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THE FISHES OF THE FAMILY SILLAGINIDAE FROM INDIA WITH A DESCRIPTION OF A NEW SPECIES*

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ABSTRACT

A review of the fishes of the family Sillaginidae from Indian waters is given with a description of a new species of *Sillago*. A key to the genera and species is provided.

INTRODUCTION

THE sandborers or Indo-Pacific sillagos of the family Sillaginidae are popular food fishes captured by seine-net, cast-net, Gill-net, lift-net and trawl-net in inshore and estuarine waters of the Indo-Pacific region from South Africa to northern Japan. The species are most numerous in Australian waters and are being reviewed by the author. In India they are known by a variety of local names and form a small but important fishery.

I am deeply grateful to Dr. W. Fischer of the Fisheries Resources Service of FAO, Rome, for the opportunity to participate in the FAO/DANIDA Expert Consultation Programme at the Central Marine Fisheries Research Institute, Cochin, 1980. During this Programme many sillaginids were examined and *Sillago vincenti* discovered. My colleagues at Cochin assisted me in collecting and photographing the new species. Dr. E. G. Silas, Director, CMFRI, Cochin made early publication of this paper possible and made facilities available for the examination and illustration of specimens. To the staff of CMFRI, especially Mr. A. Noble and the artist Mr. A. Muniyandhi, my appreciation for their generous assistance. To my friend Mr. S. G. Vincent of CMFRI my thanks for his valuable assistance in collecting specimens, obtaining information for this study recognising the two species in the field and assisting with the measurements.

MATERIAL AND METHODS

This study is based on material collected by the Central Marine Fisheries Research Institute, Cochin before and during the FAO/DANIDA Expert Consultation Programme, January to February 1980 and specimens made available by museums and scientific institutions throughout the world. Specimens not collected from India are not included in this review and will be treated in a world revision

* In view of the delay in the issue of this number of the Journal, this paper of topical interest is included here.

—*Editor*,

currently in manuscript. Anal spines are normally two slender elements that may be reduced in size and require careful observation. Lateral-line scales bearing pores were counted from the upper margin of the operculum to the caudal flexure at the posterior margin of the hypural bone. Transverse scale rows were counted from the origin of the dorsal fin in an oblique row to, but not including, the lateral line scale, and then from the origin of the anal fin obliquely forward and upward to the lateral line scales. Cheek scale rows were counted from below the eye to the lower angle of the preopercle, but do not include the row of scales on the area of the preopercle on the ventral surface of the head.

The vertebrae were counted from boiled and defleshed fresh specimens. The axial skeleton was subdivided into three sections the abdominal vertebrae from the base of the skull to the first haemal arch, the modified vertebrae forming the haemal funnel (Hotta, 1961 ; Kwang-Tsao and Kun-Hsiung 1978) and the caudal vertebrae bearing straight haemal spines (Fig. 1e) including the urostylar vertebra. Measurements were made along the longitudinal axis of the body using vernier calipers. The standard length (SL) was taken from the tip of the snout (not including the fleshy upper lip) to the caudal flexure ; head, length from tip of snout to posterior margin of the fleshy opercle ; snout, length from tip to anterior fleshy margin (adipose tissue) of the eye ; eye diameter, the horizontal diameter between the fleshy (adipose) margins of the orbit ; interorbital width, the least witdth of the bony (not fleshy) interorbital space ; the greatest body depth was normally at the middle of the abdomen.

The swimbladder was exposed by cutting along the mid-line of the body to one side of the vent and along the base of the anal fin. Care should be taken not to damage the post-coelomic extensions of the swimbladder, the lateral appendages, or the duct-like process that arises on the ventral surface of the swimbladder and extends to the ventral surface of the body near the vent. The swimblader is closely invested with a thin peritoneum that should be very carefully removed to expose the organ. The gills must be removed to observe the anterior projections of the swimbladder when these are present.

