SYSTEMATICS AND COMPARATIVE OSTEOLOGY OF INDIAN LIZARD FISHES (*SAURIDA* SPP.)*

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ABSTRACT

Brief descriptions of the four species of Saurida, viz., *S. tumbil, S. unlosquamis, S. longimanus* and *S. gracilis* are given along with a key for their identification. A comparative study of different morphological and osteological characters of the first three species from Waltair coast showed that they exhibit marked similarity in many characters but differ in respect of some characters by which they can be distinguished. *S. undosquamis* and *S. longimanus* resemble each other closely in respect of most of the characters and stand apart from *S. tumbil.* An osteological key for the identification of the three species is given. A compaison of specimens of *tumbil* and *undosquamis* of Bay of Bengal with those of East China and Japan seas indicated that these species from Indian and Japanese waters may represent different races.

INTRODUCTION

A study of the systematics and osteology of the lizard fishes of the genus *Saurida* was undertaken at Waltair in connection with the investigation on their biology. The investigation covered mainly the continental shelf between Lat. 16° 40' N and 21°00'N along the north western part of the Bay of Bengal. Of the four species of the genus *Saurida* namely, *S. tumbil,S. undosquamis, S. longimanus* and *S. gracilis* occurring in Indian waters, only the first three species were recorded during the peried of this investigation (1964 to 1970) from the north-western part of the Bay of Bengal. A few specimens of *S. gracilis* were collected from the south-west coast of India. The material available enabled the present author to make a detailed study of the important characters of these species.

Regan (1911) included the lizard fish in the family synodontidae under the order Iniomi. He divided the order Iniomi into three suborders, Myctophoidea, Alepidosauroidea and Ateleopoidea and the families Aulopidae, Synodontidae, Sudidae and Myctophoidae were included under the suborder Myctophoidea. Later, Berg (1940) revised this classification and included the lizard

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fish in the family Synodidae (Sauridae, Synodontidae) under the order Scopeliformes. The order Scopeliformes is divided into 12 families, including the Synodidae.

Family Synodidae includes the Bombayduck (Harpodon) and the lizard fishes. In regard to lizard fishes, four genera *Synodus* Gronow, *Saurida* Cuvier and Valenciennes, *Trachinocephalus* Gill and *Xystodus* Ogilby are at present recognized. *Xystodus* is known only from Australia while the other three genera occur in the Atlantic, the Pacific and the Indian oceans (Anderson *et al* 1966) Two species of the genus *Saurida, Saurida tumbil* (Bloch) and *Saurida nebulosa* Cuv. & Val. - Synonym *S. gracilis* (Quoy and Gaimard)- were described by Day (1878) from Indian waters. These two species along with a third one, *Saurida grandisquamis* Gunther were described by Weber and Beaufort (1913) from the Indo-Australian Archipelago. Jordan and Herre (1907) reviewed the lizard fishes (Synodontidae) of the waters of Japan.

Norman (1935) in his revision of the fishes of the genus *Saurida* recognized four species from the Atlantic and five species (*S. gracilis, S. undosquamis, S. filamentosa* and *S. elongata*) from the Indo-Pacific. Subsequently, he described (Norman 1939) a new species, *S. longimanus,* from the Gulf of Oman. Of the six species of the genus *Saurida* so far described from the Indo-Pacific, four species i.e., *S. gracilis, S. tumbil, S. undosquamis* and *S. longimanus* occur in Indian waters.

Regan (1911), Parr (1929) and Gregory (1933) have given brief accounts of the osteology of the order "Iniomi." Hollister (1937) has described the caudal skeleton of *Synodus* sp. and *Trachinocephalus myops* while Clothier (1950) has given a brief note about the vertebral column of *Synodus lucioceps.* Although Matsubara and Iwai (1951) have pointed out the differences in respect of some osteological characters among three species of *Saurida, S. elongata, S. tumbil* and *S. undosquamis* from the Japanese waters, so far no detailed study has been made of the skeletal system of any species of *Saurida.*

Materials and Methods

The material was collected from the catches of the trawl and other nets at Waltair, Kakinada and Tuticorin on the east coast, and Mangalore and Bombay on the west coast. The fish were first studied in fresh condition and then preserved in 5% formalin for about a month before taking morphometric measurements. Skeletons were prepared and the bones of the skull were disarticulated and studied. Alizarin staining technique followed by Hollister (1934) and Clothier (1950) was used for studying the skeleton in situ.

Specimens preserved in 5% formalin were used for this study. The fish were placed in 4% Potassium hydroxide (KOH). Smaller specimens 6-15 cm) took 15 to 20 days to become transparent while the larger ones (17-25 cm)

took 1½ to 2 months. After the specimens became transparent they were placed in fresh KOH (4%) and the staining solution was added drop by drop till the solution showed a violet pink colour. The specimens took stain in 4 or 5 days. After the specimens were stained, the used-up solution was pipetted out, fresh KOH and increasing quantities of glycerine were added at regular intervals and specimens preserved finally in glycerine. Care was taken to see that the specimens were kept for at least 48 hours at each stage.

In naming the various bones the works of Starks (1901, 1910), Gregory (1933), Hollister (1937), Ford (1937), Clothier (1950), Ramaswami (1952) and Harrington (1955) were followed. Based on a study of the material collected by the present author, brief descriptions of the genus *Saurida* and the four species occuring in Indian waters are given below. For synonymy reference may be made to Weber and Beaufort (1913), Norman (1935), Misra (1952) and Rao (1974)

Genus *Saurida* Valenciennes.

Hist. Nat. Poiss. xxii P. 499

Genotype: *Salmo tumbil* Bloch, 1795.

Diagnosis: Body elongate, more or less rounded, scales deciduous: without photophores. Caudal region sometimes depressed, with or without lateral keels. Snout obtusely pointed, rather short. Eye moderate with anterior and posterior adipose lids. Head depressed, naked above; cheeks and opercular bones scaled. Cleft of mouth very wide, more or less oblique, bordered above by the long premaxillary with which the slender maxillary is connected. Teeth in jaws in several rows, those of the innermost row largest, slender, pointed and depressible; similar teeth on the palate, in a double band on each side, the inner part much shorter than the outer; small teeth sometimes present on the head of the vomer; teeth present on the tongue and on the branchial arches. Gill openings very wide; 13 to 16 branchiostegal rays; pseudobranchiae well developed; gill rakers rudimentary. Dorsal with 10-13 rays, situated nearly in the middle of length; adipose fin small, above the short anal. Anal with 9-13 rays, origin nearer to caudal base than to ventral base; anal base widely separated from caudal. Pectorals with 11-16 rays, rather short, placed above the middle of height. Pelvics 9-rayed, anterior, not far behind pectorals, the inner rays not much longer than the outer ones; pelvic bones with short, laminar, posterior processes. Caudal forked. Vent posterior, nearer to base of caudal than to insertion of pelvics. Vertebrae 45-62.

Saurida tumbil (Bloch 1795)

Salmo tumbil Bloch 1795, *Naturg. Ausl. Fische*, 9: 112; Schneider 1801, in Bloch, *Syst. Ichth.*, p. 405.

Diagnosis: B.14-16; D. 11-13; P. 14-16; V. 9; A. 10-13; L.l. 53-58 L.Tr. 4½-5/7; Pyl. Caecae 17-22; Vertebrae 50-53.

Number of specimens studied: 63; Length range: 129-372 mm (standard length).

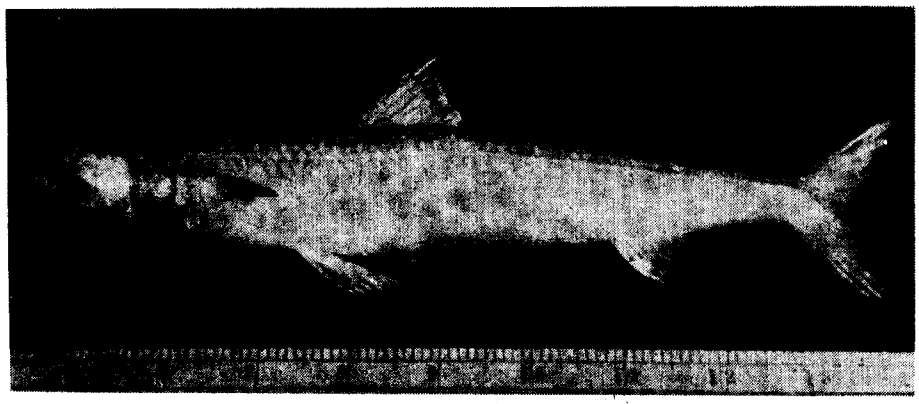

FIG. 1. *Saurida tumbil* (Bloch).

