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A REDESCRIPTION OF *PSEUDORHOMBUS MEGALOPS*, WITH COMMENTS ON *CEPHALOPSETTA VENTROCELLATA* (OSTEICHTHYES: PLEURONECTIFORMES: PARALICHTHYIDAE)

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Abstract.—*Pseudorhombus megalops* has not been recorded in the literature since first described by Fowler (1934) from the Philippine Islands. The species is redescribed from the type specimens and additional material from the Philippine Islands, eastern Indian Ocean, Bali Strait, and Arafura Sea. *Pseudorhombus megalops* has a very distinct black spot or ocellus on the left pelvic fin. The only other Indo-Pacific paralichthyid with a similar character is *Cephalopsetta ventrocellata.* These species are compared and characters are given for their separation. *Cephalopsetta ventrocellata,* previously known from the east and west coasts of India and Pakistan, is shown to range to the Andaman Sea and Gulf of Oman. *Cephalopsetta* has been considered a close relative of *Ancylopsetta* (western Atlantic and eastern Pacific) and *Gastropsetta* (western Atlantic) because they share an elongate left pelvic fin. Osteological characters of the caudal fin, however, support placement of *Cephalopsetta* in with the Indo-Pacific genera *Pseudorhombus* and *Tarphops.*

Fowler (1934) described many new flatfish species collected mainly from the Philippine Islands and adjacent regions. Most authors have overlooked Fowler's publication, apparently because it appeared during the same year as, and thus was not cited in, Norman's (1934) monograph on flatfishes. Most of Fowler's descriptions and figures of the new flatfishes were inadequate. In addition, he based many of his interpretations upon the older classification of Weber & de Beaufort (1929). Thus, the status of most of Fowler's (1934) genera and species was uncertain. One species described in this work was *Pseudorhombus megalops.* The description and figure of this species were poor, and there have been no other published records of *P. megalops.* Additional specimens were recently collected from the eastern Indian Ocean, Bali Strait, and Arafura Sea during the Joint Eastern Tropical Indian Ocean Fishery Survey (JETINDOFISH; see Gloerfelt-Tarp & Kailola 1984). We originally could not identify the JETINDOFISH specimens to species and left them as "*Pseudorhombus* sp. 1" in Gloerfelt-Tarp & Kailola (1984), stating that the species appeared very close to *P. megalops.* Since that time we have found additional specimens from the Philippine Islands and have had the opportunity to make the necessary comparisons with Fowler's types for a positive identification as *P. megalops.*

Dutt & Rao (1965) described *Cephalopsetta ventrocellata* from the east coast of India. The only other published records of the species are those of Kotthaus (1977) from the west coast of India and Pakistan. We have examined additional material from the Andaman Sea, west coast of India, and Gulf of Oman. *Cephalopsetta ventrocellata* shows some similarity to *P. megalops* and can be confused with that species.

In this paper we redescribe *P. megalops*

Fig. 1. *Pseudorhombus megalops,* holotype, USNM 93082, 152.0 mm SL.

from the type specimens and additional material and discuss some of the characters and possible phylogenetic position of *C. ventrocellata* and compare it with *P. megalops.*

Materials and Methods

Methods of counts and measurements follow those of Hubbs & Lagler (1949) with two changes. Because all dorsal- and anal-fin rays are unbranched, all ray elements are counted as individual rays. Length of the pelvic fin is the length of the longest ray of that fin. Measurements were made with dial calipers to the nearest 0.1 mm. For regression analysis all variates were transformed to natural logarithms. Standard length was treated as the independent variable. Tests for allometry were performed with the geometric-mean-functional-regression model of Ricker (1973). In this model 95% confidence limits are determined for the slope (v). If unity is outside of these limits allometry is assumed (positive if below, negative if above); isometry is assumed if unity is within the limits.

Caudal-fin drawings were made from radiographs or specimens cleared and stained according to the method of Taylor (1967).

The institutional abbreviations are as follows: ANSP—Academy of Natural Sciences, Philadelphia; CSIRO—Commonwealth Science and Industrial Research Organization, Hobart, Tasmania; FDNR—Florida Department of Natural Resources, St. Petersburg, Florida; HUMZ—Hokkaido University, Laboratory of Marine Zoology, Faculty of Fisheries, Hakodate; NTM—Northern Territory Museum of Arts and Sciences, Darwin, Australia; UPRM—University of Puerto Rico-Mayagüez; and USNM—National Museum of Natural History, Smithsonian Institution, Washington, D.C. Standard length and total length are abbreviated SL and TL.

