii* [= *Scomberomorus croockewitii* (Bleeker)] and *S. guttatus* with the remarks that "I am therefore not sure that *S. croockewitii* is a good species." Munro (1943) while recognising *S.crookewitii* did not assign it to any one of the nine subgenera of *Scomberomorus* he dealt with. The figure and redescription of *S. croockewitii*

given by de Beaufort (1951) indicate that the species possesses the following salient characters :

(1) The depth of the body is greater than the length of the head, the ratios being 4.7 and 4.3, and 6.1 and 5.6 in length with and without caudal respectively.

(2) Gill rakers 2+8—10.

(3) Origin of second dorsal midway between base of upper caudal rays and of tip of snout.

(4) Second dorsal and anal relatively large and slightly falcate.

(5) Lateral line almost straight to below anterior dorsal finlets, gently bent downwards here and continued along the middle of the caudal peduncle to the peduncular keel.

(6) Pectoral about as long as head without snout.

(7) Fin ray counts: Günther (1860) remarks that " The frequent typographical errors in Dr. Bleeker's papers are sometimes very annoying. In this instance both accounts quoted (Bleeker, *Nat. Tydschr. Ned. Ind.*, 1850, i, p. 161 and *Verh. Bat. Gen.*, 24, Makr. p. 37.) give the formula of the fins that is quiet impossible in a fish of the genus, *viz.*, :— D 15 $\frac{7}{17}$ VII. A. $\frac{6}{28}$ VII., and D. 15 $\frac{7}{17}$ VII. A. $\frac{6}{18}$ VII." de Beaufort (1951) who re-examined the type specimen gives the following fin formulae for *S.croockewitii* : D_1. 15 ; D_2. 7. 17 + 7 ; A. 3. 17 + 7 ; P_1. 2. 18; V. 1. 5.

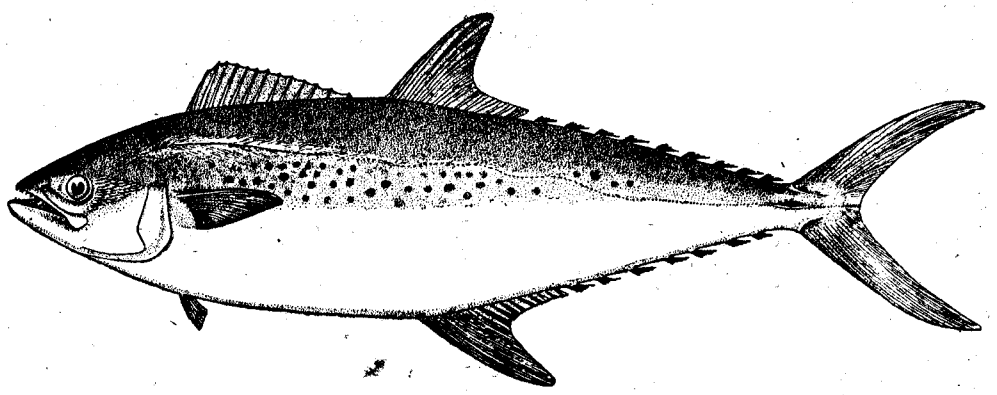
(8) "Colour of the preserved specimen brownish above, silvery below. All fins light or dusky. According to Bleeker a broad black band from dorsal to anal, sides with dark diffuse blotches, first dorsal totally black." (de Beaufort).

No mention is made by Bleeker or subsequent authors regarding the nature of the lateral line and its branching if any. Barring this and the colour characteristics given above under item 8, the characters fully agree with that for *S. guttatus*, as will be seen from the redescription of the latter given latter on. Bleeker's figure of *croockewitii* reproduced by de Beaufort (1951) shows clearly the broad vertical stripe between bases of second dorsal and anal, while de Beaufort found both the preserved specimens "... uniform, without any trace of black vertical band mentioned by Bleeker." I have invariably found all specimens of *Scomberomorus* caught along the Indian coast in drift nets (gill nets) show a distinct vertical broad band as shown in the photograph of *S. guttatus* on plate I, fig. E. caught similarly at Tuticorin, Gulf of Mannar. Such discolouration due to friction of the skin with the strands of the net are very conspicuous in *S. guttatus* below about 500 mm. taken by such gear, and the colour in the form of a broad vertical band generally broader dorsally below or partly in front of second dorsal and narrower towards anal persists even on preservation. Wang's specimen of *S. guttatus* from the China coast, the figure of which is reproduced here (plate I, fig. C.) also shows such a faint vertical marking below second dorsal, and apparently was also captured in a gill net. The vertical dark band of *croockewitii* could have been caused under similar circumstances and I have no hesitation in considering it as an artefact. The dark diffuse blotches on the sides of the body of *croockewitii* mentioned by Bleeker are characteristic of *S. guttatus* though the type specimens at present do not show these, perhaps on account of being in preservative for a long time.

Although information regarding the nature of the lateral line in *croockewitii* is wanting, on account of its similarities in other characters to *S. guttatus* there can be no doubt that it is a synonym of the latter.

CYBIUM KOREANUM KISHINOUYE 1915, A SYNONYM OF *S. GUTTATUS* (BLOCH AND SCHNEIDER)

The comparison of the diagnostic characters of *S. guttatus* and *C. koreanum* (*Scomberomorus koreanus* (Text-fig. 1) shows considerable similarities between the two except in minor details. *S. koreanus* is not so well-known as *S. guttatus* and it may be stated that



Text Fig. 1.—*Cybium koreanum* Kishinouye (after Kishinouye, 1923).

examination of more material of the former for morphometric and meristic characters may show still overlap in characters with the latter. I do not agree with Fraser-Brunner (1950) in considering *C. koreanum* a synonym of *S. semifasciatus*. The unbranched lateral line; the low vertebral count of 44–45 vertebrae; the broad caudal peduncular keels; the dorsal and anal finlets ranging from 8 to 10, with the mode for both being 9; and the colouration, especially the sides of the body having twelve to twenty broad vertical bands of dark grey in *S. semifasciatus* easily separate it from *S. koreanus*, the salient characters of which are discussed below, in comparison with those of *S. guttatus*.

(1) Lateral line: In both *S. guttatus* and *S. koreanus* the lateral line shows the peculiar branching caused by cutaneous mucous canals running backward, being densest towards the anterior part. The lateral line in both is not strongly curved in any part along its course, but may slightly undulate in its posterior one-third.

(2) Vertebrae: *S. koreanus* is said to have 20 + 26 = 46 vertebrae (Kishinouye 1923) while Munro (1943) gives the count for *S. guttatus* as 20 + 26 = 46, and for *S. kuhlii* as 21 + 30 = 51. Kishinouye (1923) gives 21 + 30 = 51 as the count for *S. guttatus* from Japanese waters. As already mentioned, specimens of *S. guttatus* examined by Jones and Silas (1961) show 48 or 49 vertebrae. It is not known as to whether the vertebral count is a constant 46 in *S. koreanus*. Even so, it falls within the known range for *S. guttatus*.

(3) Number of dorsal spines : For the genus *Scomberomorus*, Munro (1943) has shown that the number of dorsal spines may vary from XII to XXII. In *S. koreanus* a count of XIV is recorded, while XV to XVII appears to be the range for *S. guttatus*. Most of the well studied species of *Scomberomorus* from the Indo-Pacific show variations from one to three spines in the dorsal count and consequently it is likely that in *S. koreanus* also variations may be expected in this character. However, if the count of XIV is found to be constant or if the variation is on the lower side, the difference in this character between *S. koreanus* and *S. guttatus* will be of some importance.

(4) Number of dorsal and anal finlets: Kishinouye (1923) gives the dorsal and anal finlet counts for *S. koreanus* as 9 and 7 respectively. However, on plate 21, fig. 35 of *S. koreanus* (= *C. koreanum*) (reproduced here as text-figure 1) and also in the original description (Kishinouye, 1915) 9 dorsal and 8 anal finlets are indicated. Munro (1943) gives the dorsal and anal finlets for *S. guttatus* as 8–9/8–10; *S. kuhlii* as 8–9/7–9; *S. crookewitii* as 7/7; and *S. koreanus* as 9/7. For the Indian specimens of *S. guttatus* I have examined, the number of dorsal and anal finlets are 7–9/7–9 respectively, with the mode at 8/8. The degree of variability of this character in *S. koreanus* is not known, but the recorded counts of 9 dorsal and 7 or 8 anal finlets are well covered by the known range for *S. guttatus* (Tables I-A and I-B).

(5) Number of gill-rakers: The gill raker count for *S. koreanus* is given by Kishinouye (1923) as 3 + 10. Munro (1943) has given the gill raker counts for *S. guttatus* and *S. kuhlii* as 2 + 9, and 2–3 + 8–9 respectively. For adults of the Indian specimens of *S. guttatus* I have examined (Tables II and III) the counts are 1–4 + 7–10, the most frequent counts being 2 + 9 = 11. It is likely that differences in the modal formulae may exist from area to area, but the known counts for *S. koreanus* falls within the known range for *S. guttatus*.