The abbreviations of institutions cited in the text are as follows : AMS-Australian Museum, Sydney ; CMFRI-Central Marine Fisheries Research Institute, Cochin ; SOSC : Smithsonian Institution Oceanographic Sorting Centre, Washington ; USNM-United States National Museum of Natural History, Washington D.C. ; WAM—Western Australian Museum, Perth ; ZSIC—Zoological Survey of India, Calcutta.

FAMILY : SILLAGINIDAE

The family Sillaginidae is represented in India by two genera and five species. The external morphology, meristic characters and colouration are similar in some species and therefore dissection is required to confirm the identification of similar species. This external similarity has frequently led to confusion between unrelated species. The new species described below has been confused with *Sillago sihama*, but these two species may be readily distinguished by an examination of the swimbladder.

The Family Sillaginidae is closely related to the family Sciaenidae in most essential characteristics, but may be recognised by the possession of vomerine teeth

and in having the lower part of the preopercle sharply angled inwards to meet that of the other side, thus forming the ventral surface of the head. The cephalic, suborbital and preopercular sensory canal system is highly developed, and is characteristic of the family. The swimbladder may be present or absent and when present, may be a very complex organ, frequently with a blind duct-like tubular extension from the ventral surface that terminates near the urogenital aperture. The osteology, swimbladder morphology, and relationships of the family will be described in papers to be published elsewhere. Externally, the family may be recognised by the presence of two dorsal fins the first consisting of 10-13 slender spines, the second of 1 spine and 16-27 rays. The anal fin has two slender spines and 14-26 rays. The unpaired fins and pectorals have scaly interradial marginals. The lateral line is almost straight with 50 to 141 pored scales to the caudal flexure. The lower jaw has two inconspicuous pores and a central pit. The lacrimal bone is broadly triangular and has a raised central dome-like arch that greatly increases the membranous suborbitral laterosensory canal; this area of the preorbital is usually swollen and somewhat transparent due to adipose tissue that covers this bone and the suborbitals, and forms an adipose orbital rim. The preopercle has the lower half abruptly bent inwards to form an extensive sensory canal system on the ventral surface of the head.

Key to the Genera and Species Recorded from India

1. (a) Snout and head greatly depressed ; second dorsal spine very elongate ; eyes small, 3 to 11 per cent of head length, and almost covered by adipose tissue ; swimbladder vestigial or absent ..... *Sillaginopsis panijus*

(b) Snout and head not depressed ; second dorsal spine not elongate ; eyes normal, 17 to 22 per cent of head length ; swimbladder present ..... genus *Sillago* 2

2. (a) Pelvic fin with the spine inconspicuous and almost hidden by the much thickened club-like first pelvic ray ; swimbladder without post-coelomic projections into the tail section ; vertebral column without modified haemal spines overlying the posterior extensions of the swimbladder (no haemal funnel) .... *Sillago chondropus*

(b) Pelvic fin without a thickened club-like first ray ; swimbladder with one or two post-coelomic extensions ; vertebral column with some modified haemal spines overlying the posterior part of the swimbladder (haemal funnel present) 3

3. (a) Base of pectoral fin with a conspicuous dark brown, black or blue-black blotch or spot ; body with irregular dark blotches ; dorsal fin rays 10 to 21 ; anal fin rays 19 to 21 ..... *Sillago maculata*

(b) Base of pectoral fin without a dark brown or blackish blotch, or spot ; body without dark blotches, although the belly or sides may be darkened ; dorsal fin rays 21 to 23 ; anal fin rays 21 to 24 4

4. (a) Second dorsal fin with at least 5 rows of dusky-black or black-brown spots that may be quite separate or somewhat confluent; swimbladder with only one post-coelomic extension and no anterolateral or anterior tubular extensions projecting forward or extending laterally towards the vent (Fig. 1 b, c)..... .....*Sillago vincenti* sp. nov.