Head 3.77 to 4.19; height 5.25 to 7.58 in standard length. Eye 4.88 to 6.12 in head and 1.05 to 1.33 in interorbital width. Outerbands of palatine teeth in 3 or more rows anteriorly where the two bands are narrowly separated; a median patch of small teeth on the head of vomer. Lateral line with 53-58 scales, 4½ to 5 between middle of dorsal fin and lateral line, 18 to 22 scales from occiput to origin of dorsal. Dorsal base 1.74 to 2.22 in head; second dorsal ray longest, 1.15 to 1.46 in head. Anal base 2.43 to 3.24 in head. Pectoral not or only just reaching the vertical through the origin of ventral, length 1.7 to 2.1 in head. Tip of pectoral reaches 9th or 10th scale in the lateral line. Ventrals 0.75 to 0.80 in head. Axillary scale long and pointed. Caudal peduncle depressed with lateral keels, its least depth 3.35 to 4.18 in head. Teeth in jaws slender, pointed, unequal, depressible and in several rows. Tongue covered with fine teeth; gill rakers rudimentary, numerous and arranged in 3 or 4 series.

Colour: Brownish above and silvery white below. Posterior part of caudal blackish. Anal and pelvics yellowish. Dusky brown spots may be present on the upper edge of the caudal and the front edge of dorsal. Specimens were collected from trawl catches at Waltair, Kakinada and Tuticorin on the east coast and Mangalore and Bombay on the west coast.

Distribution: East coast of Africa and Red Sea, through the Indian Ocean and Archipelago to Australia, the coast of China, Japan and the Pacific.

In India: Along both the west and east coasts. Common in offshore waters 15-45 m in depth.

Remarks: According to Matsubara and Iwai (1951) specimens from Japanese waters seem to have only 2 rows in the outer bands of palatine teeth anteriorly. Sexual dimorphism has been reported in *S. tumbil* from the East China and Yellow seas by Matsubara and Iwai (1951), Okada and Kyushin (1955), and Liu and Tung (1959). These authors have observed that in mature males >150 mm in standard length, the second dorsal ray is prolonged into a filament, sometimes extending to two-thirds the distance between the origin of dorsal and adipose when the fin is laid back, while the females did not exhibit this character. In *S. tumbil* from Indian waters sexual dimorphism has not been observed. The present author did not find a single male specimen with a prolonged, filamentous, second dorsal ray.

Matsubara and Iwai (1951) state that adult male *S. tumbil* from Japanese waters exactly resembles *S. filamentosa* Ogilby in all the characters and that they could not find any difference between them. It may be pointed out here that in *S. filamentosa* the females also have the second dorsal ray prolonged into a filament which is shorter than that of males.

Saurida undosquamis (Richardson 1848)

Saurus undosquamis, Richardson 1848, Zool. Voy. *'Erebus' and 'Terror'*, fish. p. 138.

Diagnosis: B. 14-15; D. 11-13; A. 10-13; P. 14-15; V. 9; L.l. 45-49; L.Tr. 3½-4/6; Pyl. caecae 13-18; Vertebrae 45-47.

Number of specimens studied: 60; length range: 60-240 mm (standard length).

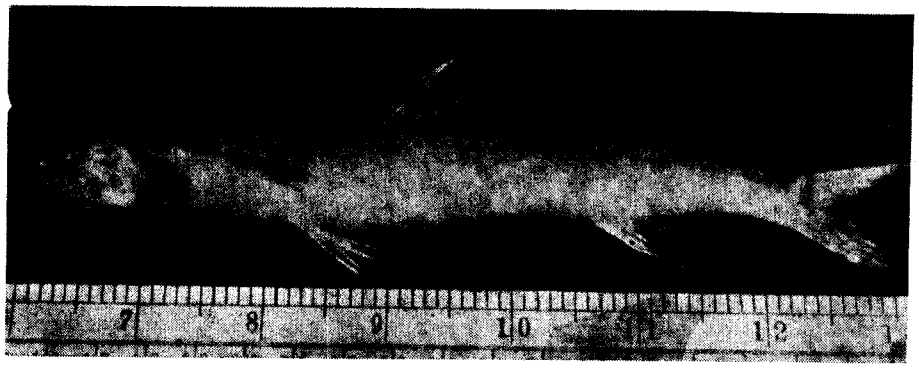

FIG. 2. *Saurida undosquamis* (Richardson).

Head 3.5 to 4.0, height 6.5 to 8.6 in standard length. Eye diameter 4.3 to 5.7 in length of head, 1.05 to 1.22 in interorbital width. Outer hands

of palatine teeth in two rows anteriorly where the two bands are widely separated; head of vomer toothless. Scales deciduous, 45-49 in the lateral line, 3½ to 4 between middle of dorsal fin and lateral line, 16 to 17 from occiput to origin of dorsal. Dorsal base 1.6 to 2.1 in head; second dorsal ray longest, 1.1 to 1.3 in head. Anal base 2.1 to 2.8 in head. Tip of pectoral extends beyond the vertical through the origin of ventral and up to 11th or 12th scale of lateral line, length 1.28 to 1.70 in length of head. Ventrals slightly shorter than head without snout. Axillary scale long and pointed. Caudal peduncle depressed with lateral keels, its least depth 3.5 to 4.1 in head. Teeth in jaws somewhat narrower than in *S. tumbil;* slender, pointed, unequal, depressible and arranged in several rows. Tongue covered with fine teeth. Gill rakers rudimentary, numerous and arranged in 3 or 4 series.

Colour: Brownish or greyish above, lighter below. A series of 8 to 10 dark spots along sides. The anterior edge of the dorsal and the upper edge of the caudal with a row of dark dots.

Specimens were collected from trawl catches off Puri, Waltair, and Kakinada on the east coast.

Distribution: East Africa and Red Sea, through the Indian Ocean and Archipelago to Australia, Japan and the Pacific.

In India: Along both the west and east coasts. It has not so far been reported from the northern part of west coast (Bombay and Saurashtra waters). Occurs in offshore waters 25 to 50 m in depth.

Remarks: The description of *Saurida grandisquamis* Gunther by Weber and Beaufort (1913), giving 12 rays for pectoral fin, seems to be erroneous. According to Norman (1935) *S. grandisquamis* Gunther is a synonym of *S. undosquamis* (Richardson) and if there had been any deviation from the normal count of 14-15 pectoral rays, Norman would have mentioned this. In this connection it may be mentioned that Hardenberg's specimens of *S. grandisquamis* Gunther from the Java Sea are said to have the normal number of 14-15 pectoral rays (Hardenberg 1933).

Norman (1935) makes a note that the 5 specimens of *S. undosquamis* (93 to 185mm long) in the Indian Museum collected near the mouth of the river Hooghly, Bengal, differed from the other Indo-Pacific forms in having a longer pectoral fin and in the absence of the characteristic dark caudal spots and is of the opinion that these may prove to represent a distinct race.

Subsequently Norman (1939) described a new species, *Saurida longimanus* from the Gulf of Oman. *S. longimanus* is closely related to *S. undosquamis,* but differs from the latter in having a longer pectoral fin and in the absence of the dark caudal spots. It is possible that these specimens referred to by Norman (1935) may belong to *S. longimanus.*

Saurida longimanus Norman, 1939

Saurida longimanus Norman 1939, *Fishes, Sci. Rept. John Murray Exped.*, 7 (1): 23-24. Type locality: Gulf of Oman.

Number of specimens studied: 31; size range: 49-187 mm (standard length).

Diagnosis: B. 15-16; D. 11-13; P. 14-16; V. 9; A. 12-13; L.l. 46-49; L.Tr. 3½-4/6; Pyl. caecae. 14-19; Vertebrae 45-48.

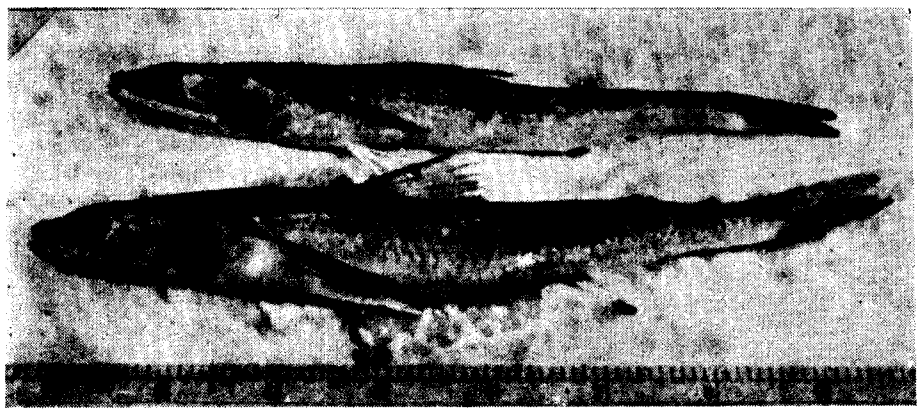

FIG. 3. *Saurida longimanus* Norman.