(6) Body proportions: Kishinouye (1915, 1923) has not given any details regarding body proportions in *S. koreanus*, except mention that the length of the head is shorter than the greatest depth of the body. This also appears to be the general rule for all specimens of *S.guttatus* that I have examined from Indian waters. The figures of *C. koreanum* and *C.guttatum* given by Kishinouye (1923: pl. 21, fig. 35, and pl. 34, fig. 61 respectively) indicate that the former has a much more deeper body (about 3.8 in fork length versus about 5.5 in figure of the latter species). In specimens of *S. guttatus* from Indian waters I find the ratio of depth of body in fork length to vary from about 4.2 to 5.

(7) Body colouration: In *S. koreanus* according to Kishinouye (1923) "the back is greyish blue, and the belly silvery. There are three or more longitudinal rows of small greyish spots along the lateral median line..." Kishinouye's figure of *C. koreanum* (pl. 21, fig. 35) shows clearly four rows of spots just behind the pectoral. There is hardly any difference in the colour pattern on the sides of the body of *S. guttatus*, except that exceptionally as many as eight rows of rounded or oval dark spots may be present on either side.

(8) Additional characters : There is no difference in the nature of the dentition in both the species. The air-bladder is also wanting in them.

From what is known it is clear that the similarities between *S. guttatus* and *S. koreanus* are considerable. When a good series of *S. koreanus* is examined it is likely that more overlap in the various characters discussed above may be seen. In view of what has been said, it will be desirable to consider *S. koreanus* as a subspecies of *S. guttatus* namely, *Scomberomorus guttatus koreanus* (Kishinouye), than treat it as its synonym, a course which is adopted here.

SCOMBEROMORUS GUTTATUS FROM WESTERN INDIAN OCEAN

Some confusion exists as to the status of the spotted spanish mackerel from the Western Indian Ocean. Williams (1960) opined that Smith (1949) and Fourmanoir (1957) erroneously used the name *Scomberomorus leopardus* (Shaw) for the species *S. lineolatus* (Cuvier). According to him, *S. guttatus* did not occur along the British East African coast. A careful study of the descriptions of the spanish mackerels from South African waters Western Indian Ocean) and Madagascar indicates that *S. guttatus* or a form closely allied to

TABLE I–A

Number of dorsal and anal finlets in species of *Scomberomorus* (adults) from Indian Seas (all localities combined)

Species	No. of specimens	Finlets											
		Dorsal						Anal					
		7 (= 6 + 1 or 7)	8 (= 7 + 1 or 8)	9 (= 8 + 1 or 9)	10 (= 9 + 1 or 10)	11 (= 10 + 1 or 11)	Mean	7 (= 6 + 1 or 7)	8 (= 7 + 1 or 8)	9 (= 8 + 1 or 9)	10 (= 9 + 1 or 10)	11 (= 10 + 1 or 11)	Mean
S. commerson (Lacépède)	7	– + –	– + –	1 + –	4 + –	2 + –	10.14	– + –	– + –	– + 1	6 + –	– + –	9.85
S. lineolatus (Cuvier)	18	– + –	– + 3	9 + 3	3 + –	– + –	9.00	– + –	– + –	10 + 3	2 + 1	1 + 1	9.38
S. guttatus guttatus (Bloch and Schneider)	40	– + 1	6 + 24	8 + 1	– + –	– + –	8.2	1 + 3	14 + 18	4 + –	– + –	– + –	8.00

The finlets are counted from the base of the caudal forwards. Thus in some specimens the last finlet nearest the second dorsal or anal fin may appear to be united with the fin presenting difficulty in making accurate counts. In order to avoid confusion, during collection of data, such conditions have been recorded as 6 + 1, 7 + 1, etc. and cases where the last finlet was distinct as 6, 7 etc. For the purpose of calculating 'mean' 6 + 1 and 7 have been considered as 7 and so on. However, in the table the frequency is indicated separately for convenience (*e.g.*, in *S. lineolatus* 9 dorsal finlets were seen in 12 specimens as follows : 8 + 1 in 9 specimens and 9 in 3 specimens respectively).

TABLE I–B

Frequency of occurrence of dorsal and anal finlets in species of *Scomberomorus* from Indian seas (all localities combined)

No. of dorsal/anal finlets	*S. commerson*		*S. lineolatus*		*S. guttatus guttatus*	
	No. of specimens	Per cent	No. of specimens	Per cent	No. of specimens	Per cent
7/7	...	...	...	...	1	2.43
8/7	...	...	...	...	3	7.31
8/8	...	...	...	...	24	58.53
8/9	...	...	2	11.11	3	7.31
8/10	...	...	1	5.55	...	...
9/8	...	...	...	...	9	21.95
9/9	...	...	10	55.55	1	2.43
9/10	1	14.28	1	5.55	...	...
9/11	...	...	1	5.55	...	...
10/9	1	14.28	1	5.55	...	...
10/10	3	42.85	1	5.55	...	...
10/11	...	...	1	5.55	...	...
11/10	2	28.57	...	...	...	...

TABLE II

Gill raker counts in adults and juveniles of species of *Scomberomorus* from Indian seas

Species and localities	No. of specimens	Gill rakers																												
		Upper limb					Lower limb												Total counts												
		0	1	2	3	4	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	13	14
S. commerson (Lac.)																																
Ratnagiri ...	2	...	1	1	...	...	...	...	1	1	...	...	...	...	...	...	...	...	...	...	...	1	...	1	...	...	...	...	...	...	...
Malwan ...	3	...	...	2	1	...	...	...	...	1	2	...	...	...	...	...	...	...		...	...	...	2	...	1	...	...	...	...	...	...
Malpe ...	2	...	...	2	...	...	...	...	...	2	...	...	..	..	..	...	...	...		...	...	...	2	...	...	...	...	...	...	...	...
Vizhingam (juveniles—after Jones 1961) ...	12	5	7	...	...	...	...	1	6	5	...	...	...	...	...	...	...	...	1	4	2	5	...	...	...	...	...	...	...	...	...
Tuticorin ...	24	...	6	18	...	...	...	...	8	13	2	1	...	...	...	...	...	...		...	5	5	11	3	...	...	...	...	...	...	...
Rameswaram ...	1	...	1	...	...	...	...	...	...	1	...	..	..	...	...	...	...	...	...	...	...	1	...	...	...	...	...	...	...	...	...
S. lineolatus (Cuvier)																																
Tuticorin ...	35	...	...	17	15	3	...	...	...	...	...	...	4	17	10	3	1	...		...	...	...	...	...	...	...	...	10	16	8	..	1
Rameswaram ..	4	...	...	4	...	...	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	...	...	...	...	...	...	...	2	2	...	...
S. guttatus guttatus (Bloch and Schneider)																																
Veraval ...	1	...	...	1	...	...	...	...	...	...	...	...	..	..	...	1	...	...	..	..	..	...	...	...	...	...	...	...	...	1	...	...
Ratnagiri ...	2	...	...	...	2	...	...	...	...	...	...	...	...	1	1	...	...	...	...	...	...	...	..	..	..	..	..	..	1	1	...	...
Vizhingam (Juveniles—after Jones 1961) ...	10	3	3	2	2	...	...	...	1	2	5	...	1	1	...	...	...	...	..	..	1	1	2	2	2	...	...	1	1	...	...	...
Tuticorin ...	23	...	1	11	10	1	...	...	...	...	...	...	3	6	12	2	...	...	...	...	...	...	...	...	...	...	1	5	9	8	...	...
Rameswaram ...	21	...	5	15	1	...	...	...	..	...	...	...	1	4	12	4		...	...	...	...	...	...	...	..	1	...	6	11	3	...	...
Waltair (Juveniles—after Jones 1961) ...	5	...	1	4	...	...	...	...	...	1	1	2	1	...	...	...	...	...	...	...	...	...	1	...	1	2	1	...	...	...	...	...

TABLE III

Gill raker counts in species of *Scomberomorus* (adults) from Indian seas (all localities combined)

Species	No. of specimens	Gill rakers																									
		Upper limb					Lower limb										Total counts											
		1	2	3	4	Mean	3	4	5	6	7	8	9	10	11	Mean	4	5	6	7	8	9	10	11	12	13	14	Mean
1. *Scomberomorus commerson* (Lacépède)	32	9	23	...	...	1.72	9	18	4	1	...	...	...	...	...	3.90	6	5	16	3	1		...	...	...	...	...	5.75
2. *Scomberomorus lineolatus* (Cuvier)	39	...	21	15	3	2.53	...	...	...	...	4	17	12	5	1	8.53	...	...	...	...	...	...	10	18	10	—		111.07
3. *Scomberomorus guttatus guttatus* (Bloch and Schneider)	47	6	27	13	1	2.19	...	...	...	4	11	25	7	...		8.74	...	...	...	...	1	1	11	21	13	...	...	10.93

that does in fact occur in those waters. The available data on this may be summarised as follows:

Fowler (1929) recorded *Scomberomorus leopardus* (Shaw) from the Natal coast based on a specimen measuring 476 mm. obtained at Natal. According to him " Though usually credited to *Cybium interruptum* Cuvier, 1831, the name *Scomber leopardus* Shaw 1801 has priority." Perhaps this statement has also been partly responsible for causing confusion in later ichthyological literature from that area, as we now know that *S. leopardus* Shaw was based on Russell's *Wingeram* (*Scomber wingeram*) from the Coramandal coast, which in turn is a synonym of *Scomber guttatus* Bloch and Schneider, while *C.interruptum* Cuvier is a synonym of *Scomberomorus lineolatus* (Cuvier). Thus Fowler was wrong in presuming *C. interruptum* to be a synonym of *S. leopardus* (Shaw). The salient characters of Fowler's specimen from Natal are given Table IV. However, it is his following statements that beyond any doubt indicate that his specimen was *S. guttatus* for regarding the lateral line he says : " Whole upper or occipital region venulose, extending back along front part of lateral line far as first dorsal, also along each side of spinous dorsal similarly." The body colour is given as, " On sides below dark colour of back 3 rows of dark blotches or spots, sometimes connected as short bars or streaks." No accompanying figure is given, but the venulose condition of the lateral line is characteristic of *S. guttatus* and is not met with in *S. lineolatus*. The colouration is rather confusing as only blotches and spots and not streaks are met with in *S. guttatus*. However, the spots may be rounded or oval.