(b) Second dorsal fin with or without rows of dusky spots on the membranes, and when spots are present these may be confluent; swimbladder with two very distinct post-coelomic extensions, two anteriorly directed extensions, and an anterolateral convoluted tube that may send off small blind tubules continues along the lateral wall of the abdomen to the region of the vent or a little beyond (Fig. 1 d).....*Sillago sihama*

Sillago vincenti sp. nov. (Fig. 1 a-c)

Material examined

HOLOTYPE: SL 207 mm, Kavanad near Neendakara, north of Quilon, Kerala State, India, January 23, 1980 collected by Mr. S. G. Vincent, CMFRI.

PARATYPES: (74 Specimens SL 158 to 308 mm); AMS (1); CMFRI (4); USNM (2); WAM (1); Mandapam Camp (10), same data as holotype; Academy of Natural Sciences, Philadelphia (2); Bernice P. Bishop Museum, Honolulu (4); British Museum (Natural History), London (1); California Academy of Sciences, San Francisco (2); CMFRI (31 defleshed); Museum National d' Histoire, Paris (1); National Science Museum, Tokyo (1); Queensland Museum Brisbane (2); Rhodes University, J.L.B. Smith Institute of Ichthyology, Grahamstown (1); University of Michigan (1); Mandapam Camp (10); Cochin Fish Markets, Kerala State, India, January 29 to February 6, 1980. P. Heemstra, W. Smith-Vaniz, S. G. Vincent, R. McKay, J. Randall.

Description

(Based on the holotype; variation of paratypes given in parenthesis frequency data for selected counts are given in Tables 1-3).

Dorsal fins XI, 1, 23 (X, XI, XII, 1, 21-23); anal fin II 23 (II, 22-24). Pectoral fin 16; lateral-line scales 71 (70-74). Transverse scales 5½ above (5-6) and 13 below (13-14); cheek scales cycloid, in 2 rows, gill rakers 4 above, 7 below. Proportional measurements as per cent of SL; greatest depth of body 19.3 (16-20); head length 27.5 (26-29); snout tip to pelvic fin origin 27 (26-30), snout tip to spinous dorsal fin origin 32.4 (31-35); snout tip to second dorsal fin origin 54.1 (52-55); snout tip to anal fin origin 54.4 (54-55); length of spinous dorsal base (1st dorsal origin to second dorsal origin) 22.2 (18-23); height of spinous dorsal fin 21.3 (19-23); least depth of caudal peduncle 6.8 (6-7).

Proportional measurements as per cent of head length: length of snout 40.4 (40-46); horizontal diameter of eye 19.3 (17.22); least width of bony interorbital space 19.3 (16-19).

Vertebrate: 14-4-16 (13), 14-5-15 (18), 14-6-14 (1); 14+4-6+14-16; 14 abdominal and 20 caudal; total 33.

Colour in life : Body and head sandy to light olive above, scale margins darker, sides silvery with a golden tinge, belly white ; head with a deeper golden tinge, the snout, preorbital and suborbital areas translucent, showing the golden surface of the lacrimal and suborbitals below ; the ventral surface transparent to translucent with a pink hue. Eye with a silver iris, somewhat golden on the outer surface, snout tip dusky and the frontal bones outlined with darker pigmentation ; opercle yellowish-gold. Pectoral-fin base yellow to gold. Pelvic fins white with yellowish tips. Spinous dorsal fin hyaline with the tip of the membranes dusky and