Head 3.4 to 3.9, height 6.5 to 8.3 in standard length. Snout rounded, slightly longer than eye, 4.0 to 4.6 in head. Eye 4.3 to 5.1 in head and equal to interorbital width. Outer bands of palatine teeth each with only two rows anteriorly, were the two bands are widely separated; some of the anterior teeth enlarged; inner bands of palatine teeth narrow, each with 2 or 3 rows; vomer toothless. 46-49 scales in the lateral line, 3½ to 4 between middle of dorsal fin and lateral line. Dorsal base 1.7 to 2.0 in head; second dorsal ray longest, 1.17 to 1.55 in head. Anal base 2.24 to 2.94 in head. Pectoral extends beyond the vertical through the origin of dorsal fin, up to the level of 6th or 7th ray of dorsal fin (in adults), 1.11 to 1.28 in head; tip of pectoral reaches 14th or 15th scale in the lateral line. Axillary scale long and pointed. Caudal peduncle depressed, with lateral keels, its least depth 3.86 to 5.00 in head. Teeth in jaws slender, pointed, unequal, depressible and arranged in several rows. Tongue covered with fine teeth. Gill rakers rudimentary, numerous and arranged in 3 or 4 series.

Colour: Dark brown above and silvery white below; distal parts of dorsal, caudal and pectorals blackish. Sometimes faint traces of dark marks along upper edge of caudal may be present.

Distribution: Gulf of Oman and Bay of Bengal (Western side).

In India: Misra (1952) in his key for the identification of the species of the genus *Saurida* from Indian waters does not mention the localities from where the specimens were collected. The present author collected specimens of *S. longimanus* from trawl catches off Puri, False Point, Waltair and Kakinada obtained from 75-100m depth. *S. longimanus* was observed in the trawl catches in the period February-April, i.e., during the upwelling period (La Fond 1954, Ganapati and Rao 1957) along with other deep-water forms like *Psenes indicus, Nemipterus japonicus, Priacanthus* sp. etc. This species has not so far been recorded from the west coast of India and also from the other regions of the Indo-Pacific.

Saurida gracilis (Quoy and Gaimard 1824)

Saurus gracilis Quoy and Gaimard 1824, *Voy', Uranie, Zool,* p. 224.

Diagnosis: B. 13; D. 10-11; P. 12-13; V.9; A. 10-11; L.l. 46-49 L.Tr. 3½/6.

Number of specimens studied: 5; size range: 145-192 mm (standard length).

Head about 3.17 to 3.45, height 6.89 to 7.60 in standard length. Eye 4.42 to 5.09 in length of head and equal to interorbital width. Teeth in jaws thin, pointed, unequal, depressible and in several rows; outer bands of palatine teeth in 1 or 2 rows anteriorly, where the two bands are narrowly separated; no teeth on vomer. 46-49 scales in lateral line, 3½ to 4 between middle of dorsal fin and lateral line, 15 to 16 from occiput to origin of dorsal. Dorsal situated midway between the end of snout and base of the caudal fin. Anal base 0.71 to 0.77 that of dorsal. Pectoral extends beyond the vertical through the origin of dorsal, length 1.55 to 1.64 in head; tip of pectoral reaches to the tenth or eleventh scale of the lateral line; axillary scale short and broad. Ventrals 0.55 to 0.61 in head; Caudal peduncle depressed with lateral keels. Gill rakers rudimentary and numerous.

Colour: Brownish above, silvery white below; a series of dark cross-bands or blotches along the middle of the sides; fins barred or with spots or patches; black dots along the upper edge of caudal.

Distribution: East Africa and the Red Sea, through the Indian Ocean and Archipelago to the Pacific.

In India: The present author did not observe *S. gracilis* along the north-east coast of India but eaxmined a few specimens from the south-west coast, collected from trawl catch at a depth of 100 fathoms off Cannanore (Lat. 12°04' N and Long. 74°27' E). According to Norman (1935) Day collected one specimen (130 mm in length) from Port Blair, Andamans.

A KEY FOR THE IDENTIFICATION OF THE FOUR SPECIES OF GENUS *SAURIDA*

I. Pectoral rays 12-13; axillary scale short, broad; back and sides mottled and blotched. 46-49 scales in the lateral line ..... *S. gracilis*

II. Pectoral with 14 to 16 rays; axillary scale long and pointed; back and sides of uniform colouration or with indistinct darker markings.

(a) Snout obtusely pointed; outer bands of palatine teeth in 3 or more rows anteriorly; Pectorals 1.7 to 2.1 in head, not or just reaching the vertical through the origin of ventral; upper edge of caudal fin without dark dots; vertebrae 50-53; scales in the lateral line 53-58 ..... *S. tumbil*

(b) Snout rounded; outerbands of palatine teeth in 2 rows anteriorly; pectoral 1.10 to 1.68 in head, extending beyond the vertical through the origin of ventral; scales in lateral line 45-50; vertebrae 45-48.

(1) Pectoral short, 1.28 to 1.68 in head and extends beyond the vertical through the origin of ventrals, upto the 11th or 12th scale in the lateral line but not beyond the vertical through the origin of dorsal; A series of 8 to 10 dark spots along sides; upper edge of caudal with a row of dark dots. ..... *S. undosquamis*

(2) Pectoral long, 1.10 to 1.28 in head and extends beyond the vertical through the origin of dorsal fin, up to the level of 6th or 7th dorsal ray or 14th or 15th scale in the lateral line; sides and upper edge of caudal without dark dots. ..... *S. longimanus*

ANALYSIS OF IMPORTANT CHARACTERS

The three species of the genus *Saurida,* namely, *S. tumbil, S. undosquamis* and *S. longimanus* occurring along Waltair coast resemble each other closely. For a comparative study of these three species, 14 morphometric and 8 meristic characters were examined. The following measurements were expressed as ratios of standard length: (1) Length of head;; (2) height at origin of dorsal; (3) distances from tip of snout to dorsal and (4) adipose fins; distances from tip of mandible to (5) ventral and (6) anal fins, while the characters, (7) length of snout, (8) diameter of eye, (9) interorbital distance, (10) least depth of caudal peduncle, (11) height of second dorsal ray, (12) length of pectoral fin, (13) length of base of dorsal fin, and (14) base of anal fin were expressed as ratios to the length of the head. The ranges of these proportions, meristic counts and their mean values in the three species are shown in Table 1.

It can be seen from Table 1 that the ranges for many characters in the three species overlap and are more or less similar. For studying the differences and degree of overlap between the three species the following seven body proportions and three meristic counts were selected.

TABLE 1. *Ranges and mean values of different body proportions and meristic counts in three species of* Saurida.

	S. tumbil		*S. undosquamis*		*S. longimanus*	
Size range (std. length) in mm	129-372		60-182		49-187	
MORPHOMETRIC CHARACTER						
In standard length	Range	Mean	Range	Mean	Range	Mean
Length of head	3.77-4.19	3.95	3.50-3.85	3.66	3.41-3.89	3.62
Height at origin of dorsal	5.25-7.58	6.56	6.55-8.58	7.51	6.56-8.30	7.58
Snout to dorsal	2.19-2.42	2.30	2.14-2.33	2.24	2.12-2.29	2.20
Snout to adipose	1.20-1.25	1.21	1.15-1.23	1.19	1.16-1.21	1.18
Tip of mandible to ventral	2.44-2.69	2.58	2.43-2.59	2.52	2.40-2.69	2.53
Tip of mandible to anal	1.26-1.34	1.30	1.27-1.35	1.31	1.27-1.35	1.30
In head length						
Snout	3.77-4.57	4.14	3.46-4.25	3.86	4.00-4.55	4.26
Eye diameter	4.88-6.12	5.53	4.33-5.44	4.74	4.30-5.04	4.83
Interorbital distance	4.27-5.17	4.77	3.90-4.90	4.30	4.30-5.04	4.83
Least depth of caudal peduncle	3.35-4.18	3.72	3.52-4.09	3.84	3.86-5.00	4.23
Height of 2nd dorsal ray	1.15-1.46	1.28	1.13-1.33	1.22	1.17-1.55	1.27
Length of pectoral fin	1.73-2.07	1.90	1.28-1.68	1.48	1.11-1.28	1.20
Length of base of dorsal fin	1.74-2.22	1.93	1.65-2.12	1.79	1.73-2.00	1.85
Length of base of anal fin	2.43-3.24	2.75	2.11-2.80	2.39	2.24-2.94	2.59
Meristic counts						
Dorsal fin rays*	11-13	11.28	11-13	11.17	11-13	11.83
Anal fin rays	10-13	11.48	10-13	12.09	12-13	12.12
Pectoral fin rays	14-16	14.76	14-15	14.41	14-16	14.61
Scales in lateral line	53-58	54.83	46-49	47.19	46-49	47.80
Predorsal scales	18-22	19.81	16-17	16.22	16-18	16.64
Total number of vertebrae	50-53	51.80	45-47	46.48	45-48	46.67
Pyloric caecae	17-22	18.76	13-18	15.73	14-19	16.80
Branchiostegal rays	15-16	15.63	14-15	14.54	15-16	15.51

* Last two rays of dorsal fin supported by a single pterygophore counted as one.
For counting the scales in lateral line, the pored scales on thebasal part of the caudal fin have been included.