Earlier, Barnard (1927) recorded *Scomberomorus lineolatus* (Cuvier) from the Natal coast, characterising the species as : " Depth equal to length of head, $4\frac{3}{4}$ – 5 in length of body. Eye $6\frac{1}{2}$—7 in length of head, 2 in snout. Maxilla reaching to level of hind margin of eye. Upper teeth not very much smaller than lower teeth. D. XVI, 16+9—10. A. II, 14+10. Anal arising below middle of soft dorsal. Scales mostly absent. Lateral line gently curving downwards, and becoming horizontal below about the 4th or 5th finlet..... *Colour*, Silvery, bluish black above, sides with numerous short longitudinally elongated spots spinous dorsal dark." Smith (1949) considered *Scomberomorus lineolatus* and *S.interuptum* as synonyms of *Scomberomorus leopardus* (Shaw) and his description of the latter does not deviate much from Barnards description of *S.lineolatus* given above, it runs as follows : " Depth about $4\frac{1}{2}$. D. XV—XVI, 16—17+9—10. A. 16+10. 6 feeble gill rakers. L.l. almost straight from below dorsal. Spots usually horizontally elongate...." It is quite evident from this that a species with a higher dorsal and anal finlet count of 9—10/10 combined with the sides of the body having longitudinally elongated spots occurs in South African waters, and these characters fitting with those for *S. lineolatus*. However, the matter is far from settled, as the figure of *S. leopardus* given by Smith (1949, pl. 64, fig. 841) and reproduced here as Plate I, fig.B, clearly shows the following characteristics for a specimen 635 mm. long.

(1) A short head, much shorter than depth of body.

(2) A very short pectoral, the length of which is contained about 9.5 times in fork length.

(3) The second predorsal distance is distinctly shorter than the fork length, being about equal to the distance from the origin of the second dorsal to the tip of the first dorsal finlet from the caudal base.

(4) The snout short, being about 2.75 in head length.

TABLE IV

Comparison of certain characters of *Scomberomorus guttatus* (Bloch and Schneider) with those in literature for the species, and its synonyms

Characters	Bloch and Schneider 1801	Cuvier, 1831		Günther, 1860	
	Scomber guttatus	*Cybium guttatum*	*C. kuhlii*	*C. guttatum*	*C. croockewitii*
(1)	(2)	(3)	(4)	(5)	(6)
Fin counts :					
First dorsal ...	XV	XVI	XV	XVI	XV
Second dorsal (total) ...	19 + 8	2, 17 + 8	1, 18 + 8	19 — 20 + 8 — 10	— 17 + 7
Anal (total) ...	20 + 7	2, 19 + 7 — 8	2, 17 + 8	21 — 22 + 7 — 8	2, 18 + 7
Pectoral ...	18	...	...	...	...
Gill rakers ...	...	...	...	...	...
Depth in total length ...	...	...	...	5	6
Depth in standard length ...	...	...	...	...	...
Head in total length ...	...	...	...	ab 5	6.3
Head in standard length ...	...	...	...	...	..
Eye in head ..	..	..	...	...	...
Markings on side of body ...	...	...	...	Above blue, beneath silvery ; back and sides with numerous round blackish spots ; immature specimens sometimes uniform; first dorsal black.	A broad blackish band from dorsal to anal ; first dorsal entirely black.
Distribution ...	Tranquebar, India.	Pondichery and Malabar, India	Java and Bombay	East Indian seas	Sea of Banka

TABLE IV—(*Contd.*)

Characters	Day, 1878		Kishinouye, 1923		Fowler, 1929
	C. kuhlii (7)	*C. guttatum* (8)	*C. guttatum* (9)	*C. koreanum* (10)	*Scomberomorus leopardus* (11)
Fin counts :					
First dorsal ...	XVI	XVI–XVII	XVI	XIV	XVI
Second dorsal (total) ...	5 — 6, 17 — 18 + 8	4 —5, 14 — 15 + 8—10	19 — 20 + 8 — 9	19 — 21 + 9	5, 14 + 9
Anal (total) ...	4, 18 + 7	3, 17 — 19 + 7 — 9	21 + 8	18 + 21 + 7	6, 15 + 9
Pectoral ...	29*	21	...	...	...
Gill rakers ...	...	...	2 + 8	3 + 10	3 + 10
Depth in total length ...	5 ...	5	...	...	...
Depth in standard length ...	...	...	...	...	4.3
Head in total length ...	5.5 —'6	5.0 — 5.3	...	...	...
Head in standard length ...	...	...	...	...	5
Eye in head ...	5	5.25 — 5.5	...	...	6.3
Markings on side of body ...	Silvery on sides and below : After death sides with dark hue and no bands or spots.	Back and sides with three rows of round or rather horizontally oval spots.	Body silvery greyish with several rows of dark spots on the side. Both dorsals* dorsal finlets and caudal black.	Back greyish blue, belly silvery. Three or more rows of small greyish spots along lateral median line, Fins except pelvics and anal blackish.	Grey blue above lateral line, body below and lower side of head silvery white. On sides below dark colour of back rows of dark blotches or spots sometimes connected as short bars or streaks.
Distribution ...	Seas of India. (14½" specimen figured from Bombay).	Seas of India, Malaya, Archipelago and China.	Widely distributed in Indo-Pacific region also, Australia. Abundant in Taiwan.	West coast and south coast of Chusan.	476 mm. specimen from Natal, S. Africa.

*Probably graphical error.

TABLE IV—(*Contd.*)

Characters		Deraniyagala, 1933 *Scomberomorus* (*Sawara*) *guttatus* (Bloch and Schneider) (12)	de Beaufort, 1951 *Scomberomorus guttatus* (13)	de Beaufort, 1951 *Scomberomorus croockewitii* (14)	Munro, 1955 *Indocybium guttatum* (15)
Fin counts :					
First dorsal	...	XV — XVI	XV—XVI	XV	XV—XVI
Second dorsal (total)	...	4, 14 — 16 + 8 — 9	4, 15—16 or 7, 15 + 8—10	7, 17 + 7	4, 14 — 16 + 8 — 9
Anal (total)	...	4,16 + 8 — 9	3, 15 — 17 or 5, 15+7—9	3, 17 + 7	4, 16+8—9
Pectoral	...	20–23	2, 17 — 18	2, 18	20—23
Gill rakers	...	— + 8	1 — 2 + 8 — 10	2 + 10	1 — 2 + 8 — 10
Depth in total length	...	4	4.7 — 5.6	5.6	4.7 — 5.6
Depth in standard length	...	...	3.7 — 4.4	4.3	...
Head in total length	...	4.25	5.2 — 5.6	6.1	...
Head in standard length	...	...	4.1 — 4.5	4.7	...
Eye in head	...	...	4 — 5.2	5.2	...
Markings on side of body	...	Sides silvery with three rows of almost circular horizontal spots as large as pupil of eye. Anteriorly they are below lateral line but rise above it when it descends under second dorsal.	Sides with several longitudinal rows of dark spots, of ten obsolete.	Dark black band from dorsal to anal.	Three rows of large circular spots almost as large as pupil of eye on sides. Band of spots crosses lateral line and originates under pectoral fin.
Distribution	...	Ceylon, India, Japan, Australia.	Iranian Gulf, Coasts of India, Siam, Indo-China, Formosa (Singapore, Sumatra, Banka, Java, Madura, Celebes, Ambon). In sea and coastal waters, entering rivers.	Sea of Banka.	Coastal waters of Ceylon, Gulf of Mannar.

(5) The second dorsal, anal, and caudal lobes more prominent.

(6) Dorsal finlets 9 and anal finlets 10.

The fish figured would be more akin in the first five characters to *S. guttatus* than to *S. lineolatus*. On the other hand I have not come across 10 distinct anal finlets in *S. guttatus* from Indian waters.

From an examination of the data given by Williams (1960) for *S. lineolatus* from East African waters and a comparison of it with the typical *S. lineolatus* and *S. guttatus* from Indian waters, the characters of which are given in Table V, makes it evident that in the following diagnostic characters Williams' material shows more affinities to *S. guttatus* than to *S. lineolatus* :—

(1) The short head which is less than or hardly equal to the depth of the body. (Head 19.27–20.47 per cent versus depth 19.49–23.2 percent in S.L.)

(2) The short snout (6.56–7.2 per cent in S.L.)

(3) Shorter maxillaries (9.32-10.8 percent in S. L.).

(4) Longest dorsal spine (5.40-6.42 per cent in S.L.).