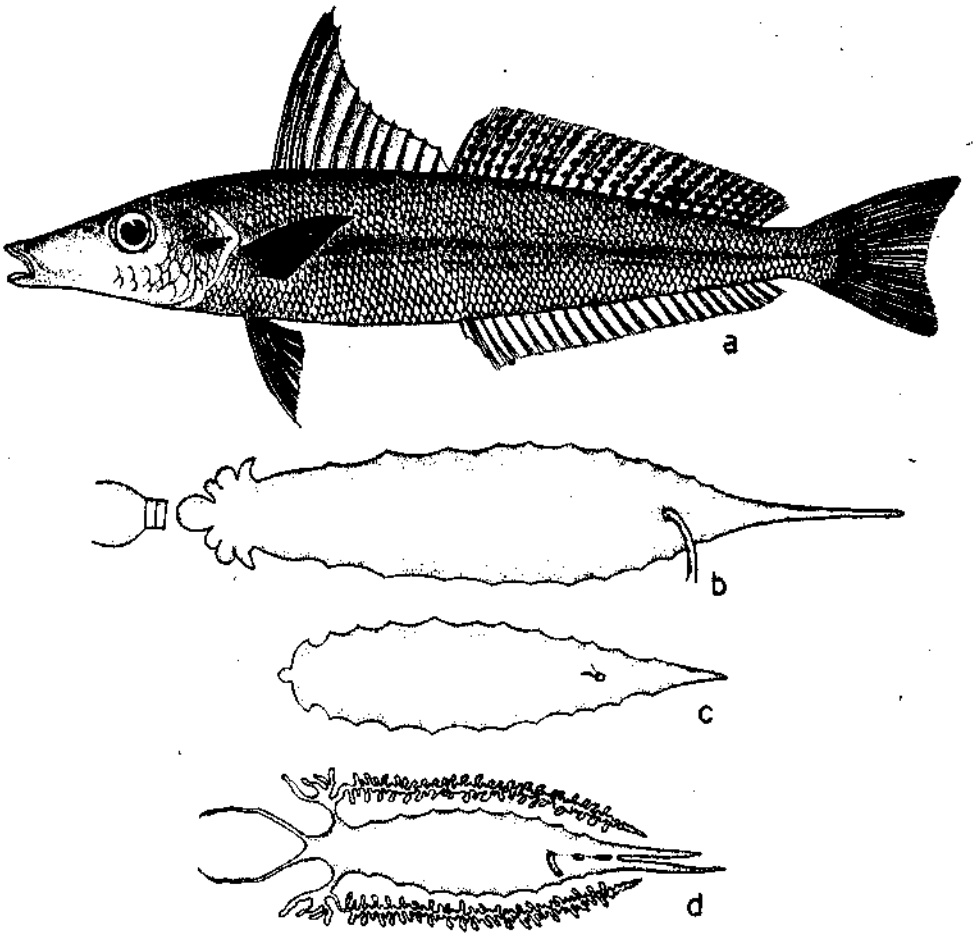

Fig. 1. a. Holotype of *Sillago vincenti* (TL-24 cm), b, c, swimbladder of *S. vincenti* and d. swimbladder of *S. sihama*.

blotched with irregular areas of very fine dust-like black spots. Second dorsal hyaline to pale white with 5 to 7 rows of blackish spots that may become somewhat confluent in large examples. Anal fin hyaline to milk white with white or yellowish tips. Caudal fin hyaline to dusky with the lower lobe and posterior margin darker in some specimens. Sides of body without a well defined silvery lateral stripe.

The golden hues and yellowish pigmentation is rapidly lost in preservative but the second doral fin remains conspicuously spotted.

Swimbladder : The anterior extremity has a very short bulbous projection with one to three anterolateral lobate or recurved projections (Fig. 1b). The posterior post-coelomic extension is single and tapers to a point ; a duct-like process is present on the ventral surface and coninues to the vent.

Distribution : Known from estuarine waters, Kerala State, India.

Remarks : This new species is very similar to *Sillago sihama* in external appearance and has been confused with that species. The two species may be distinguished when in a fresh condition by the conspicuously spotted second dorsal fin and lighter colouration of *Sillago vincenti*. The two species were sometimes found sorted in the fish market at Cochin, although some of the smaller *Sillago sihama* with two rows of spots on the base of the second dorsal fin were occasionally misidentified. A quick dissection of the base of the anterior half of the anal fin allows rapid field identification of doubtful specimens, whereas a positive identification requires full dissection of the swimbladder and the counting of fin ray elements and scales. The vertebral count, frequently of diagnostic value in other species of *Sillago*, was found to overlap in these two species (Table 3). The saggital otolith of *Sillago vincenti* has a more elongate caudal than that of *Sillago sihama*, and will be illustrated in a later paper discussing the osteology of the species.