Morphometric characters: (1) Head length (2) Height (3) Snout length (4) Eye diameter (5) Interorbital distance (6) Least depth of the caudal peduncle (7) Length of pectoral fin.

Meristic counts: (1) Number of scales in the lateral line (2) Total number of vertebrae (3) Number of predorsal scales. Size range of the specimens, ranges of different body proportions, mean ratios and other details are presented in Table 2.

TABLE 2. *Body proportions of* S. tumbil, S. undosquamis *and* S. longimanus *as hundred times ratios to standard length or head length**.

Character|Species	No. of specimen	Std. length or head length (range in cm)	Range of ratio	Mean ratio	Std. deviation	Std. error
1. Std. length|Head length						
S. tumbil	63	12.9-37.2	377-419	395	2.93	0.37
S. undosquamis	31	6.0-18.2	350-385	366	8.97	1.61
S. longimanus	31	4.9-18.7	341-389	362	12.37	2.22
2. Std. length|Height						
S. tumbil	63	12.9-37.2	525-758	656	49.35	6.22
S. undosquamis	31	6.0-18.2	655-858	751	51.81	9.30
S. longimanus	31	4.9-18.7	656-830	758	42.48	7.63
3. Head length|Snout						
S. tumbil	63	3.3-9.8	377-457	414	18.90	2.38
S. undosquamis	31	1.7-4.9	346-425	386	21.56	3.87
S. longimanus	31	1.4-5.3	400-455	426	15.39	2.76
4. Head length|Eye diameter						
S. tumbil	63	3.3-9.8	488-612	553	23.93	3.01
S. undosquamis	31	1.7-4.9	433-544	474	23.97	4.30
S. longimanus	31	1.4-5.3	430-504	483	16fl20	2.91
5. Head length|Interorbital distance						
S. tumbil	63	3.3-9.8	427-517	477	19.43	2.45
S. undosquamis	31	1.7-4.9	390-490	430	26.44	4.75
S. longimanus	31	1.4-5.3	430-504	483	16.20	2.91
6. Head length|Least depth of caudal peduncle						
S. tumbil	63	3.3-9.8	335-418	372	17.61	2.22
S. undosquamis	31	1.7-4.9	352-409	384	14.66	2.63
S. longimanus	31	1.4-5.3	386-500	423	27.19	4.88
7. Head length|Length of pectoral fin						
S. tumbil	63	3.3-9.8	173-207	190	7.96	1.00
S. undosquamis	31	1.7-4.9	128-168	148	11.21	2.01
S. longimanus	31	1.4-5.3	111-128	120	4.59	0.82

* Head length and height are expressed as ratios to standard length while the other characters i. e., Snout, Eye diameter, Intreorbital distance, Least depth of caudal peduncle and Length of pectoral fin are expressed as ratios to head length.

The size ranges for *S. tumbil* and *S. undosquamis* are not strictly comparable but the proportions are indicative of the trend in each species. In the case of *S. undosquamis* and *S. longimanus* the size ranges for both are more or less same and comparable. It can be seen from Table 2 that there is overlapping in all the body proportions among these three species except in the length of pectoral fin. The results are presented graphically in Fig. 4 according to the improved graphical method of Hubbs and Hubbs (1953).

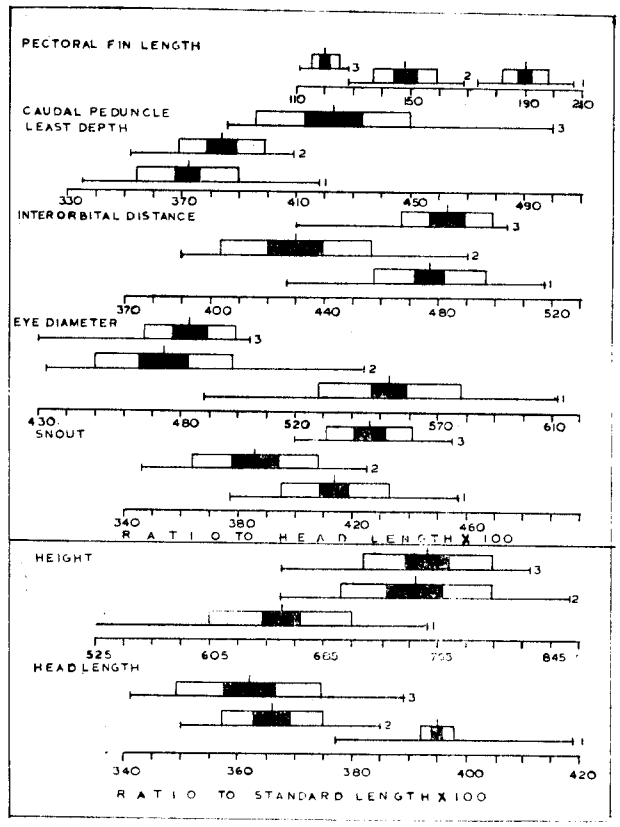

FIG. 4. Variations in 7 characters in samples of *S. tumbil* (1), *S. undosquamis* (2), and *S. longimanus* (3) from Waltair coast. (The horizontal line represents the total range: the short vertical line the mean; the solid rectangle two standard errors on each side of the mean and the hollow rectangle one standard deviation on each side. the number of specimens studied: *tumbil* - 63; *undosquamis* - 31; *longimanus* -31.)

The divergence and intergradation levels in these body proportions between *S. tumbil* and *S. undosquamis*, between *S. undosquamis* and *S. longimanus* and between *S. tumbil* and *S. longimanus* were studied and the results are presented in Tables 3, 4 and 5 respectively.

It can be seen from Table 3 that the divergence between *S. tumbil* and *S. undosquamis* in respect of the character pectoral length was 100%. Eye diameter and head length showed divergence levels of 97% and 94.4% respectively. In the case of interorbital distance and height the divergence was 84.8% and 75.1% respectively. Least depth of the caudal peduncle did not show any divergence. This suggests that the characters pectoral length, eye diameter, head length and interorbital distance are useful in comparing *S. tumbil* and *S. undosquamis*.

For comparing *S. undosquamis* and *S. longimanus* in addition to the character pectoral length, snout length, interorbital distance and least depth of caudal peduncle are useful as they show good differences with divergence levels ranging from 92.0% to 77.5% (Table 4).

TABLE 3. *Percentage divergence and intergradation between* S. tumbil *and* S. undosquamis.

S. No.	Character	Divergence	Intergradation
1.	Head length	94.4	5.6
2.	Height	75.1	24.9
3.	Snout length	76.7	23.3
4.	Eye diameter	97.6	2.4
5.	Interorbital distance	84.8	15.2
6.	Least depth of caudal peduncle	0	100.0
7.	Length of pectoral fin	100.0	0

TABLE 4. *Percentage divergence and intergradation between* S. undosquamis *and* S. longimanus.

S. No.	Character	Divergence	Intergradation
1.	Head length	0	100.0
2.	Height	0	100.0
3.	Snout length	92.0	8.0
4.	Eye diameter	0	100.0
5.	Interorbital distance	37.2	12.8
6.	Least depth of caudal peduncle	77.5	22.5
7.	Length of pectoral fin	100.0	0

In the case of *S. tumbil* and *S. longimanus*, except snout length and interorbital distance which do not show divergence, the other characters can be used for comparing them as they show divergence levels ranging from 84.0% to 100% (Table 5).

TABLE 5. *Percentage divergence and intergradation between* S. tumbil *and* S. longimanus.