(5) Height of second dorsal and anal (13.8—16.75 and 12.86—15.43 per cent in S. L. respectively).

(6) Second predorsal distance (46.89—50.00 per cent in S. L.)

TABLE V

Body proportions expressed as thousandths of fork length in *S. guttatus guttatus* and *S. lineolatus* from Indian waters

Characters	*S. g. guttatus*[1] (Fork length 242–800 mm.)		*S. lineolatus*[2] (Fork length 235–800 mm.)	
	Range	Mean	Range	Mean
Head/F.L.	193–216	206	189–219	203
First predorsal distance/F.L.	233–259	243	239–268	252
Second predorsal distance/F.L. ...	450–500	478	493–529	510
Prepectoral distance	196–218	210	202–236	220
Prepelvic distance	231–271	254	237–272	259
Preanal distance	470–535	514	497–534	512
Greatest depth of body	201–236	226	163–196	189
Length of pectoral	114–134	124	133–164	147
Diameter of eye	28–42	36	26—37	31
Length of maxilla	100–116	109	106–120	115
Length of snout	64—77	73	80—86	83
Length of longest gill-raker	10—16	13	10—13	11
Height of first dorsal	55—76	65	46—54	51
Height of second dorsal	122–165	142	109–143	124
Height of anal	123–165	143	109–139	123
Origin of second dorsal to posterior end of caudal peduncular keel	516–548	523	466–506	480
Origin of anal to posterior end of caudal peduncular keel...	473–523	491	483–524	494

[1] 15 specimens 242–526 mm. from Tuticorin ; 2 specimens 452 and 468 mm. from Ratnagiri, and 1 specimen 800 mm. from Veraval, Gujarat.

[2] 25 specimens 235 to 800 mm. from Tuticorin.

Although Williams has given the percentage of each character in relation to standard length (measured from anterior tip of head with jaws closed, to base of central caudal rays) and in Table V. I have given the proportions in thousandths of fork length* for *S. guttatus guttatus* and *S. lineolatus*, it is evident that in the above characters *S. lineolatus* from East African Coast differs from the typical *S. lineolatus* from Indian waters. Whether the lateral line is branched as in *S. guttatus* or simple as in *S. lineolatus* is not known, except that it is " ... formed of small modified scales, from origin in an even curve well above pectoral to a point varying between the origin of the second dorsal and the second dorsal finlet, thence becoming, mainly downwards, finally rising slowly in a straight line to the caudal peduncle." A very good photograph of a 640 mm., specimen of *S. lineolatus* from East African waters showing immediate post-mortem colouration is given by Williams (1960). However, I have not come across such a colour pattern in freshly landed *S. lineolatus* up to 800 mm. long, examined from both the east and west coasts of India. The immediate post-mortem colour of the body is given by Munro (1960) as : " Body iridescent blue grey above lateral line, silver below becoming whitish ventrally. On the sides of body a series of about six to eight interrupted horizontal black lines (above lower base of pectoral) much narrower than the interspaces. Anteriorly usually only one of the lines is above the lateral line, posteriorly they are replaced by a number of short oblique black lines. Under the 1st or 2nd dorsal finlets the series of horizontal lines becomes somewhat confused and only two to three of the lines continue through to the caudal peduncle. The horizontal black lines on the body are interrupted to varying degrees, the lines being almost intact in places, and broken up into a series of small rectangular "spots" in others. Upper areas of caudal peduncle and median keel black, lower areas dusky, " In formalin preserved specimens the body is dark brown above lateral line and paler below." " The pattern of interrupted black horizontal lines on the sides is as in the post-mortem colouration, but the degrees of clarity of the lines varies considerably between specimens." Thus both in the post-mortem or in the preserved state, the markings on the body of the East African *S. lineolatus* is said to be very distinctive although the number and degree of interruptions of the horizontal black lines are considerably variable from specimen to specimen and from side to side. The colourations in the Indian specimens of *S. guttatus* and *S. lineolatus* are figured by Jones and Silas (1961, 1962), (Also see plate II, fig. A.) These differences between the typical *S. guttatus and S. lineolatus* from Indian waters on the one hand and from Western Indian Ocean on the other pose several problems with some of the following possibilities:

(1) That in South African waters a species closely related to *S. guttatus* or a sub-species of the latter occurs, the typical *S. guttatus* thus being not present in the Western Indian Ocean. As far as is known this species or sub-species has a striking colour pattern and also a definitely higher dorsal and anal finlet count.

(2) That two species closely related to *S. guttatus* and *S. lineolatus* each occurs in South African waters.

(3) That in East African waters what has been considered as S. *lineolatus* is not in fact the typical *S. lineolatus* as found in Indian waters, but may be a closely related species or sub-species of it.

* Fork length measured here is from tip of snout to caudal fork depressing small fleshy flap extending posteriorly to indicate end of hypural [see Jones and Silas, 1960. *Indian J. Fish.*, 7 (2) : 371-73]. This would correspond to the standard length measurements given by Williams (1960).

(4) That in East African waters what has been considered as *S. lineolatus* is nothing but a closely allied species or sub-species of *S. guttatus* as mentioned under item 1.

The picture is far from clear and it will be desirable if good series of specimens from Western Indian Ocean at present known under the names *S. lineolatus* and *S. leopardus* are examined and compared with the typical *S. guttatus* and *S. lineolatus* which occur along the Indian coast. It is felt that on account of the differences already mentioned, until such time that such a study could be carried out it will be difficult to evaluate the status and relationships of these forms from the Western Indian Ocean.

SYNONYMS

(Alphabetically arranged)

1. *Scomberomorus guttatus guttatus* (Bloch and Schneider), 1801

Cybium crockewitii Bleeker, 1859
Cybium guttatum Bleeker, 1845
Cybium guttatum (in part) Pillay, 1929
Cybium guttatus Sorley, 1933
? *Cybium interruptum* Pearson, 1912
Cybium kuhlii Cuvier, 1831
? *Cybium leopardus* Fourmanoir, 1957
Indocybium guttatum Munro, 1955
Scomber guttatus Bloch and Schneider, 1801
Scomber wingeram Russell, 1803
Scomber leopardus Shaw, 1803
? *Scomber wingeram* Schinz, 1822
Scomberomorus croockewitii Munro, 1943: de Beaufort. 1951
Somberomorus guttatus Fowler, 1905b
Scomberomorus guttatus guttatus Jones and Silas, 1962
Scomberomorus (*Indocybium*) *guttatus* Munro, 1943
Scomberomorus (*Sawara*) *guttatus* Deraniyagala, 1933a
Scomberomorus (*Scomberomorus*) *guttatus* (in part) Fraser-Brunner, 1950
Scomberomorus kuhlii Hardenberg, 1936
Scomberomorus kuhlii Hardenberg, 1937
Scomberomorus (*Pseudosawara*) *kuhlii* Munro, 1943
? *Scomberomorus leopardus* Fowler, 1929
? *Scomberomorus lineolatus* (*nec* Cuvier ?) Fowler, 1934

2. *Scomberomorus guttatus koreanus* (Kishinouye), 1915

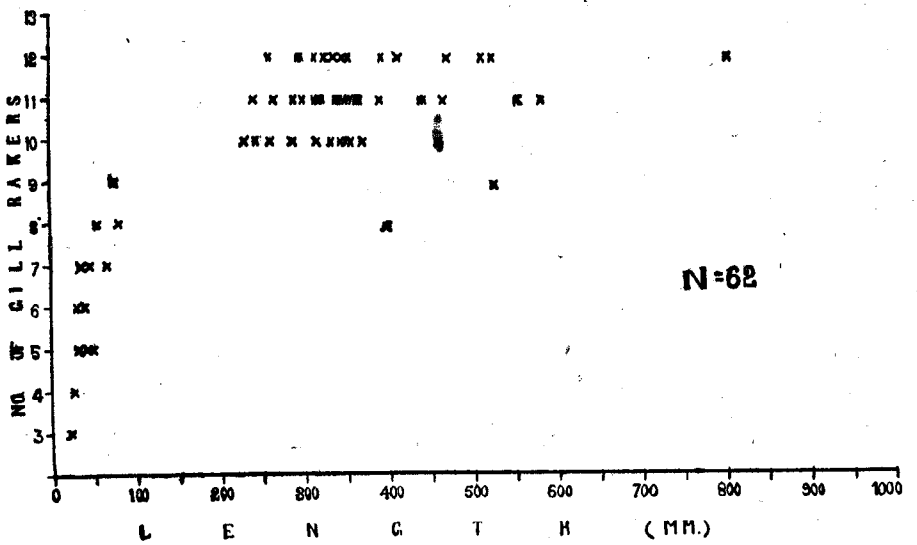
Cybium coreanum Parks, 1939
Cybium koreanum Kishinouye, 1915
Sawara koreanum Soldatov and Lindberg, 1930
Scomberomorus (*Pseudosawara*) *koreanus* Munro, 1943
Scomberomorus (*Scomberomorus*) *semifasciatus* (in part) Fraser-Brunner, 1950

For the different synonyms and combinations, more references are listed in the section Annotated Bibliography."