TABLE 1. *Frequency distributions of dorsal and anal fin rays of* Sillago sihama *and* Sillago vincenti *from Kerala State.*

Dorsal	21	21	21	22	22	22	23	23	23
Anal	21	22	23	22	23	24	22	23	24
S. sihama	2	15	1	7	2	1	1		
S. vincenti	—	2	1	26	31	3	1	9	1

TABLE 2. *Frequency distribution of lateral line scales of* Sillago sihama *and* Sillago vincenti *from Kerala State.*

Lateral line scales	67	68	69	70	71	72	73	74
S. sihama	1	7	8	9	5	—	—	—
S. vincenti	—	—	—	4	31	25	11	3

Variation : The variation in the dorsal and anal fin ray counts of *Sillago vincenti* is given in Table 1 ; the variation in lateral line scales in Table 2, and the variation in the vertebral count in Table 3. The variation in the shape of the swimbladder is shown in Fig. 1 b-c.

Biology : Little is known of the biology of this species. It occurs with *Sillago sihama*, apparently in mixed schools in the estuarine waters on muddy substrates in approximately three metres depth some 5 to 8 kilometres inside the lake near Neendakara. The species is not known to occur in coastal waters, but was quite common at Cochin where they were reported from the backwater areas inside the estuary. During late January to early February large females of 250 to 277 mm SL were found to be running ripe, and the ova was released on gentle pressure. Males were ripe and milt could be expressed. The species has a potential for fish culture in Kerala waters.

Derivation : Named in honour of Mr. S. G. Vincent, Central Marine Fisheries Research Institute, Cochin.

Sillago sihama (Forsskal, 1779) (Fig. 1d)

Material examined

HOLOTYPE : *Atherina sihama* (Forsskal), registered No. 71 in the Zoological Museum of Copenhagen, photograph and radiograph (Klausewitz and Nielsen, 1965, p. 27, pl. 38, No. 71).

INDIAN MATERIAL : SOSC 334 (4) Cochin : USNM 149705 (5) Travancore SOSC 334 (4) Pondicherry, Madras State, WAM P15715-8 Mylapore ; SOSC 381 (83) Porto Novo ; SOSC 334 (2) Porto Novo ; SOSC 334 (3) Ennore, SOSC 334 (8) Mandapam Camp ; SOSC 334 Royapuram Beach ; SOSC 334 Thirumullaivasal Village ; SOSC 334 (4) Pulicat Lake ; AMS B 8212 (2) Madras ; USNM 32695 India ; CMFRI (9) Neendakara ; CMFRI (20) Cochin.

Description : Dorsal fins XI (rarely X) I, 20-23, anal fin II, 21-23. Lateral line scales 66-72. Transverse scales 4-6 above, 10-12 below. Cheek scales cycloid, in two rows.

Proportional measurements as per cent of SL (22 specimens from Neendakara and Cochin) : greatest depth of body 17-21 ; head length 25-28 ; snout tip to pelvic fin origin 25-30 ; snout tip to spinous dorsal fin origin 31-35 ; snout tip to second dorsal fin origin 53-55 ; snout tip to anal fin origin 54-59, least depth of caudal peduncle 6-8.

Proportional measurement as per cent of head length : length of snout 38-44 ; horizontal diameter of eye 18-21 ; least width of interorbital 17-21.

Vertebrae : 14 abdominal, 20 caudal, total 34 (Table 3).

