

A Review of the Indo-West Pacific Sciaenid Genus *Panna* (Teleostei, Perciformes)

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Abstract A review of the Indo-West Pacific sciaenid genus, *Panna*, revealed *P. microdon* (Bleeker), formerly thought to be widespread in the Indo-West Pacific, to be restricted to the Western Pacific. *P. heterolepis* Trewavas, formerly known only from the holotype from Calcutta, was resurrected as the sole representative of the genus in the Indian Ocean, where it had long been misidentified as *P. microdon*. *Sciaenoides perarmatus* Chabanaud, transferred to *Otolithoides* by Trewavas (1977), was recognized as the third species of *Panna*.

Mohan (1969) proposed *Panna* as a new, monotypic Indo-West Pacific sciaenid genus, characterized primarily by having a swimbladder with a pair of tubular appendages arising anteriorly and immediately dividing into cephalic and abdominal portions. The type species of the genus, *Otolithus microdon* Bleeker, 1849 (type locality: Java), was believed to occur from Java westward to India. Subsequently, Trewavas (1977) described *Panna heterolepis*, based only on the small, apparently juvenile holotype (52 mm SL) from Calcutta. However, the validity of the species has been uncertain because of the lack of comparisons with juvenile *P. microdon*.

Following the examination of a number of specimens from the Bay of Bengal, at first identified as *Panna microdon*, it was realized that all of the diagnostic characters provided by Trewavas (1977) were simply reflections of the small size of the holotype and thus invalid for species separation, leading to the initial conclusion that *P. heterolepis* was a junior synonym of *P. microdon*. However, examination of juvenile specimens of the genus from Malaysia and Thailand revealed that they differed significantly from those from the Bay of Bengal in two juvenile characters: pattern of head spination and scale condition. This led to further comparisons of specimens on a broader geographic basis, resulting in the confirmation of two species of *Panna*: *P. microdon* in the Western Pacific and *P. heterolepis* in the Indian Ocean.

Trewavas (1977) placed *Sciaenoides perarmatus* Chabanaud, 1926 (type locality: Gulf of Thailand,

Viet Nam), in *Otolithoides*, based only on external characters of the type material. The finding of non-type material made possible an examination of the swimbladder and otolith, resulting in the transfer of the species from *Otolithoides* to *Panna*.

Counts and measurements follow Sasaki and Kailola (1988). Institutional abbreviations follow Leviton et al. (1985). Standard length and head length are expressed as SL and HL, respectively.

Genus *Panna* Mohan

Panna Mohan, 1969: 296 (type species by original designation: *Otolithus microdon* Bleeker, 1849).

Diagnosis. A genus of Sciaenidae with the following combination of characters: swimbladder with a pair of tube-like appendages arising anteriorly, each appendage immediately dividing into a simple abdominal portion and a simple or branched cephalic portion; cephalic portion entering head beyond septum transversum; sulcus tail of sagitta sharply curved.

Panna microdon (Bleeker) (Figs. 1-4, 6)

Otolithus microdon Bleeker, 1849: 10 (type locality: Madura, Java).

Otolithoides microdon: Weber and de Beaufort, 1936: 503, fig. 97.

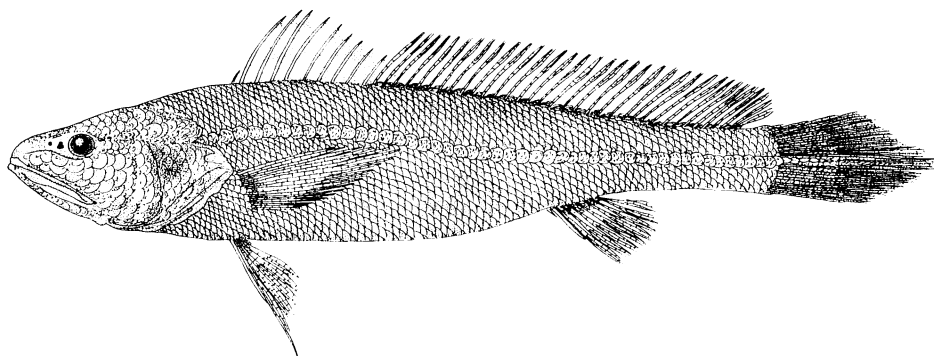


Fig. 1. *Panna microdon*, BSKU 81973, 250.0 mm SL.

Panna microdon: Trewavas, 1977: 306 (in part; Madura, Singapore, Borneo).