S. No.	Character	Divergence	Intergradation
1.	Head length	94.4	5.6
1.	Height	84.0	16.0
3.	Snout length	0.	100.0
4.	Eye diameter	99.2	0.8
5.	Interorbital distance	0	100.0
6.	Least depth of caudal peduncle	85.6	14.4
7.	Length of pectoral fin	100.0	0

The frequency distribution of the three meristic counts, scales in the lateral line, predorsal scales and the total number of vertebrae in the three species is given in Table 6. It can be seen that there is no overlap in the ranges of the three meristc characters chosen (100% divergence) between *S. tumbil* and the other two species. Between *S. undosquamis* and *S. longimanus,* the ranges of these characters completely overlap and do not show divergence. This shows that the three meristic counts considered are useful for separating *S. tumbil* from the other two species but are not useful for distinguishing *S. undosquamis* from *S. longimanus.*

SALIENT FEATURES OF THE SKELETON

The salient features of the skeleton of the three species may be summarised as follows: Bones thin, light and oily; the cranium is depressed, broad in the posterior part and narrow anteriorly; epiotics further apart and the posterior temporal fossae much reduced in size; the premaxillaries exclude the maxillaries from the gape; supramaxillary absent; the suspensorium is inclined backwards oblquely; hyomandibular well developed; teeth in jaws in several rows and the inner row is predominant over the outer; the entopterygoid less developed; parasphenoid laminar; orbitosphenoid absent; the frontals and alishpenoids form a complete double interorbital septum; ossified vomer with or without teeth present; the posterior processes of pelvic bones slender; vertebrae 45-62; the vertebral column can be divided into three portions, the trunk, the precaudal and caudal; each trunk vertebra bears one pair of epipleural spines on the dorsolateral sides, and one pair of epipleural spines and one pair of pleural ribs attached on the ventral side to the parapophyses; the precaudal vertebrae lack both the ribs and the haemal arches bearing haemal spines; the caudal vertebrae have closed haemal arches bearing spines; the dorsal and anal rays are supported by corresponding number of pterygiophores (interneurals) which are long and stout.

TABLE 6. *Frequency distribution of three meristic characters in the three species of* Saurida *from Waltair coast.*

Species	No. of fish	No. of scales in the lateral line													Mean	Std. deviation	Std. error
		46	47	48	49	50	51	52	53	54	55	56	57	58			
S. longimanus	31	3	9	10	9										47.8064	0.980	0.176
S. undosquamis	31	8	11	10	2										47.1935	10.909	0.163
S. tumbil	128								7	41	54	19	6	1	54.8359	0.962	0.085

		No. of predorsal scales								
		16	17	18	19	20	21	22		
S. longimanus	31	12	18	1					16.6451	0.550	0.098
S. undosquamis	31	24	7						16.2258	0.425	0.076
S. tumbil	128			3	42	60	22	1	19.8125	0.771	0.068

		Number of vertebrae (including urostyle												
		45	46	47	48	49	50	51	52	53				
S. longimanus	31	2	7	21	1								46.6774	0.652	0.117
S. undosquamis	31	1	14	16									46.4838	0.571	0.102
S. tumbil	126						4	30	79	13			51.8015	0.657	0.058

TABLE 7. *Comparison of different body proportions and meristic counts of* S. tumbil *from Bay of Bengal (Visakhapatnam) and Japan and East China Sea.*

	Bay of Bengal (Visakhapatnam)		Japan and East China Sea	
No of fish	63		49	
Size range (Std. length in mm)	129-372		170-519.5	
MORPHOMETRIC CHARACTERS				
In standard length				
	Range	Mean	Range	Mode
Length of head	3.77-4.19	3.95	3.95-4.67	4.11-4.20
Height at origin of dorsal	5.25-7.58	6.56	5.32-8.69	7.01-7.30
Snout to dorsal	2.19-2.42	2.30	2.25-2.53	2.31-2.40
Snout to adipose	1.20-1.25	1.21	1.15-1.33	1.21-1.25
Tip of mandible to ventral	2.44-2.69	2.58	2.52-2.92	2.71-2.80
Tip of mandible to anal	1.26-1.34	1.30	1.29-1.42	1.35-1.40
In head length				
Snout	3.77-4.57	4.14	3.64-4.40	4.11-4.20
Eye diameter	4.88-6.12	5.53	5.03-6.11	5.91-6.00
Interorbital distance	4.27-5.17	4.77	4.42-5.54	4.91-5.00
Least depth of caudal peduncle	3.35-4.18	3.72	3.00-4.13	3.61-3.80
Height of 2nd dorsal ray	1.15-1.46	1.28	0.86-1.13	0.91-1.00
			1.10-1.30	1.11-1.20
Length of pectoral fin	1.73-2.07	1.80	1.34-1.69	11.51-1.55
Length of base of dorsl fin	1.74-2.22	1.93	1.56-2.09	1.61-1.80
Length of base of anal fin	2.43-3.24	2.75	2.06-3.07	2.41-2.60
MERISTIC COUNTS				
Dorsal fin rays	11-13	11.28(11)	11-12	12
Anal fin rays	10-13	11.48(12)	11-12	11
Pectoral fin rays	14-16	14.76(15)	14-15	14
Scales in lateral line	53-58	54.83(55)	56-60	58
Predorsal scales	18-22	19.81(20)	20-23	21
Total no. of vertebrae	50-53	51.80(52)	49-54	53
Plyoric caecae	17-22	18.76(18)	18-23	21
Branchiostegal rays	15-16	15.63(16)	15-16	15

Figures in brackets indicate the model values for meristic counts

TABLE 8. *Comparison of different body proportions and meristic counts of* S. undosquamis *from Bay of Bengal (Visakhapatnam) and Japan and East China sea.*

	Bay of Bengal (Visakhapatnam)		Japan and East China sea	
No of fish	31		93	
Size range (Std. length in mm)	60.0-182.0		71.5-244.5	
	Range	Mean	Range	Mode
MORPHOMETRIC CHARACTERS				
In standard length				
Length of head	3.50-3.85	3.66	3.96-4.78	4.31-4.40
Height at origin of dorsal	6.55-8.58	7.51	5.52-8.44	7.31-7.60
Snout to dorsal	2.14-2.33	2.24	2.00-2.66	2.31-2.40
Snout to adipose	1.15-1.23	1.19	1.05-1.30	1.21-1.25
Tip of mandible to ventral	2.43-2.59	2.52	2.35-3.10	2.61-2.70
Tip of mandible to anal	1.27-1.35	1.31	1.81-1.42	1.31-1.40
In head length				
Snout	3.46-4.25	3.86	3.60-4.64	3.91-4.00
Eye diameter	4.33-5.44	4.74	5.84-6.93	6.41-6.50
Interorbital distance	3.90-4.90	4.30	3.91-5.49	4.91-5.00
Least depth of caudal peduncle	3.52-4.09	3.84	3.30-4.20	3.51-3.70
Height of 2nd dorsal ray	1.13-1.33	1.22	1.00-1.24	1.11-1.20
Length of pectoral fin	1.28-1.68	1.48	1.21-1.60	1.41-1.45
Length of base of dorsal fin	1.65-2.12	1.79	1.48-2.26	1.61-1.80
Length of base of anal fin	2.11-2.80	2.39	1.92-2.99	2.21-2.40
MERISTIC COUNTS				
Dorsal fin rays	11-13	11.17(12)	11-12	12
Anal fin rays	10-13	12.09(12)	11-12	11
Pectoral fin rays	14-15	14.41(14)	14-15	14
Scales in lateral line	46-49	47.19(47)	48-53	51
Predorsal scales	16-17	16.22(16)	17-20	18
Total no. of vertebrae	45-47	46.48(47)	47-50	48
Pyloric caecae	13-18	15.73(15,17)	13-18	15
Branchiostegal rays	14-15	14.54(15)	15	15

Figures in brackets indicate the modal value for meristic counts

TABLE 9. *Comparison of the ranges of selected body proportions and meristic counts in different species of the genus* Saurida *from the Indo-Pacific region.*

Species	Head length / Pectoral fin length	Std. length / Head length	Head length / Eye diameter	scale in lateral line	Predorsal scales	Vertebrae	No. of rows in the outer bands of palatine teeth	Teeth on vomer	No. of rays in pectoral fin
*elongata**	1.53-2.03	4.18-497	5.76-7.24	62-66	23-26	57-62	3 or 4	Present	14-15
tumbil	1.73-2.07	3.77-4.19	4.88-6.12	53-58	18-22	50-53	3	Present	14-16
gracilis	1.55-1.64	3.17-3.45	4.42-5.09	46-49	15-16	53	2	Absent	12-13
undosquamis	1.28-1.68	3.50-3.85	4.33-5.44	46-49	16-17	45-47	2	Absent	14-15
*filamentosa***	1.33	4.00	4.50	About 50	—	—	—	—	14-15
longimanus	1.11-1.28	3.41-3.89	4.30-5.04	46-49	16-18	45-48	2	Absent	14-16

* Data from Matsubara and Iwai (1951)
** Data from Norman (1935)

The general shape of the cranium is more or less the same in the three species. The width of the neurocranium at the extremities of the frontals is more (5.4 to 5.6 in length) in *S. undosquamis* and *S. longimanus* than in *S. tumbil* (6.1 to 6.2 in length). The orbits are large, about 2½ in the length of the neurocranium. The horizontal diameter of the orbit is slightly greater in *S. tumbil* than in the other two species.