Colour in life : This species is variable in colouration depending on the substrate, and may be light sandy, buff or pale brown with light or hyaline fins on sand bottoms, to a rich gold colour with bright yellow to orange, fins with or without dark blotches on the first dorsal fin or basal spots on the membranes of the second dorsal fin, on dark muddy bottoms. Some specimens may have the lower sides belly, and head, covered with very fine dust-like brown to blackish spots that may be intensified on the snout and upper head. The caudal fin may be dusky with the lower lobe or posterior margin black.

Swimbladder : Two anterior extensions extend forward and diverge to terminate on each side of the basioccipital ; two anterolateral convoluted tubes extend anteriorly for a short distance and then send a blind, much convoluted tube, with or without blind tubules, posteriorly along the abdominal wall just ventral to the swimbladder, to reach the duct-like process ventrally ; two posterior post-coelomic tapering extensions continue into the haemal funnel, one is generally longer than the other (Fig. 1 d).

Variation : The variation in the dorsal and anal fin ray counts is given in Table 1, the variation in the lateral line scales in Table 2, and the variation in the vertebral count in Table 3.

TABLE 3. *Vertebral counts of* Sillago sihama *and* Sillago vincenti *from Kerala State*

Abdominal	..	14	14	14	14
Modified	..	4	5	6	4
Caudal	..	16	15	14	17
S. sihama	..	1	15	2	1
S. vincenti	..	13	18	1	—

Distribution : Widely distributed in the Indo-West Pacific from Natal to northern Japan, this species is common on the west and east coasts of India.

Biology : *Sillago sihama* is an inshore species that frequently penetrates estuaries for a considerable distance. It has been recorded from freshwater despite the absence of renal corpuscles or tubercles in the kidney (Nadkarni, 1963).

This species forms small but important fisheries throughout its range. In India it is an important food fish of delicate flavour. The maximum size is approximately 31 cm. The biology of the species has been outlined by Gopinath, 1946 (fishery) ; Chacko, 1949a, 1949b (food and feeding), 1950 (spawning, eggs, larvae) ; Tripathy, 1952 (parasites) ; Radhakrishnan, 1954, 1957, (growth) ; Palekar and Bal, 1955 (fishery), 1961 (maturation and spawning) ; Ramamurthy and Dhulkhed, 1977 (fry).

Remarks : This species has previously been confused with *Sillago vincenti* and a dissection of the swimbladder of *Sillago* ' *sihama* ' from other localities in Indian waters is necessary to establish in identity of the species.

Sillago chondropus Bleeker, 1849

Material examined

ZSIC 6068/2 Colva Beach, Goa. SOSC 381 Thirumullaivasal, Madras State ; AMS B 8095 Madras ; CMFRI Cochin, CMFRI Vizhinjam ; CMFRI Mulepeta, Kakinada.

Description : Dorsal fins XI-XII I, 20-22 anal fin II, 22-23, Lateral line scales 66-73. Transverse scales 6 above, 9-10 below. Cheek scales all ctenoid in 3 to 4 rows.

Proportional dimensions as per cent of SL : greatest depth of body 15-16 ; head 26-27; snout tip to spinous dorsal fin origin 28-31; snout tip to second dorsal fin origin 50-52 ; snout tip to anal fin origin 47-50; least depth of caudal peduncle 8.

Proportional dimensions as per cent of head ; length of snout 32-40 ; horizontal diameter of eye 16-22 ; least width of interorbital 14-17.

Vertebrae : 12-13 abdominal, 22-23 caudal, total 35.

Colour in alcohol : Pale sandy-brown above, paler below ; scale margins dusky ; snout tip dusky ; a dull silver-grey mid-lateral stripe. Fins hyaline the spinous dorsal tinged brown with a fine dusting of black spots at the tip ; lower lobe of caudal fin dusky.

Swimbladder : Without anterior projections ; posterior portion tapering to terminate before the unmodified caudal vertebrae (Fig. 1 e). Palekar and Bal (1955) examined 12 specimens from near Karwar and stated that the swimbladder was absent.

Distribution : Natal, South Africa to Philippines but not recorded from southern New Guinea or Australia. In India it is found on the west and east coasts.