Pseudorhombus megalops Fowler

Figs. 1, 2A–B, 3A–B, 5B, Tables 1–2

Pseudorhombus megalops Fowler, 1934:329, fig. 83 (Philippine Islands).

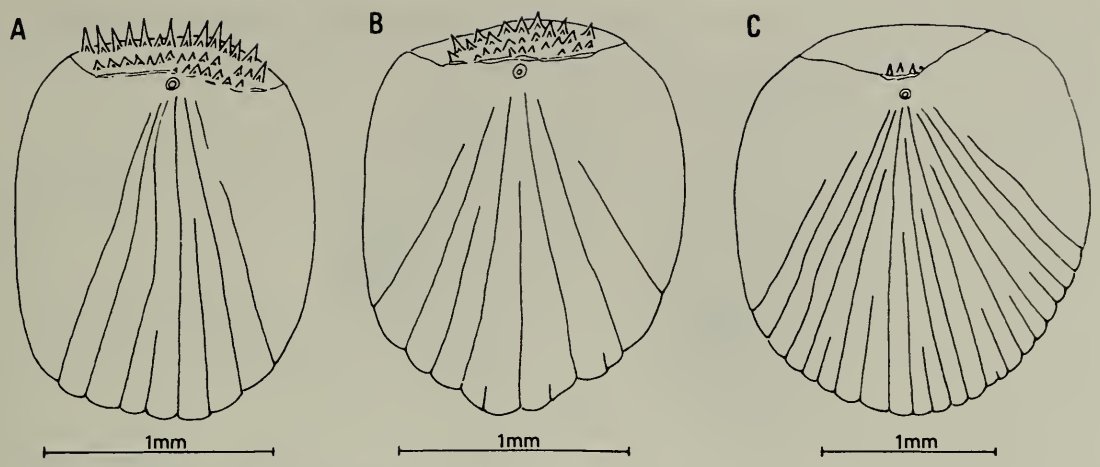

Fig. 2. Scales from near mid-length of body immediately above lateral line: A, left side of *Pseudorhombus megalops,* HUMZ 111769, 146.5 mm SL; B, right side of *P. megalops,* HUMZ 111769, 146.5 mm SL; C, left side of *Cephalopsetta ventrocellata,* ANSP 153379, 161.7 mm SL.

Pseudorhombus sp. 1.—Gloerfelt-Tarp & Kailola, 1984:272 (unnumbered plate), 273, 357 (eastern Indian Ocean, Bali Strait, and Arafura Sea).

Diagnosis.—Dorsal-fin rays 67–70; anal-fin rays 50–53; lateral-line scales 70–77. Gill rakers elongate, 15–18 on lower limb. Lower jaw with 12–20 teeth on blind side, 2–4 large canines near symphysis. Scales on ocular side ctenoid, most scales on blind side ctenoid (Fig. 2A–B). Tip of first interhemal spine stout, usually projecting through body wall anterior to first anal-fin ray. Pelvic fin of ocular side with distinct black spot over fourth or fifth ray (Fig. 3A–B); pelvic fin of blind side longer than that of ocular side.

Description.—Morphometrics as % SL are presented in Table 1. Dorsal-fin rays 67–70; anal-fin rays 50–53; pectoral-fin rays ocular side 11–13, blind side 11–12; pelvic-fin rays ocular side 6, blind side 6; lateral line scales 70–77; gill rakers ocular side 5–9 + 15–18; teeth on blind side of lower jaw 12–20.

Head length 3.0–3.3, body depth 1.9–2.4, both in SL. Measurements in head length are as follows: Snout length 3.9–4.5; upper-jaw length ocular side 2.0–2.2; lower-jaw length ocular side 1.6–1.8; lower-eye length 3.4–4.8; pectoral-fin length ocular side 1.5–1.9, blind side 2.1–2.9; pelvic-fin length ocular side 3.0–4.2, blind side 2.7–3.8; length of first dorsal-fin ray 2.6–3.5, second 3.1–4.0, third 3.6–4.7, fourth 3.6–5.4; length of caudal peduncle 3.6–5.2, depth of caudal peduncle 2.8–3.4.