The supraoccipital crest is not developed on the top of the cranium and carried by the frontals but is carried backwards into a process which is free from the exoccipitals. Three grooves, the supratemporal, temporal and dilator are preesent on either side on the dorsal surface in the posterior portion, separated by the temporal and pterotic ridges.

INDIVIDUAL BONES

The individual bones of the skull as well as axial, appendicular and caudal skeleton were studied to see if there are differences among the three species (Figs 2 to 5). For detailed descriptions of bones, Rao (1974) may be referred.

Though there was marked similarity between the three species in the shape and structure of the individual bones of the skull, branchial arches, girdles, fins, vertebral column and caudal skeleton, they however differed amongst themselves in respect of some characters mentioned in Tables 10 to 11.

A key for the identification of the three species of *Saurida* based on osteological characters is given below:

I. Total number of vertebrae 50 to 53, number of vertebrae with epipleural spines and ribs 35 to 36; number of vertebrae without ribs and epipleural spines 3 or 4; urineurals 3 or 4; hypocoracoid foramen below the keel of the hypocoracoid; ventral process of basisphenoid directed forwards and upwards reaching ½ the vertical height of the orbit; vomer bears teeth; outer bands of palatine teeth in the anterior region in 3 rows. *S. tumbil*

II. Total number of vertebrae 45 to 48; number of vertebrae with epipleural spines and ribs 30 to 34; number of vertebrae without ribs and epipleural spines 2 or 3; uroneurals 2; hypocoracoid foramen just above the keel of hypocoracoid; ventral process of basisphenoid runs downwards and forwards and does not reach ½ the vertical height of the orbit; vomer does not bear teeth; outer bands of palatine teeth in the anterior region in 2 rows.

(a) Number of vertebrae with epipleural spines and ribs 30 to 32; neural process of first vertebra directed backwards and upwards; the distance between the posterior processes of the pelvic girdle at the inner convex points is wide, 3.0 to 4.0 in the base of the triangular pelvic bones; posterior end of the supraoccipital crest rounded. *S. undosquamis*

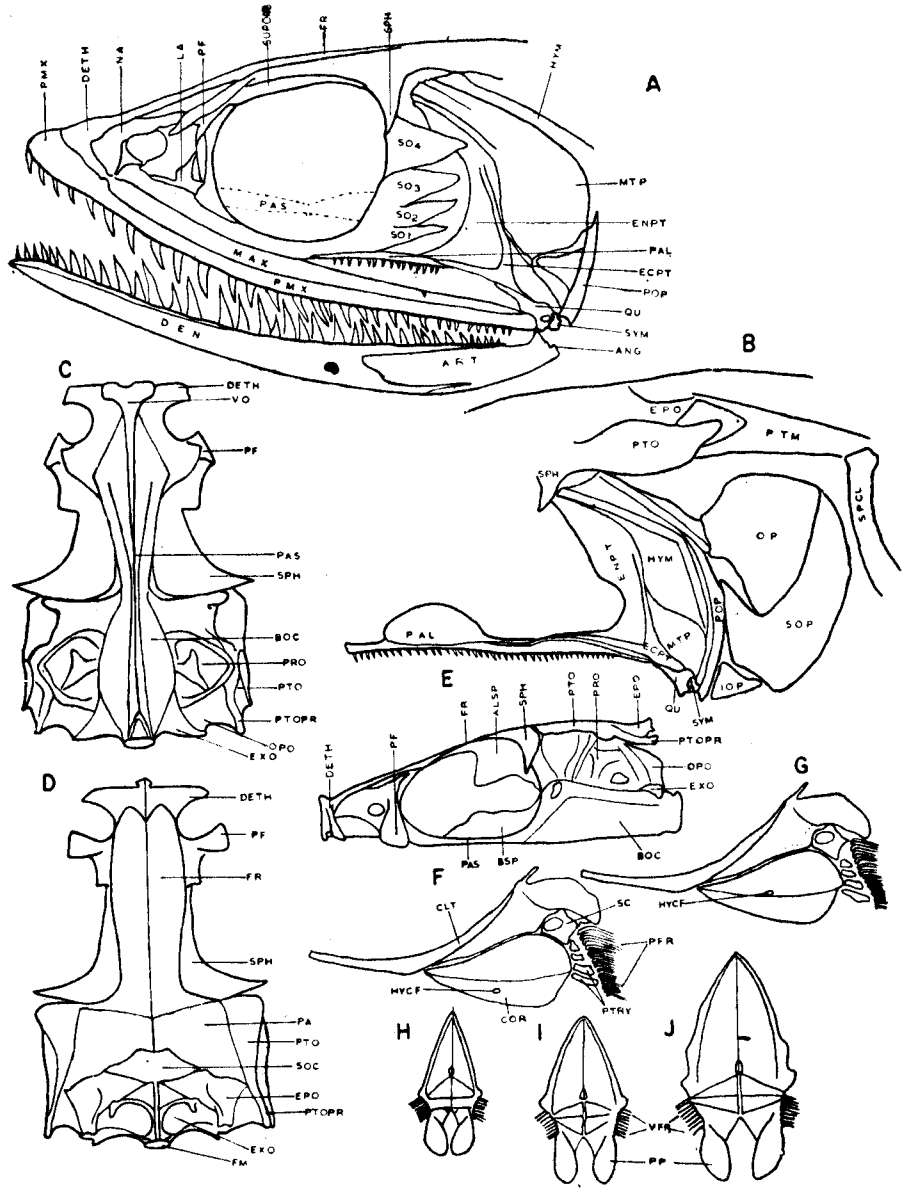

FIG. 5. A to F: Skull and girdles of *S. tumbil* - A: lateral view of skull; B: palatopterygoid arcade; C: ventral view of neurocranium; D: dorsal view of neurocranium; E: lateral view of neurocranium; F: pectoral girdle. G: pectoral girdle of *S. undosquamis*. H: pelvic girdle of *S. longimanus*. I: pelvic girdle of *S. undosquamis*. J: pelvic girdle of *S. tumbil*.

EXplanations to abbreviations in figure: ALSP - alisphenoid; ANG - angular; ART - articular; BOC - basioccipital; BSP - basisphenoid; CLT - cleithrum; COR - coracoid; DEN - dentary; ECPT - ectopterygoid; ENPT - entopterygoid; EPO - epiotic; EXC - exoccipital; FR - frontal; FM - foramen magnum; HYM - hyomandibular;

TABLE 10. *Number of vertebrae in the trunk, precaudal and caudal sections in* Saurida *spp.*

S. tumbil				*S. undosquamis*				*S. longimanus*			
T	TR	PC	C	T	TR	PC	C	T	TR	PC	C
52	36	8	8	46	32	6	8	46	33	5	8
51	35	7	9	45	30	6	9	46	31	7	8
53	36	9	8	47	32	6	9	48	34	5	9
52	36	7	9	46	31	6	9	47	33	6	8
53	36	8	9	46	32	5	9	47	32	6	9
50	35	7	8	47	32	6	9	45	32	5	8

T Total number of vertebae
TR Number of vertebrae in the trunk section
PC Number of vertebrae in the precaudal section
C Number of vertebrae in the caudal section including the urostyle.

(b) Number of vertebrae with epipleural spines and ribs 31 to 34; neural process of first vertebra directed backwards almost parallel to the vertebral column; the distance between the posterior processes of the pelvic gridle at the inner convex points is narrow, 6.0 to 8.0 in the base of the triangular pelvic bone; posterior end of the supraoccipital crest pointed. *S. longimanus.*

DISCUSSION

From the descriptions and analyses of important characters it can be seen that *S. longimanus* closely resembles *S. undosquamis* but may be readily recognised from the latter by the longer pectoral fin, narrower bands of palatine teeth and the absence of dark spots along side, front edge of dorsal and upper edge of caudal fin. According to Norman (1939) *S. longimanus* has a larger head, somewhat longer snout and slightly larger eye than *S. undosquamis.* The present results show that the range for the ratio standard length/head length is more or less same for both the species but the lower mean value for *S. longimanus* may indicate that it has a slightly longer head.

In the case of proportions, head length/snout length and head length/eye diameter the ranges overlap but the mean values for *S. longimanus* are higher than those for *S. undosquamis* indicating that the former has slightly shorter snout and smaller eye than the latter or at least there is not much difference between them.