Sillago maculata (Quoy and Gaimard)

Material examined

No specimens examined from India or the western Indian Ocean.

Description : Based on 46 examples from Queensland and New South Wales, Australia. Dorsal fins XI, 1, 19-21 ; anal fin II, 19-20. Lateral line scales 71-75. Transverse scales 8-9 above, 9-11 below ; 5-6 scales between lateral-line and spinous dorsal origin. Cheek scales in 3-4 rows, mostly cycloid.

Proportional dimensions as per cent of SL : greatest depth of body 19-23 ; head length 26-29, snout tip to pelvic fin origin 27-32 ; snout tip to spinous dorsal fin origin 31-35 ; snout tip to second dorsal fin origin 53-57 ; snout tip to anal fin origin 56-60 ; least depth of caudal peduncle 7-8.

Proportional dimensions as per cent of head length ; length of snout 37-44 ; horizontal diameter of eye 20-25 ; least width of interorbital 18-22.

Vertebrae : 13-15 abdominal, 8-11 modified (haemal funnel), 10-14 caudal ; 13—15+20—21, total 34—36.

Colour in alcohol : Body light brown to brown, darker above; back and sides with 7 to 9 irregular dusky or black blotches directed obliquely forwards in most specimens. Pectoral fin with a conspicuous brown or black spot on the base.

Swimbladder : The swimbladder has a single tapering posterior post-coelomic extension. The morphology of this organ in Indian specimens has not been studied.

Distribution : South Africa to the Phillippines including Australia. In India the species is occasionally encountered in southern waters and at the Andaman Islands.

Remarks : *Sillago maculata* may be separated into three subspecies, one from the Phillippines to Singapore, one from Eastern Australia, and one from Western Australia northwards and eastwards to the Gulf of Carpentaria. Specimens from India and the Western Indian Ocean require detailed examination.

Sillaginopsis panijus (Ham-Buch.)

Material examined

WAM P 15370-9 (15) Bay of Bengal ; SOSC 4 (5) 21° 52'N, 90° 36'E.

Description : Dorsal fins X, 1, 26-27 ; anal fin II, 24-26. Lateral line scales 84-88. Transverse scales 6 above, 13 below. Cheek scales mostly ctenoid but some cycloid scales are present, in 3-4 rows.

Proportional dimensions as per cent of SL (10 specimens from Bay of Bengal) : greatest depth of body 14-16 ; head length 28-30 ; snout tip to pelvic fin origin 30-33 ; snout tip to spinous dorsal fin origin 31-34 ; snout tip to second dorsal fin origin 45-47 ; snout tip to anal fin origin 51-54 ; least depth of caudal peduncle 6.

Proportional dimensions as per cent of head : length of snout 40-43 ; horizontal diameter of eye 3-11 ; least width of interorbital space 14-18.

Vertebrae : 15 abdominal, 27 caudal, total 42.

Colour in alcohol : Body light brown above, paler to whitish below. Fins pale brownish with a light dusting of fine black spots.

Swimbladder : Swimbladder absent.

Distribution : Pondicherry northwards along the Coromandel Coast, Ganges delta, Burma, southwards to Malaysia, and rarely to the Indonesian Archipelago. Mr. S. G. Vincent of CMFRI, Cochin has observed this species on rare occasions 30 kilometres north of Cape Comorin.

Biology : *Sillaginopsis panijus* attains a length of 44 cm and is a commercially important fish captured by nets and long lines in the Hooghly and Ganges delta. Krishnayya (1963) has outlined the biology of the species and Mukherjee, Ganguly and Mazumdar (1946) has recorded gut contents.

Remarks : The very small eyes, flattened head, filamentous second dorsal spine, and the absence of a swimbladder suggest demersal adaptation to muddy water conditions. The outer row of teeth in both jaws are slightly enlarged, with the two anterior-most teeth in the upper jaw caninoid.

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