Anterior profile of head with indentation anterior to upper eye. Anterior margins of eyes at same transverse levels. Posterior end of maxilla below middle to posterior one-third of lower eye. Nostrils of ocular side at same horizontal level as upper margin of lower eye. First dorsal-fin ray variable in position, above either nostril or interspace between nostrils. Tip of isthmus below posterior one-quarter or posterior margin of lower eye. Teeth of upper jaw similar on ocular and blind sides, small and closely spaced laterally with from four to six widely spaced, large canines anteriorly; teeth of lower jaw similar on ocular and blind sides, large and widely spaced laterally with from two to four (usually two) very large canines anteriorly. Lower jaw with prominent symphysial knob. Gill rakers elongate, pointed, with small teeth.

Scales on ocular side ctenoid; most scales on blind side ctenoid, cycloid scales probably being replacement scales (Fig. 2A–B). Supratemporal branch of lateral line reaching one-half to three-quarters of distance to dorsal fin base.

First interhemal spine stout, usually projecting through body wall immediately anterior to first anal-fin ray.

First few dorsal-fin rays slightly elongate.

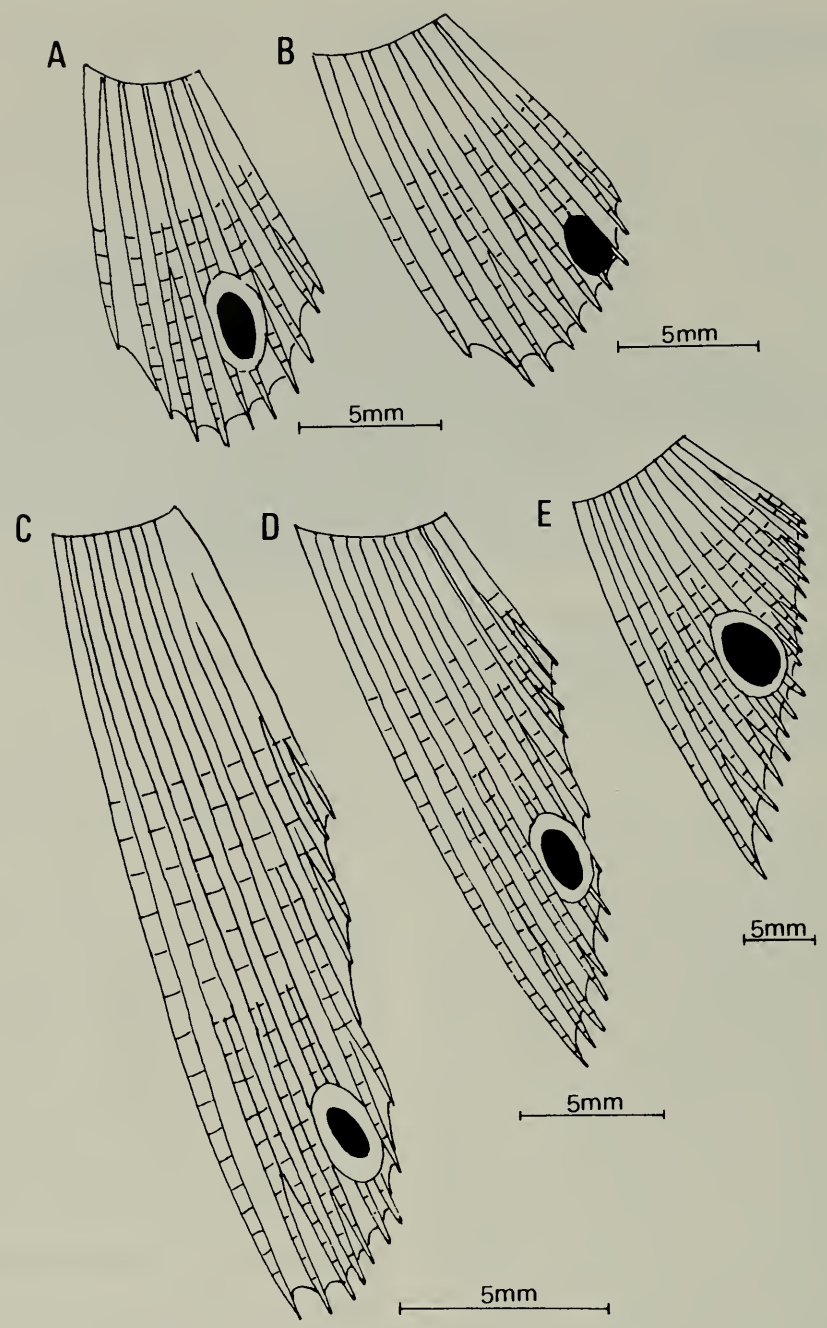

Fig. 3. Left pelvic fins: A, *Pseudorhombus megalops,* CSIRO CA2526, 129.8 mm SL; B, *P. megalops,* holotype, USNM 93082, 152.0 mm SL; C, *Cephalopsetta ventrocellata,* ANSP 153383, 66.0 mm SL; D, *C. ventrocellata,* ANSP 153382, 102.4 mm SL; E, *C. ventrocellata,* ANSP 153379, 161.7 mm SL.

Pelvic fin of blind side slightly longer than that of ocular side.

Color in alcohol.—Ocular side tan to dark grey. Some specimens with dark rings arranged in two longitudinal series above and below lateral line, scattered, smaller dark rings and blotches, and dark streaks on dorsal and anal fins (see unnumbered plate of "*Pseudorhombus* sp. 1" in Gloerfelt-Tarp & Kailola 1984:272). All preserved specimens with distinct black spot on fourth or fifth ray of pelvic fin of ocular side (Fig. 3A–B); some indication that black spot may have white margin in life. Blind side tan or whitish.

Discussion

Norman (1934) recognized 21 species of *Pseudorhombus* Bleeker as valid and three as being of doubtful validity. Subsequently, Fowler (1934) described *P. megalops* and