S. undosquamis and *S. longimanus* stand apart from *S. tumbil* in respect of some morphometric and meristic characters, as stated earlier. *S. gracilis* is closer to *S. undosquamis* and *S. longimanus* than to *S. tumbil* in some characters but differs from all the others in the number of pectoral rays.

HYCF - hypocoracoid foramen; IOP - interopercle; LA - lacrymal; MTP - metapterygoid; MAX - maxilla; NA - nasal; OP - opercle; OPO - opisthotic; PA - parietal; PAS - paraphenoid; PF - prefrontal; PFR - pectoralfin rays; PAL - palatine; PMX - premaxilla; POP - preopercle; PRO - prootic; PTM - posttemporal; PTO - pterotic; PTOPR - pterotic process; PTRY - pterygial; QU - quadrate; SC - scapula; SO1-SO4 - circumorbital series (postorbitals); SO - suborbital; SOC - supraoccipital; SPH - sphenotic; SPCL - supracleithrum; SYM - symplectic; VO - vomer.

TABLE 11. *Distinguishing osteological features between* Saurida, Synodus *and* Trachinocephalus.

Character	*Saurida*	*Synodus*	*Trachinocephalus*
Vomer	Present	Absent	Absent
Orbitosphenoid	Absent	Present	Absent?
Total no. of vertebrae	45-62	49-58	55
No. of trunk vertebrae	30-36	30-38	46
No. of simple vertebrae in the precaudal series without ribs, epipleural spines and haemal processes	2 to 4	4 to 7	1
Position of the last posterior pair of ribs	On the centrum which is enterior by 2 centra to the anterior external margin of the anal fin.	On the centrum dorsal to the anterior margin of the anal fin.	On the centrum dorsal to the anal fin at its mid length.
Epipleural spines	Present upto the mid length of the anal fin.	Present upto the mid length of the anal fin.	Present above the entire length of the anal fin.
Posterior processes of the pelvic bons.	Slender	Short and laminar	

A comparison of the different body proportions and meristic counts between specimens of *S. tumbil* from Bay of Bengal and those given for specimens from Japan and East China seas (Matsubara and Iwai 1951) is shown in Table

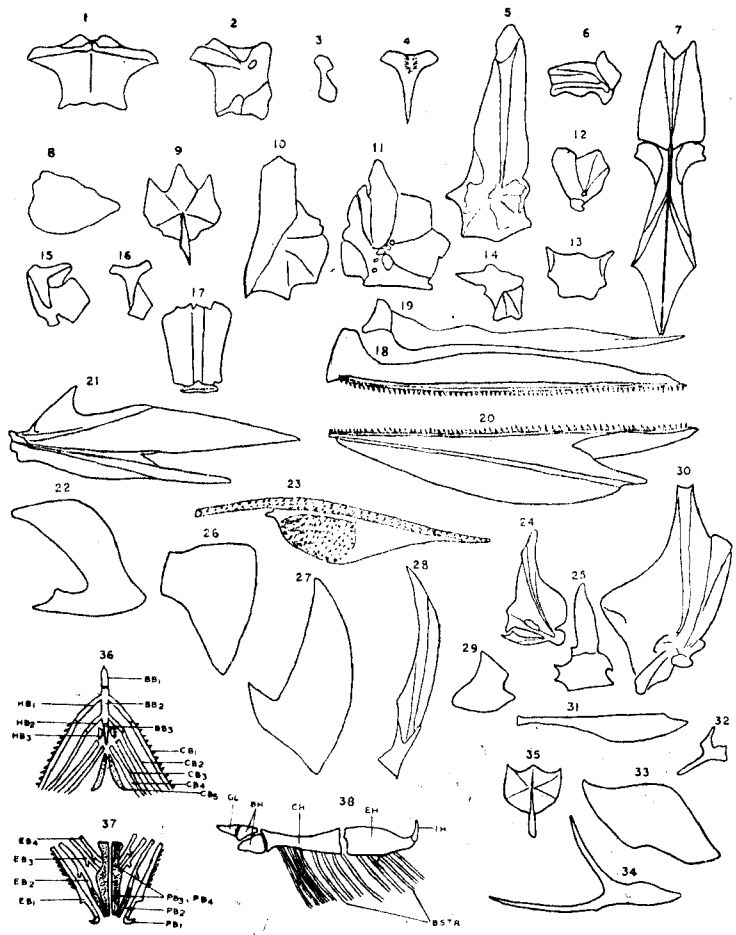

FIG. 6. Disarticulated bones of skull and branchial arches of *S. tumbil*: 1 - dermethmoid; 2 - prefrontal; 3 - nasal; 4 - vomer; 5 - frontal; 6 - alisphenoid; 7 - parasphenoid; 8 - parietal; 9 - supraoccipital; 10 - pterotic; 11 - prootic; 12 - epiotic; 13 - opisthotic; 14 - sphenotic; 15 - exoccipital; 16 - basisphenoid; 17 - basioccipital; 18 - premavilla; 19 - maxilla; 20 - dentary; 21 - artiuclar; 22 - entopterygoid; 23 - palatine; 24 - quadrate; 25 - symplectic; 26 - opercle; 27 - suborpercle; 28 - preopercle; 29 - interopercle; 30 - hyomandibular; 31 - urohyal; 32 - lacrymal; 33 - metapterygoid; 34 - ectopterygoid; 35 - supraoccipital of *S. undosquamis;* 36 - ventral half of branchial arches; 37 - dorsal half of branchial arches (gill rakers indicated only on the outermost arch); 38 - hyoid arch and glossohyal; BB1-BB3 - basibranchials 1-3; CB1-CB5 - ceratobranchials 1-5; EB1-EB4 - epibranchials 1-4; HB1-HB3 - hypobranchials 1-3; PB1-PB4 - pharyngobranchials 1-4; BH - basihyal; CH - ceratohyal; EH - epihyal; GL - glossohyal; IH - interhyal; BSTR - branchiostegal rays.

7. It can be seen from this table that the ranges for different body proportions more or less overlap except for the height of the second dorsal ray in males and length of pectoral fin. As already mentioned the difference in the height of the second dorsal ray is due to the sexual dimorphism. There is no overlap in the range of the proportion head length/pectoral length (100% divergence).

Among meristic counts, modal values for the characters, scales in the lateral line, predorsal scales, vertebrae and pyloric caecae are higher in Japanese specimens than those from Bay of Bengal while in respect of the anal fin rays, pectoral fin rays and branchiostegals the reverse is the case.

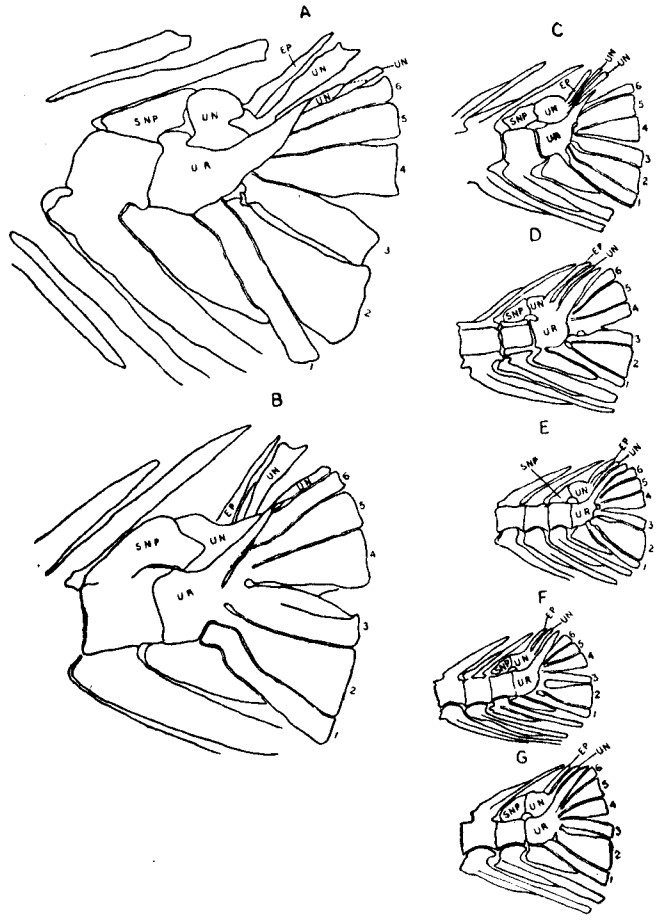

FIG. 7. Caudal skeletons of A - *S. tumbil* 330 mm. in length; B - *S. tumbil* 300 mm; C - *S. tumbil* 100 mm; D - *S. undosquamis* 98 mm; E- - *S. undosquamis* 77 mm; F - *S. longimanus* 71 mm; G - *S. longimanus* 87 mm. SNP - specialised neural process; UN - uroneural; EP - epineural; UR - urostyle; 1-6 - hypurals.