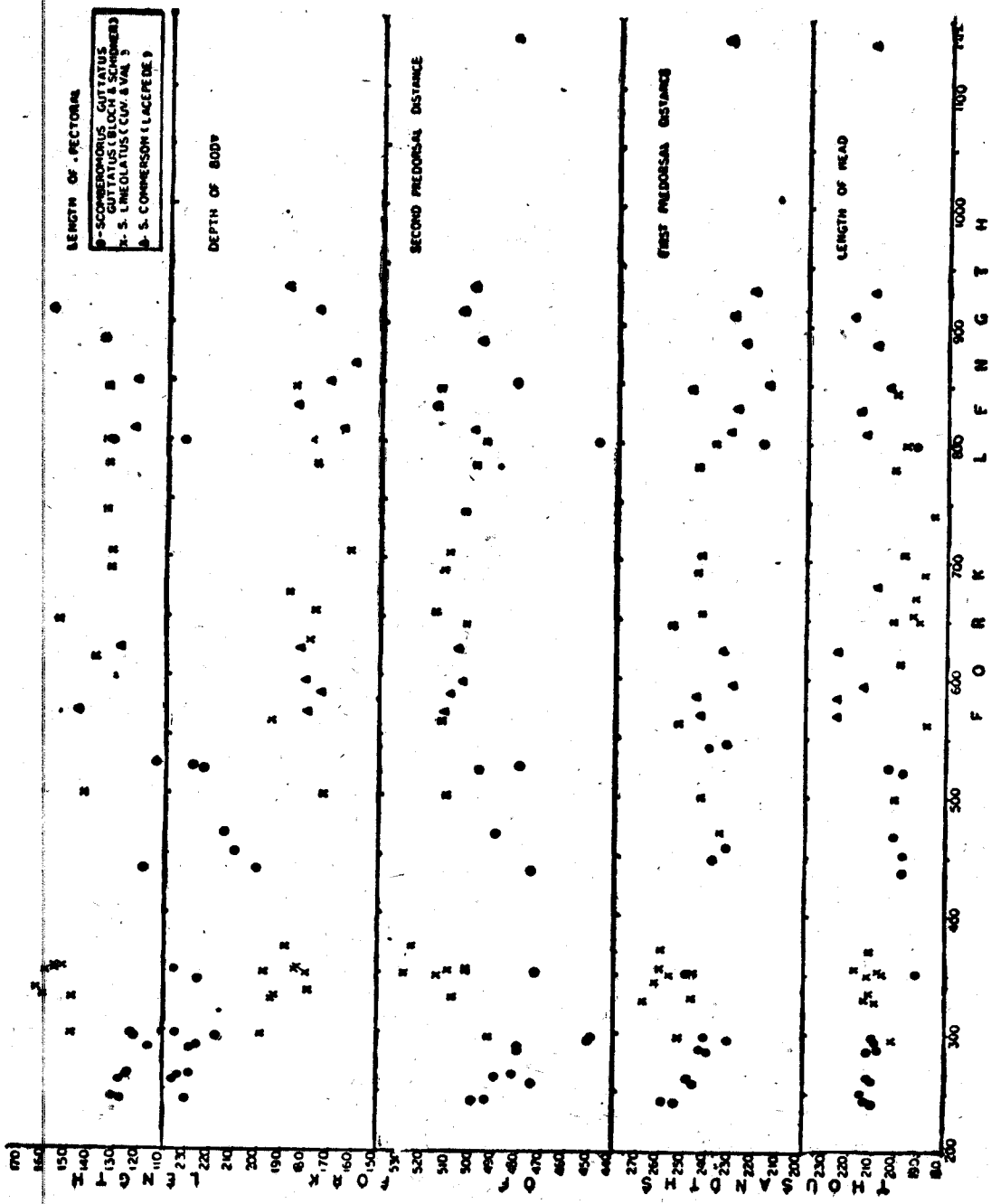
TABLE VI

Common and Vernacular Names

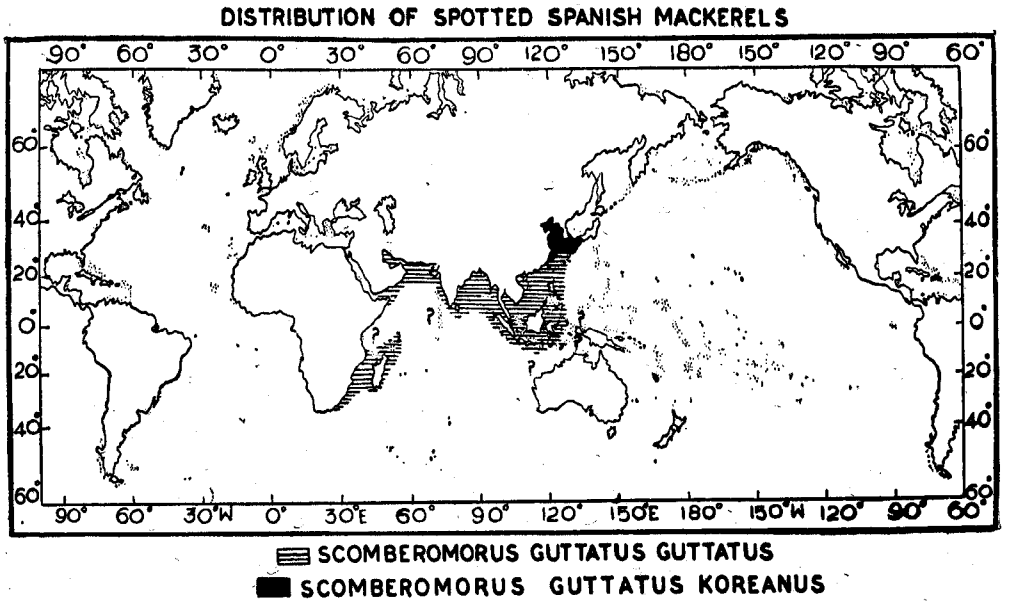
Country	Standard common name	Vernacular name(s)
	I. *Scomberomorus guttatus guttatus* (Bloch and Schneider)	
Borneo (West)	...	Tengiri.
Ceylon	... Spotted seer	Spotted spanish mackerel ; Aru maha ; Alu thora ; Ganu thora ; Sekkal thora ; Bambra tora ; Anjilava (young) (*Sinhalese*). Nei Arekula ; Anjilia (*Tamil*).
China		Kan yu ; Kaou yu ; Kau ü, eaou yu.
Indo-China	...	Ca song toi ; Ca thu ; Ca chan.
India	... Spotted spanish mackerel Seerfish	Tuwar ; Touri ; Towar : Kargan ; Surmai ; Surma Hadra (spotted) (*Marathi*). Khullkul (*Canarese*). Anjal (*Tulu*). Ney-meen ; Arrakeeah ; Varimeen ; Seela (*Malayalam*). Vanjiram ; Wantasaran ; Cheela ; Katta-cheela (*Tamil*). Vanjaramu ; Wingram (*Telugu*). (Some of the vernacular names mentioned above are also used to denote *S. commerson*, and *S. lineolatus*).
Indonesia	...	Gepanterde tenggiri
Iranian Gulf	...	Ghobad ; Ghobart ; Ghobab ; Sheer.
Japan	...	Kahpah.
Malaya	...	Tenggiri ; Tenggiri papan ; Luding ; Tohok langi.
Philippines	... Spotted spanish mackerel	Spotted seer ; spotted tanginigi.
Union of South Africa	...	Snoek ; Kingfish.
	II. *Scomberomorus guttatus koreanus* (Kishinouye)	
Japan	...	Hirasawaral



Text Fig. 2.—Graph showing increase in number of gill rakers during growth in juveniles and adults of *Scomberomorus guttatus guttatus* from Indian waters.



Text Fig. 3.—Scatter diagrams showing relationships for five characters in specimens of *S. guttatus guttatus*, *S. lineolatus* and *S. commerson*, from Indian waters.



Text Fig. 4.—Geographical distribution of the spotted spanish mackerels, namely, *Scomberomorus guttatus guttatus* (Bloch and Schneider), and *S. g. koreanus* (Kishinouye) of the Indo-Pacific.

ADDITIONAL REMARKS AND COMPARISONS BETWEEN INDIAN SPECIES OF *SCOMBEROMORUS*

Jones and Silas (1961) drew attention to some of the important differences between the Indian species of *Scomberomorus*, and the Wahoo. Additional data are given below:

(1) Gill rakers: Reference may be made to Tables II and III, and also to text-fig. 2. As will be seen from the latter, the full complement of gill rakers is attained in *S. g. guttatus* by the time the fish reaches about 200 mm. in length. The data given for larvae and juveniles of *S. commerson* by Jones (1961) show that in that species the full complement of gill rakers is attained by the time the fish reaches about 100–130 mm. in length. No information is available for *S. lineolatus*.

(2) Lateral line: The venulose branched condition of the lateral line in *S.g.guttatus* is shown in plate II, figs. B and C. This may be compared with the non-branching lateral line seen in *S. lineolatus* shown in plate II, fig. D. In large specimens of *S.commerson*, as in *Acanthocybium solandri*, perpendicular dorsal and ventral branchings of the lateral line may be seen. But for this, the lateral line in it is simple as in *S. lineolatus*.

(3) Head: Compared to *S. commerson* the head is relatively smaller in both *S. g. guttatus* and *S. lineolatus* (Text-fig. 3, and plate III, figs. A, B & C).