Table 1.—Morphometric proportions expressed as percentage of SL for specimens of *Pseudorhombus megalops*.

	Holotype (USNM 93082)	Philippine Islands, including paratypes (USNM 93550) (n = 7)	Eastern Indian Ocean, Bali Strait, and Arafura Sea (n = 5)
Standard length (mm)	152.0	131.7–174.7	116.8–154.2
Head length	31.3	31.9–33.4	30.2–33.1
Body depth	48.9	47.4–51.9	40.9–48.4
Upper-jaw length (ocular side)	15.3	15.0–16.1	13.9–16.6
Lower-jaw length (ocular side)	18.9	18.4–19.5	17.6–20.1
Eye length (lower)	8.6	7.9–8.9	6.2–9.2
Snout length	7.2	7.4–8.4	6.7–7.7
Depth of caudal peduncle	9.5	9.5–10.1	9.6–11.0
Length of caudal peduncle	6.8	6.4–7.2	5.8–8.7
Pectoral-fin length (ocular side)	19.3	17.9–22.0	15.8–20.8
Pectoral-fin length (blind side)	14.6	13.0–15.8	10.4–14.5
Pelvic-fin length (ocular side)	8.8	8.0–9.3	7.5–10.9
Pelvic-fin length (blind side)	11.4	8.6–10.5	8.1–11.5
First dorsal-fin ray length	9.9	10.0–11.6	8.7–12.7
Second dorsal-fin ray length	8.5	7.9–9.1	7.6–10.8
Third dorsal-fin ray length	7.8	7.0–8.7	6.5–9.2
Fourth dorsal-fin ray length	7.0	6.1–8.1	7.0–9.2

Amaoka (1969) *P. oculocirris*. Characters given in the "Diagnosis" will distinguish *P. megalops* from all known species of *Pseudorhombus*.

Dutt & Rao (1965) described a new genus and species of paralichthyid, *Cephalopsetta ventrocellata,* from the east coast of India (Visakhapatnam). This species resembles *P. megalops* in having a very distinct black spot enclosed by a light-colored ring between the third and fifth ray of the pelvic fin of the ocular side (Figs. 3, 4). These species are the only known Indo-Pacific paralichthyids with a distinctive dark spot or ocellus on this fin. The South African species *Pseudorhombus natalensis* Gilchrist has a small dark spot on this fin but the spot is relatively diffuse and frequently absent, at least in preserved specimens. Other paralichthyids with an ocellus or distinctive dark spot on the pelvic fin of the ocular side are western Atlantic (*Ancylopsetta kumperae* Tyler, *Paralichthys oblongus* [Mitchill], *Paralichthys isosceles* Jordan) or eastern Pacific species (*Lioglossina tetrophthalmus* Gilbert). *C. ventrocellata* and *P. megalops* can be distinguished by characters presented in Table 2.