Specimens of *S. tumbil* from Japan and East China seas differ from those of Bay of Bengal in having a long filamentous second dorsal ray (males), longer pectoral fin and higher modal values for scales in lateral line, vertebrae,

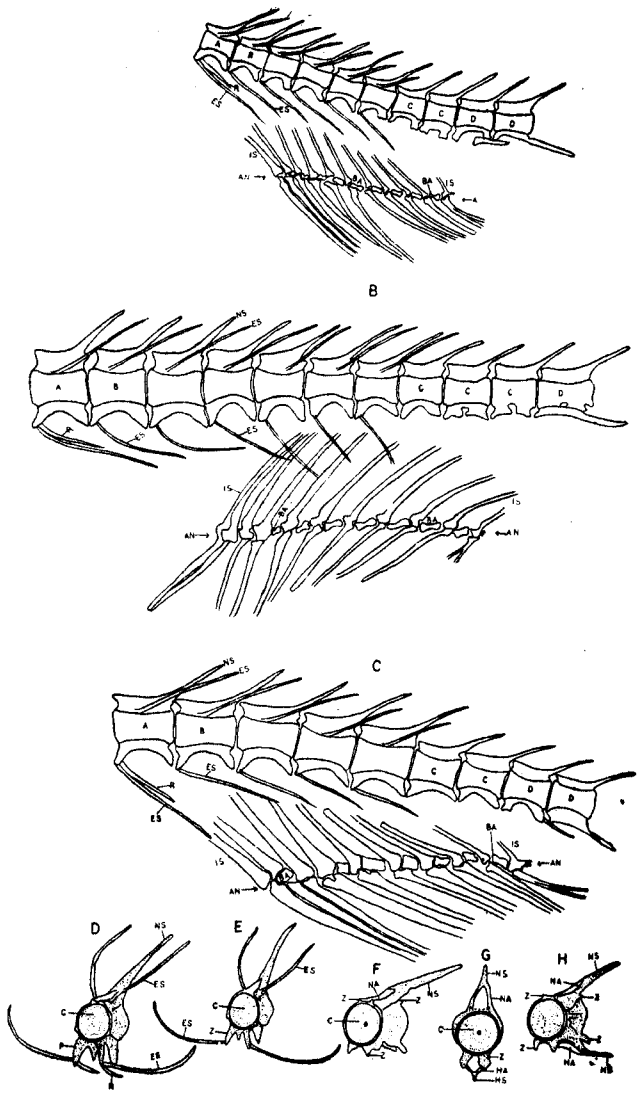

FIG. 8. Caudal skeletons: A - precaudal of tail of *S. longimanus* 73 mm; B - precaudal of tail of *S. tumbil* 100 mm; C - precaudal of tail of *S. undosquamis* 100 mm; D - posterior trunk vertebra; E - first precaudal vertebra; F - posterior simple vertebra without ribs, epipleural spines and an open haemal; G - anterior caudal vertebra; H - caudal vertebra.

An - anal fin; BA - baseost; C - centrum; ES - epipleural spine; HA - haemal arch; HS - haemal spine; IS - interhaemal; NA - neural arch; NS - neural spine; P - parapophyses; R - rib; Z - zygapophyses.

predorsal scales, pyloric caecae and also in the presence of only 2 rows in the outer bands of palatine teeth as reported by Matsubara and Iwai (1951). These differences indicate that *S. tumbil* in Japan Sea and East China Sea may belong to a different race. The differences in these characters could not be statistically tested for significance as the above authors have not given the relevant data.

The range of different body proportions and meristic counts of *S. undosquamis* from Bay of Bengal and those given by Matsubara and Iwai (1951) for specimens from Japan and East China seas are presented in Table 8. It can be seen from this table that in many characters the ranges overlap and are more or less similar except the length of the head and eye diameter. In these two characters there is no overlap in the ranges indicating 100% divergence. The specimens from Japanese waters appear to have a shorter head and smaller eye than those from Bay of Bengal.

Among meristic counts, scales in lateral line, predorsal scales and vertebrae show higher values for the range as well as the mode in specimens from Japanese waters than those from Bay of Bengal. The reverse is the case in respect of anal fin rays.

The differences in the morphometric and meristic characters could not be statistically tested as Matsubara and Iwai (1951) have not given the other relevant data except the range and the mode. The differences mentioned above in respect of body proportions, length of head and eye diameter and higher modal values for meristic counts, scales in the lateral line, predorsal scales and vertebrae indicate that *S. undosquamis* in the East China and Japan seas may represent a separate race.

Table 9 gives a comparative picture of the ranges for selected body proportions and meristic counts for the 6 species of the genus *Saurida* from the Indo-Pacific. The data for *S. elongata* and *S. filamentosa* are taken from the works of Matsubara and Iwai (1951), and Norman (1935) respectively. The values for meristic counts are arranged in descending order to see if there is any relationship or sequence in these characters. It can be seen that with a decrease in the meristic counts, there is considerable increase in the length of the pectoral fin and also a slight increase in the size of the head. It is likely that this descending trend in the meristic counts, perhaps, may indicate the course of phylogenesis among the species of *Saurida*. Viewed in this light, *S. elongata* and *S. tumbil* may represent the most advanced species. *S. longimanus* the most primitive and *S. gracilis, S. undosquamis* and *S. filamentosa* occupying the intermediate positions.

S. elongata and *S. tumbil* come very close in having a short pectoral fin; higher counts of scales in the lateral line, vertebrae and predorsal scales; 3 or 4 rows in outerbands of palatine teeth; and in the presence of teeth on the

vomer. Similarly, *S. undosquamis, S. filamentosa* and *S. longimanus* come close together in having a long pectoral fin, lower meristic counts, 2 rows in outer-bands of palatine teeth and in the absence of teeth on the vomer.

S. gracilis comes near *S. undosquamis* and *S. longimanus* in having a long head; a long pectoral fin which extends beyond the vertical through the origin of ventral; in the meristic counts — scales in the lateral line and predorsal scales; the number of rows in the outer bands of palatine teeth and in the absence of teeth on the vomer. *S. gracilis* differs from all the other species in having 12 or 13 pectoral rays.

Saurida spp. (Fam. Synodidae) are closer to the Clupeiformes in the structure of the skull and other osteological characters but they are much further advanced than the Clupeiformes in the predominance of the premaxilla, loss of supramaxilla, backward inclination of the suspensorium, predominance of the inner over the outer rows of teeth in the upper jaw and the loss of mesocoracoid arch.

The Synodiae differ from the Clupeidae in having a few vertebrae between the trunk and the caudal region, which lack ribs characteristic of the trunk region and which also lack closed haemal arches bearing haemal spines, characteristic of the caudal vertebrae.

Of the different families under the order Scopeliformes, the Synodidae resemble closely the Aulopidae in the shape and structure of the skull and other osteological characters but differ from them in the following characters of specialization: backwardly directed suspensorium, less developed entopterygoid, more depressed skull, epiotics which are farther apart, much reduced temporal fossae, laminar parasphenoid and the absence of orbitosphenoid.

Though the osteology of the genera *Saurida, Synodus, Trachinocephalus* and *Harpodon* of the family Synodidae conforms to similar pattern, differences are found in respect of some characters. In Table 11 are shown the differences in some osteological characters between *Saurida, Synodus* and *Trachinocephalus* based on the results of present studies and the works of Regan (1911), Gregory (1933) and Hollister (1937). It can be seen from Table 11 that *Synodus* is closer to *Saurida* than *Trachinocephalus* in respect of the characters of the vertebral column.

Saurida resembles *Harpodon* in the absence of orbitosphenoid and in the absence of the laminar expansion of the lowest radial in the pectoral girdle. *Harpodon* is more specialized than *Saurida* in that the maxillary is no longer recognizable as a separate element, the skeleton is feebly ossified and the transverse processes are not developed on the vertebrae, the ribs being sessile.

The three species of *Saurida, S. tumbil, S. undosquamis* and *S. longimanus* exhibit a marked similarity in the shape and structure of the skull and

individual bones. They, however, differ amongst themselves in respect of characters such as width of the cranium at the extremity of frontals, shape of the posterior part of the occipital crest, number of rows in the outer band of palatine teeth, structure of orbitosphenoid, position of the hypocoracoid foramen, number of vertebrae, structure and disposition of the precaudal vertebrae and the caudal skeleton. *S. undosquamis* and *S. longimanus* resemble each other closely in respect of most of the characters and stand apart from *S. tumbil*. These results of osteological studies support the results of studies on taxonomy.

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