(4) First predorsal distance: The distance between the tip of the snout and the anterior insertion of the spinous dorsal is relatively greater in *S. lineolatus*, than in *S. g. guttatus* and *S. commerson* (Text-fig. 3).

(5) Second predorsal distance: The distance between the tip of the snout and the anterior insertion of the second dorsal is distinctly greater in both *S. commerson* and *S. lineolatus* than in *S. g. guttatus* (Text fig. 3).

(6) Greatest depth of body: Size for size, the body is distinctly deeper in *S. g. guttatus* than in *S. lineolatus* and *S. commerson*. The available data for sizes between 200--800 mm. (Text-fig. 3) show hardly any overlap in this character between the first and the other two species.

(7) Length of pectoral fin: On the other hand the pectoral fin is relatively shorter in *S. g. guttatus* than in *S. lineolatus* and in *S. commerson* (Text-fig. 3, and Plate III, figs. A. and C.).

(8) The caudal peduncular keel: This is not so well developed in *S. g. guttatus* and in *S. lineolatus* (Plate III, figs. D & E). Jones and Silas (1961) have given more information on this character for the three species.

GEOGRAPHICAL DISTRIBUTION

The known distributional ranges of *S. g. guttatus* and *S. g. koreanus* are shown in text-fig. 4. A disjunct distribution of the spotted spanish mackerel in the Western Indian Ocean may be noted. This is puzzling, especially in view of the continuous distribution of *S. g. guttatus* along the rest of its distributional range. As already mentioned, the spotted spanish mackerel of the Western Indian Ocean needs restudy, and until such time it is tentatively placed under *S. g. guttatus*. The possibility of a distinct subspecies of *S. guttatus* occurring in the Western Indian Ocean just as *S. g. koreanus* occurs at one extreme end of its range of distribution cannot be overruled.

S. guttatus is not truly oceanic in habit as some of its congeners, but is essentially known from coastal waters and is found between 40°N. lat. and about 33°S. lat., and about 27°E. long. to about 140°E long. in the Indo-Pacific. The subspecies *S. g. koreanus* has a restricted distribution, being known from Chosen and adjacent waters west of Korea perhaps extending on to Japanese waters. Kishinouye (1923) speaking of *Cybium koreanum* (= *S. g. koreanus*) remarks that "It is remarkable that this species ascends the brackish parts of rivers" and that it "……can withstand water of very low density." "Generally speaking fishes of the Scombridae and Cybiidae are adapted to water of lower density, 1.022--1.025, while plecostean fishes prefer water of higher density 1.025--1.027." The same tendency of ascending estuaries of larger rivers is also seen in the case of the typical form *S. g. guttatus* as it has been recorded from river mouths and estuaries (Hardenberg, 1936; Hora, 1953).

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Anatomy
Kishinouye, 1923

Angling (see under sport fishing)

Catch composition
Krishnamurthi, 1957, 1958
Nayar, 1958

Chemical analysis
Joshi and Magar, 1955
Joshi, Master and Magar, 1953
Love, Lovern and Jones, 1959
Peterson, 1951

Common names
Anonymous, 1951
Bleeker, 1859
Blegvad and Loppenthin, 1944
Burton, 1945
Cuvier, 1831
Day, 1865, 1878 and 1889
de Beaufort, 1951
Delsman and Hardenberg, 1934
Deraniyagala, 1933*a*, 1933*b* and 1952
Duncker, 1904
Fowler, 1938
Fraser-Brunner, 1950
Hardenberg, 1936
Herre, 1953
Jones and Silas, 1961, 1962
Kishinouye, 1915, 1923
Koumans, 1940
Lane, 1916
Macdonald, 1947
Maxwell, 1921
Mendes, 1954
Munro, 1955
Pillay, 1929
Rosa, 1950
Russell, 1803
Smith, 1949, 1961

Classification
Fraser-Brunner, 1950
Jones and Silas, 1962
Kishinouye, 1923

Contents of stomach
(*see* Food and Feeding habits)

Curing
Day, 1865*a*, 1878
Nayar, 1958
Nicholson, 1920

Cybium coreanum
Park, 1939

Cybium croockewitii
Bleeker, 1859
Boeseman, 1962
Günther, 1860
Martens, 1876

Cybium guttatum
Anonymous, 1951
Bassett-Smith, 1898
Bleeker, 1845, 1852, 1859
Burton, 1945
Chabanaud, 1926
Cantor, 1849 (1850)
Cuvier, 1831
Day, 1865*a*, 1865*b*, 1878, 1889
Delsman and Hardenburg, 1934
Duncker, 1904
Hardenberg, 1931
Hutton, 1895
Kishinouye, 1923
Koumans, 1940
Lane, 1916
La Poulain and Durand, 1949
Macdonald, 1947
Maxwell, 1921
Nayar, 1958
Nicholson, 1930
Richardson, 1845
Southwell, 1929, 1930
Suvatti, 1936
Tampi, 1959
Tripathi, 1954, 1957
Vinciguerra, 1926
Whitley, 1936

Cybium guttatum (*partim*)
Pillay, 1929

Cybium guttatus
Sorley, 1933

Cybium interruptum
Pearson, 1912
Lane, 1916

Cybium koreanum
Kishinouye, 1915, 1923

Cybium kuhlii
Blanc and Bauchot, 1962
Boeseman, 1962
Cuvier, 1831
Day, 1878, 1889
Duncker, 1904
Hardenberg, 1931
Maxwell, 1921
Sorley, 1933
Spence and Prater, 1931
Tirant, 1883

Cybium leopardus
Fourmanoir, 1957

Cybium guttatum
Chauhan, 1953*a*, 1953*b*

Description
Anonymous, 1951
Blegvad and Loppenthin, 1944
Bloch and Schneider, 1801
Cantor, 1849 (1950)
Chu, 1931
Cuvier, 1831
Day, 1865*a*, 1865*b*, 1878, 1889
de Beaufort, 1951
Delsman, 1931
Deraniyagala, 1933*b*, 1952
Fowler, 1905*b*, 1927, 1929*a*, 1934
Günther, 1860
Jones, 1961
Jones and Silas, 1961, 1962
Kishinouye, 1915, 1923
Lane, 1916
Le Poulain and Durand, 1949
Munro, 1955
Richardson, 1845
Russell, 1803
Smith, 1949, 1961, 1962
Vijayaraghavan, 1955
Wang, 1935

Distribution
Bleeker, 1859
Blegvad and Loppenthin, 1944
Day, 1865*b*, 1878, 1889
de Beaufort, 1951
Deraniyagala, 1933*a*, 1933*b*, 1952
Fowler, 1938
Fraser-Brunner, 1950
Günther, 1860
Hardenberg, 1931
Herre, 1953
Jones and Silas, 1961, 1962
Kishinouye, 1923
Rosa, 1950
Smith, 1949, 1961, 1962
Vinciguerra, 1926

Dussumieria—Feeder
Kow, 1950

Ecology—(other than oceanographic conditions or food):
Hardenberg, 1931
Hora, 1953
Kishinouye, 1923

Eggs
Munro, 1942
Krishnamoorthi, 1958
Vijayaraghavan, 1955

Figures
Anonymous, 1951
Blegvad and Loppenthin, 1944
Chu, 1931
Day, 1878
de Beaufort, 1951
Delsman and Hardenberg, 1934
Deraniyagala, 1933*a*, 1933*b*, 1952
Fraser-Brunner, 1950
Hora, 1953
Jones, 1961
Jones and Kumaran, 1962
Jones and Silas, 1961, 1962
Kishinouye, 1923
Maxwell, 1921
Munro, 1942, 1955
Russell, 1803
Smith, 1948, 1961, 1962
Spence and Prater, 1931
Tampi, 1959
Venkataraman, 1960
Vijayaraghavan, 1955
Wang, 1935

Fishing condition correlated in the area
Hardenberg, 1931
Krishnamurtni, 1958

Fishing conditions correlated in the seasons
(see under fishing seasons)

Fishery
Anonymous 1957, 1959, 1960
Kaikini, 1960
Krishnamurthi, 1957, 1958

Fishing methods and gear
Anonymous, 1951
Blegvad and Loppenthin, 1944
Hardenberg, 1931
Kishinouye, 1923
Macdonald, 1947
Nayar, 1958

Fishing seasons
Anonymous, 1959
Day, 1878, 1889
Krishnamurthi, 1957, 1958
Kishinouye, 1923
Pillay, 1929

Food and feeding habits
Ah Kow, 1950
Anonymous, 1959, 1960
Blegvad and Loppenthin, 1944
Kishinouye, 1923
Krishnamurthi, 1958

Food and feeding habits—(Contd.)
Kumaran, 1962
Rao, 1962
Venkataraman, 1960
Vijayaraghavan, 1955

Indocybium guttatum
Munro, 1955
John, 1959

Juveniles—(See under larvae and juveniles)

Key for identification
de Beaufort, 1951
Fowler, 1936
Fraser-Brunner, 1950
Jones and Silas, 1961, 1962
Kishinouye, 1923
Mendes, 1954
Munro, 1942, 1955
Smith, 1962

Larvae and Juveniles
Delsman and Hardenberg, 1934
Herre and Myers, 1937
Jones and Kumaran, 1962
Kaikini, 1960
Kishinouye, 1923
Kumaran, 1962
Munro, 1942
Rao, 1962
Venkataraman, 1960
Vijayaraghavan, 1955