Kotthaus (1977) examined specimens of *C. ventrocellata* from the west coast of India and Pakistan and described some additional characters not mentioned by Dutt & Rao (1965). We have examined specimens from the Andaman Sea, eastern Arabian Sea, and Gulf of Oman. Our specimens agree with the descriptions of Dutt & Rao (1965) and Kotthaus (1977) with some exceptions. Dutt & Rao (1965) state that the ocular side has "a few irregular dark blotches." Most of our specimens show distinct dark spots arranged in about five longitudinal rows. The most distinctive dark spots are those immediately below the bases of the dorsal and anal fins and usually a series of three spots along the lateral line. In some specimens there is a faint pattern of several broad, dark transverse bars. Kotthaus (1977) describes the dorsal-fin origin as being immediately above the posterior nostril on the blind side. This character is variable in our specimens, the base of the first dorsal-fin ray being above either nostril or the space between them. According to Dutt & Rao (1965), *C. ventrocellata* has scales with very weak ctenii on the ocular side of the body and cycloid scales on the head and blind side. Kotthaus

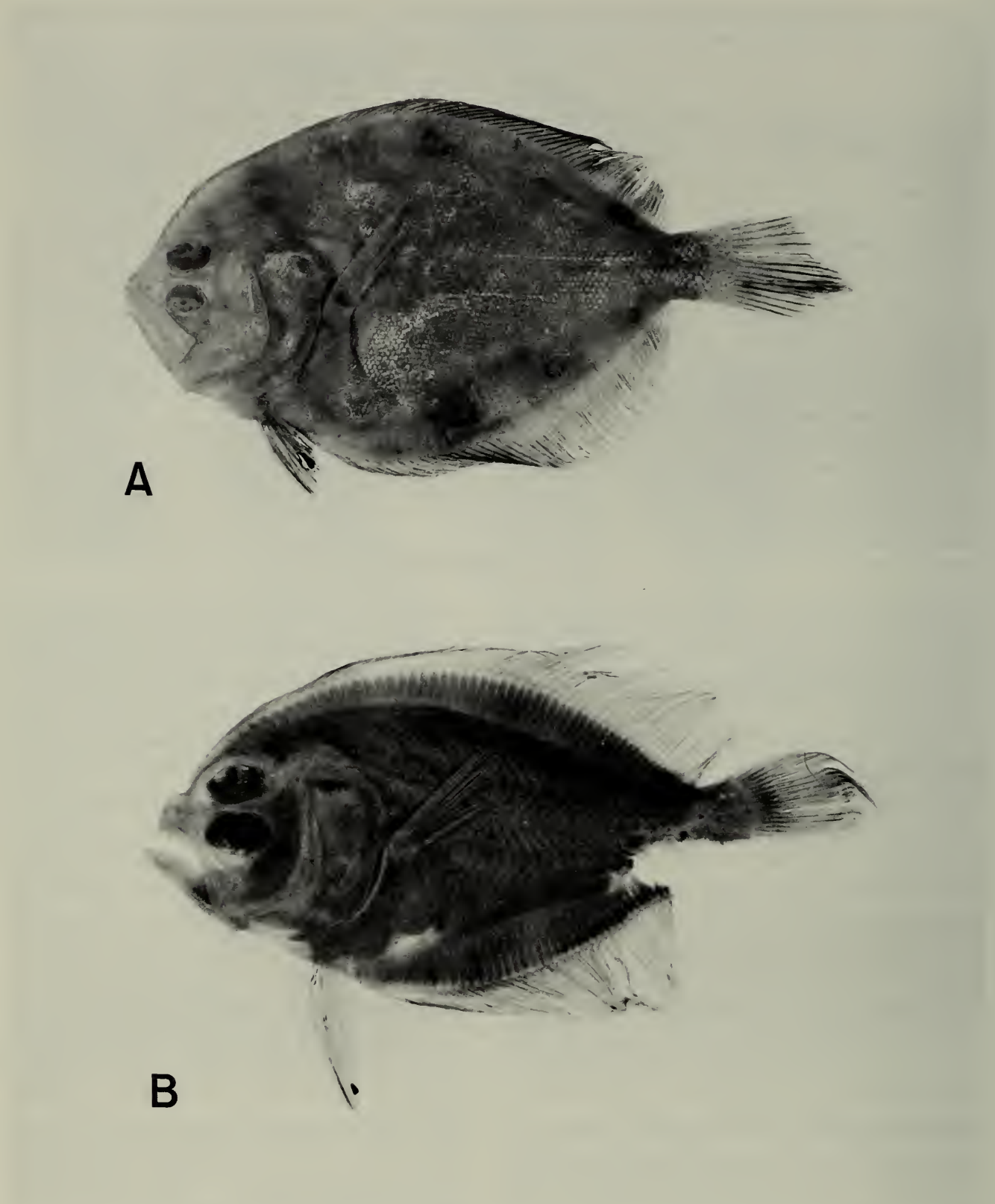

Fig. 4. *Cephalopsetta ventrocellata*: A, adult, ANSP 153379, 168.4 mm SL; B, juvenile, ANSP 153383, 66.0 mm SL.

(1977) expanded on this by saying the scales are covered by skin. Scales on the ocular side of our specimens are covered by skin with only their posterior edges visible. They appear to be cycloid except for some very small ctenii proximal to the exposed edges (Fig. 2C). The specimens we examined have the elongate left pelvic fin described by Dutt

Table 2.—Characters useful for distinguishing *Pseudorhombus megalops* and *Cephalopsetta ventrocellatus*.

	P. megalops	*C. ventrocellatus*
Standard length/head length	3.0–3.3	2.3–3.1 (usually 2.3–2.9)
Head length/length of pelvic fin of ocular side	3.0–4.2	1.4–2.3
Head length/snout length	3.9–4.5	4.7–5.9
Length of pelvic fin of ocular side/length of pelvic fin of blind side	0.8–0.9	1.2–1.8
Number of teeth on lower jaw on blind side	12–20	23–31
Morphology of lower-jaw teeth	Widely spaced, large canines anteriorly	Closely spaced, no large canines
Scales on ocular side	Well-developed ctenii	Feeble ctenii
Scales on blind side	Most ctenoid	Cycloid