Length-weight relationship
Krishnamurthi, 1958

Mackerel, Spotted Spanish
Jones and Silas, 1961
Munro, 1955
Rosa, 1950

Mackerel, Indian Spanish
Fraser-Brunner, 1950

Marketing
Krishnamurthi, 1957, 1958

Maturity
Anonymous, 1959
Hardenberg, 1931
Kishinouye, 1923
Krishnamurthi, 1958

Meristic counts
Blegvad and Loppenthin, 1944
Chu, 1931
Cuvier, 1831
Day, 1865*a*, 1865*b*, 1878, 1889
de Beaufort, 1951
Deraniyagala, 1933*b*, 1952
Fourmanoir, 1957

Meristic counts—(Contd.)
Fowler, 1927, 1929*a*
Günther, 1860
Herre and Herald, 1951
Jones, 1961
Jones and Silas, 1961, 1962
Kishinouye, 1915, 1923
Krishnamurthi, 1958
Munro, 1942, 1955
Russell, 1803
Smith, 1949, 1961, 1962
Tirant, 1883
Vinciguerra, 1926
Wang, 1935

Morphometrics
Krishnamurthi, 1958

Occurrence
Blanc and Bauchot, 1962
Bleeker, 1845, 1852, 1859
Blegvad and Loppenthin, 1944
Cantor, 1849 (1850)
Chabanaud, 1926
Chacko, 1956
Chu, 1931
Day, 1865*a*, 1865*b*, 1869, 1878, 1889
de Beaufort, 1951
Deraniyagala, 1933*b*, 1929*b*, 1934, 1936, 1952
Duncker, 1904
Fourmanoir, 1957
Fowler, 1905*b*, 1927, 1929*a*, 1929*b*, 1934, 1936
Günther, 1860
Hardenberg, 1931, 1936, 1937
Herre, 1950
Herre and Herald, 1951
Herre and Myers, 1937
Hora 1953
John, 1959
Jones, 1961
Jones and Kumaran, 1962
Jones and Silas, 1961, 1962
Jordan and Seale, 1907
Kaikini, 1960
Kishinouye, 1915, 1923
Koumans, 1940
Lane, 1916
Le Poulain and Durand, 1949
Martens, 1876
Maxwell, 1921
Munro, 1955
Pillay, 1929
Richardson, 1845
Rosa, 1950
Smith, 1956
Soldatov and Lindberg, 1930
Suvatti, 1936
Tirant, 1883
Wang, 1935

Osteology
Kishinouye, 1923

Parasites—Monogenetic Trematodes
Chauhan, 1953*a*, 1953*b*
Ramalingam, 1951, 1961*a*, 1961*b*
Silas, 1962
Tripathi, 1954, 1957

Parasites : Digenetic Trematodes
Chauhan, 1953*b*
Park, 1937
Silas, 1962

Parasites : Cestoda
Shipley and Hornell, 1906
Silas, 1962
Southwell, 1929, 1930

Parasites : Copepoda
Bassett-Smith, 1898
Kirtisinghe, 1935, 1937
Silas and Ummerkutty, 1962

Physiology
Tampi, 1959

Sawara koreanum
Soldatov and Lindberg, 1930

Scomber guttatus
Bloch and Schneider, 1801

Scomber leopardus
Shaw, 1803

Scomber wingeram
Russell, 1803
Schinz, 1822

Scomberomorus croockewitii
de Beaufort, 1951
Munro, 1943

Scomberomorus guttatum
Joshi and Magar 1955
Joshi *et al.*, 1953
Love *et al.*, 1959

Scomberomorus guttatus
Ah Kow, 1950
Anonymous, 1957, 1959, 1960.
Boeseman, 1962
Chacko, 1956
Chu, 1931
de Beaufort, 1951
Delsman and Hardenberg, 1934
Deraniyagala, 1952
Fowler, 1905*b*, 1929*b*, 1936, 1938
Hardenberg, 1936, 1937

Scomberomorus guttatus—(Contd.)
Herre, 1950, 1953
Herre and Myers, 1937
Hora, 1953
Jones, 1961
Jones and Kumaran, 1962
Jones and Silas, 1961
Jordan and Seale, 1907
Kaikini, 1960
Krishnamurthi, 1958
Kumaran, 1962
Munro, 1943
Petersen, 1951
Ramalingam, 1961*a*, 1961*b*
Rao, 1962
Smith, 1956
Suter, 1948
Vijayaraghavan, 1955
Wang, 1935
Williams, 1960

Scomberomorus guttatus (*nec* Bloch and Schneider)
McCulloch, 1929

Scomberomorus guttatus guttatus
Jones and Silas, 1962
Silas, 1962

Scomberomorus (*Indocybium*) *guttatus*
Munro, 1943

Scomberomorus (*Sawara*) *guttatus*
Deraniyagala, 1933*a*, 1933*b*

Scomberomorus (*Scomberomorus*) *guttatus*
Fraser-Brunner, 1950
Rosa, 1950

Scomberomorus kuhlii
Hardenberg, 1936
Herre, 1953

Scomberomorus kuhlii
Hardenberg, 1937
Herre and Herald, 1951
Fowler, 1927, 1938

Scomberomorus (*Pseudosawara*) *kuhlii*
Munro, 1943
Rosa, 1950

Scomberomorus leoparadus
Fowler, 1929*a*
Smith, 1949, 1961

Scomberomorus lineolatus (*nec* Cuvier)
Fowler, 1934

Shoaling
Anonymous, 1951
Blegvad and Loppenthin, 1944
Burton, 1945

Size
Ah Kow, 1950
Anonymous, 1951
Day, 1865*a*, 1865*b*, 1878, 1899
Hardenberg, 1931
Kishinouye, 1915, 1923
Pillay, 1929
Smith, 1949, 1961
Suter, 1948

Size composition
Anonymous, 1959, 1960
Hardenberg, 1931
Krishnamurthi, 1958

Spawning
Kishinouye, 1923
Krishnamurthi, 1958

Sport fishing
Burton, 1945
Smith, 1947, 1961
Suter, 1948
Thomas, 1897

Stolephorus-feeder
Ah Kow, 1950

Stomach contents (see under food and feeding habits)

Synonymy
Bleeker, 1859
Blegvad and Loppenthin, 1944
Cuvier, 1831
de Beaufort, 1951
Day, 1865*b*
Deraniyagala, 1952
Fourmanoir, 1957
Fowler, 1938

Synonymy—(Contd.)
Fraser-Brunner, 1950
Günther, 1860
Herre, 1953
John, 1959
Jones and Silas, 1961, 1962
Kishinouye, 1923
McCulloch, 1929
Mendes, 1954
Munro, 1955
Rosa, 1950
Smith, 1959, 1961, 1962
Tirant, 1883
Vinciguerra, 1926

Taxonomic notes
de Beaufort, 1951
Jones, 1962
Jones and Silas, 1962*a*, 1962*b*
Munro, 1943
Williams, 1960

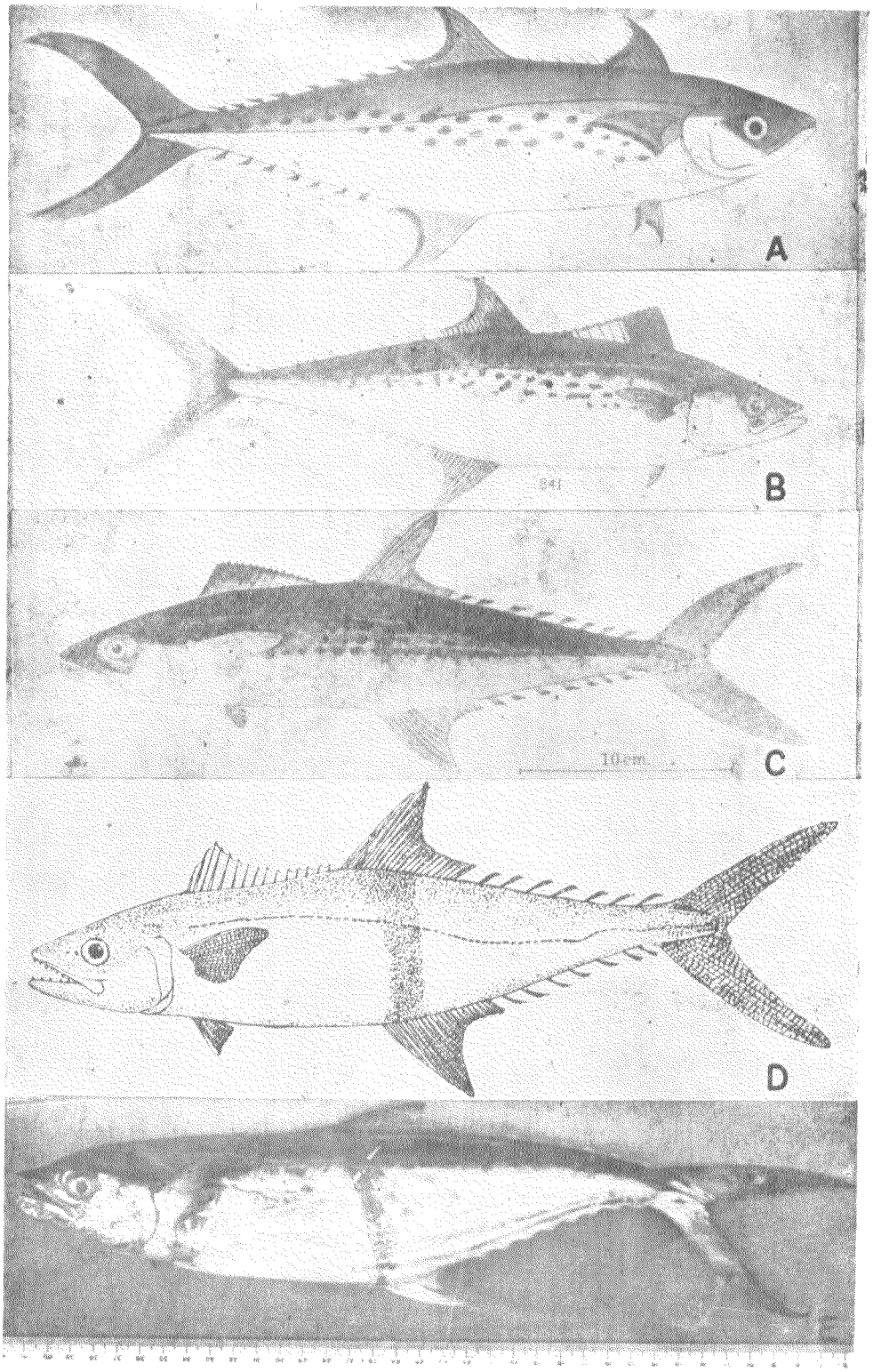
Types
Blanc and Bauchot, 1962
Boeseman, 1962

Utility as food
Blegvad and Loppenthin, 1944
Day, 1865*a*, 1865*b*, 1878
Kishinouye, 1923
Pillay, 1929

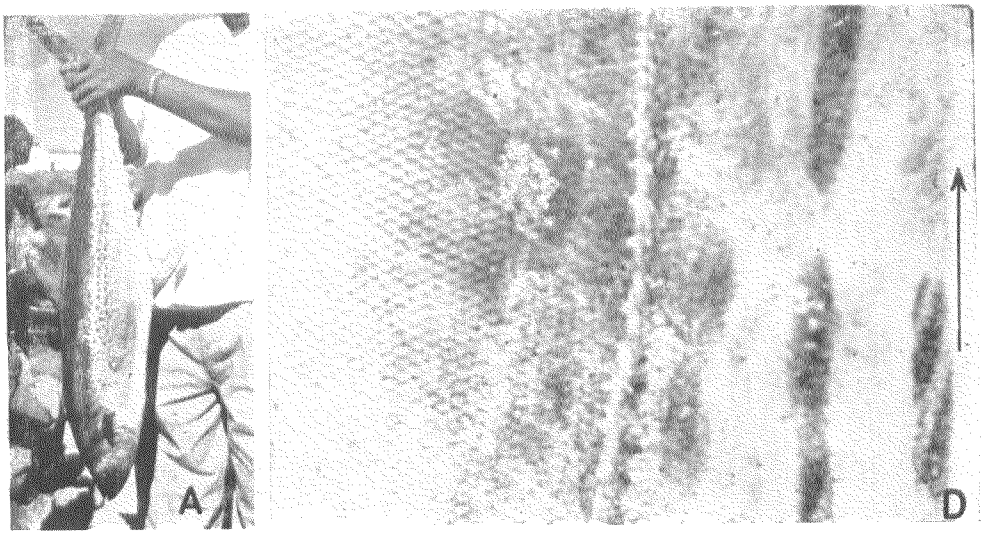
Weight
Blegvad and Loppenthin, 1944
Burton, 1945
Kishinouye, 1923
Krishnamurthi, 1958
Suter, 1948

Yield
Krishnamurthi, 1957, 1958

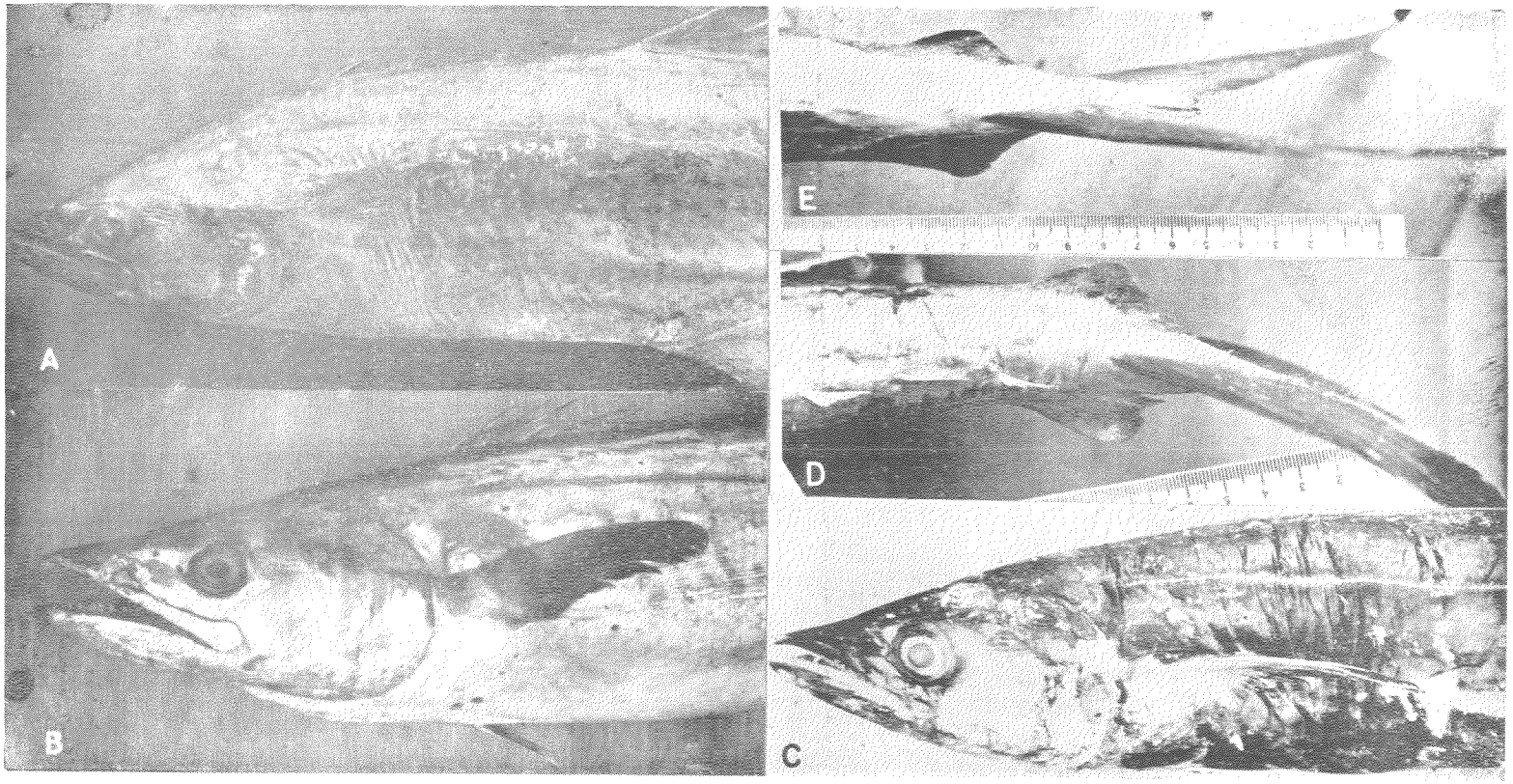
Young—(see under larvae and juveniles)



A. The *Wingeram*, after Russell (1801) from Coromandel Coast, India ; B. *Scomberomorus leopardus* (Shaw), 25 inch specimen from South African waters (after Smith, 1961) ; C. *Scomberomorus guttatus* (Bloch and Schneider) 35 cm. specimen from Shangtung coast, China (after Wang, 1935) ; D. *Scomberomorus croockewitii* (Bleeker), 45 cm. holotype (after de Beaufort, 1951) ; and E. *Scomberomorus guttatus guttatus* (Bloch and Schneider), 31 cm. specimen caught in gill net off Tuticorin, Gulf of Mannar.



A. *Scomberomorus guttatus guttatus* (Bloch and Schneider), 80 cm. specimen caught off Veraval, Gujarat, Western India; B and C. Lateral line of specimen 50 cm. showing characteristic branching at (B) just above gill opening and pectoral, and (C) below second dorsal ; D. Simple unbranched lateral line in *Scomberomorus lineolatus* (Cuvier) in a specimen 60 cm. long. (The arrow in each figure indicates antero-posterior direction).



A. *Scomberomorus guttatus guttatus* (Bloch and Schneider), head and anterior part of body of a specimen 80 cm. from Veraval, Gujarat, Western India ; B. *S. commerson* (Lacépède), 78 cm. from Kilakarai, Ramnad Coast, Gulf of Mannar ; C. *S. lineolatus* (Cuvier), 72 cm. from Tuticorin, Gulf of Mannar ; D. Conspicuously prominent wing-like caudal peduncular keel of same ; E. Relatively illdeveloped caudal peduncular keel of specimen mentioned under A.