& Rao (1965) and Kotthaus (1977). In addition, our specimens showed negative allometric growth of this fin ($v = 0.5492 \pm 0.1437$). Thus, our smallest specimen (66.0 mm SL) had a left-pelvic-fin length of 28.9% SL, specimens of 100.7–168.4 mm SL 16.8–22.2% SL, and a 207.5-mm-SL specimen 15.6% SL (Figs. 3C–E, 4).

The major characters used by Dutt & Rao (1965) to define *Cephalopsetta* are a large head (2.3–3.1 in SL) and an elongate left pelvic fin. *Ancylopsetta* Gill (western Atlantic and eastern Pacific) and *Gastropsetta* Bean (western Atlantic) also have the pelvic fin of the ocular side longer than that of the blind side, and were thus treated by Norman (1934) as being closely related and distinct from other paralichthyid genera. For the same reason Dutt and Rao considered *Cephalopsetta* closely related to *Ancylopsetta* and *Gastropsetta* and restricted their comparative statements to these genera.

Current knowledge of relationships within the Paralichthyidae was recently reviewed by Ahlstrom et al. (1984) and Hensley & Ahlstrom (1984). These authors regard *Cephalopsetta* as a member of the *Pseudorhombus* group (along with the Indo-Pacific genera *Pseudorhombus* and *Tarphops* Jordan & Thompson), a group they considered as probably monophyletic. *Ancylopsetta* and *Gastropsetta* were left in a group (referred to as the *Paralichthys* group) composed of *Paralichthys* Girard, *Hippoglossina* Steindachner, *Lioglossina* Gilbert, *Verecundum* Jordan, and *Xystreurys* Jordan & Gilbert; the authors could find no current evidence for monophyly of this group.

Much of the evidence Ahlstrom et al. (1984) and Hensley & Ahlstrom (1984) used for placing *Cephalopsetta* in the *Pseudorhombus* group and excluding *Ancylopsetta* and *Gastropsetta* involved caudal-fin structure. Species of the *Paralichthys* group have 18 caudal-fin rays, at least one free epural (except in one species of *Hippoglossina* [Sumida et al. 1979]), and a splinter ray on the base of the ventralmost caudal-fin ray (Fig. 5C). The splinter ray is probably a remnant of a ray lost through fusion with an adjacent ray (Okiyama 1974). Amaoka (1969) and Hensley & Ahlstrom (1984) considered these characters as probably being plesiomorphic. The *Pseudorhombus* group usually has 17 caudal-fin rays, the epural fused to the fifth hypural and no splinter ray (Fig. 5A–B). These authors regarded these characters as probably derived and indicative of monophyly.

Although we tentatively treat *Cephalopsetta* as a member of the *Pseudorhombus* group, it should be noted that Gutherz (1966) found that juveniles of *Ancylopsetta antillarum* Gutherz and *Gastropsetta frontalis* Bean have greater relative lengths of left pelvic fins than adults, a growth pattern similar to that seen in *C. ventrocellata*. However, other paralichthyids are known to have elongate left pelvic fins at some stage of development. Several species of what

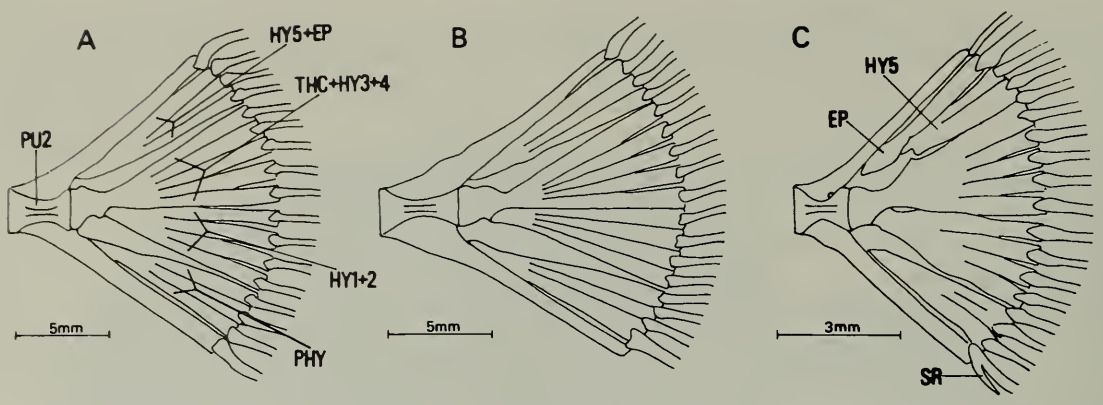

Fig. 5. Caudal skeletons: A, *Cephalopsetta ventrocellata,* ANSP 153379, 161.7 mm SL; B, *Pseudorhombus megalops,* HUMZ 111769, 146.5 mm SL; C, *Ancylopsetta quadrocellata,* FDNR 6115, 52.9 mm SL; abbreviations: EP = epural; HY 1–5 = hypurals 1–5; PHY = parhypural; PU2 = preural centrum 2; SR = splinter ray; THC = terminal half-centrum.

Ahlstrom et al. (1984) and Hensley & Ahlstrom (1984) called the *Cyclopsetta* group have elongate pelvic fin rays on the ocular side as larvae, while adults have short pelvic fins of approximately equal length (see Ahlstrom et al. 1984). Nielsen (1963) has shown that post-metamorphic individuals of at least one species of *Cyclopsetta* (named *Dorsopsetta norma* in Nielsen 1963) have elongate rays in the left pelvic fin. A more detailed comparative analysis of pelvic-fin growth patterns is needed before they can be used for phylogenetic inference.

Material examined.—Pseudorhombus megalops: Philippine Islands: USNM 93082, holotype, 152.0 mm SL; USNM 93550, paratypes, 2 specimens, 141.1–147.8; USNM 93551, 2, 131.8–136.4; USNM 93548, 2, 144.3–174.7; USNM 93549, 131.7. Indian Ocean (south coasts of Sumatra, Java, and Lombok): HUMZ 111768, 154.0; HUMZ 111769, 146.5; NTM 10760-006, 154.2. Bali Strait: NTM S.11022-002, 116.8. Arafura Sea: CSIRO CA2526, 129.8.

Cephalopsetta ventrocellata: Gulf of Oman: ANSP 153383, 66.0. India (west coast): ANSP 153379, 6, 100.7–168.4; ANSP 153380, 207.5; ANSP 153382, 102.4; Andaman Sea: ANSP 153381, 138.0.

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