Material examined. *Syntypes*.—BMNH 1880.4.21.134–135, (2 specimens), 193.4–238.2 mm SL, RMNH 5978, (6), 178.3–218.5 mm SL, Madura, Java. *Other material*.—ANSP 76865, 188.0 mm SL, Saigon, Dec. 1934, H. Rutherford; ANSP 89609, (2), 169.6–177.0 mm SL, Tachin, Thailand, 1936, R. M. deSchauensee; BSKU 81971, 29.9 mm SL, Perak, Matang, Malaysia, mangrove forest, Y. Suzawa, 9 Sept. 1993; BSKU 81972, 273.2 mm SL, BSKU 81973, 250.0 mm SL, Surabaya, Indonesia, Y. Machida, 19 Feb. 1985; USNM 11967, (2), 37.9–45.7 mm SL, Bangpakong River, Central Thailand, 26 June 1933, H. M. Smith; USNM 324584, 58.1 mm SL, Bangpakong River, Central Thailand, 27 June 1933, H. M. Smith.

Diagnosis. A species of *Panna* with the following combination of characters: dorsal fin rays IX–X (usually X), 33–36; gill rakers 5–6+1+9–11; head length 27.1–34.4% SL; snout length 6.9–8.5% SL (24.0–28.8% HL); interorbital width 6.8–9.5% SL (23.0–28.9% HL); second anal fin spine length 4.7–12.0% SL (16.1–35.0% HL); one or two spines on supraorbital ridge of frontal in juveniles (up to 50 mm SL); transition from cycloid to ctenoid scales initiated at around 30 mm SL; all body scales, except on throat, ctenoid over 60 mm SL; scales absent on soft parts of dorsal and anal fins; lateral line scales covered with small, subsidiary scales; cephalic portion of swimbladder appendage terminating on carotid foramen of cranium.

Description. Dorsal fin rays IX–X (usually X), 33–36; anal fin rays II, 6–7; pectoral fin rays 18–21; lateral line scales 48–55; scales above lateral line 13–17, below lateral line 16–23; gill rakers 5–6+1+9–11; vertebrae 11+14, last well-developed pleural rib on 11th vertebra, first anal proximal radial between

12th and 13th vertebrae. Proportions as % SL (data on 29.9–58.1 mm SL specimens first, those on 169.6–273.2 mm SL specimens in parentheses): head length 30.5–34.8 (27.1–30.5); body depth 22.7–26.7 (19.0–23.4); body width 11.0–13.7 (10.2–15.0); caudal peduncle length 22.7–24.9 (21.7–24.8); caudal peduncle depth 6.2–7.4 (5.2–6.8); snout length 7.4–8.5 (6.9–8.3); eye diameter 5.5–6.7 (3.7–4.9); interorbital width 8.8–10.4 (6.8–8.1); upper jaw length 14.4–16.2 (11.3–12.3); lower jaw length 15.8–18.1 (13.4–14.7); pectoral fin length 21.0–23.7 (19.7–22.7); pelvic fin length 18.1–23.1 (13.0–15.2); second dorsal fin spine length 10.3–10.7 (9.1–10.3); third dorsal fin spine length 10.7 (10.5–12.7); fourth dorsal fin spine length 9.7–12.0 (8.6–10.9); fifth dorsal fin spine length 8.4–10.7 (4.7–9.2); second anal fin spine length 9.5–14.4 (10.7–12.3); gill raker length 4.0–5.4 (1.8–2.9); gill filament length 4.6–5.0 (2.7–4.1). Proportions as % HL (specimen order as above): snout length 21.2–24.9 (24.8–28.8); eye diameter 17.2–19.8 (12.7–16.3); interorbital width 25.5–31.7 (23.0–27.5); upper jaw length 42.0–49.6 (38.7–42.7); lower jaw length 47.8–53.7 (46.2–49.6); second anal fin spine length 31.1–41.3 (16.1–23.1); gill raker length 12.5–16.5 (6.1–9.8); gill filament length 13.4–15.8 (9.8–13.8). Proportions as % eye diameter (specimen order as above): gill raker length 65.0–83.3 (44.1–66.2); gill filament length 31.1–41.3 (61.5–92.5).

Body slender, cylindrical; snout long, pointed, equal to interorbital width. Snout pores three upper and five marginal, outer pair of marginal pores in a slight notch. Mental pores three pairs, anterior pair small, at front of chin separated by symphysis.

Mouth terminal, strongly (ca. 45° in young) to moderately (ca. 30° in adults) oblique; maxillary extending backward below or slightly beyond poste-

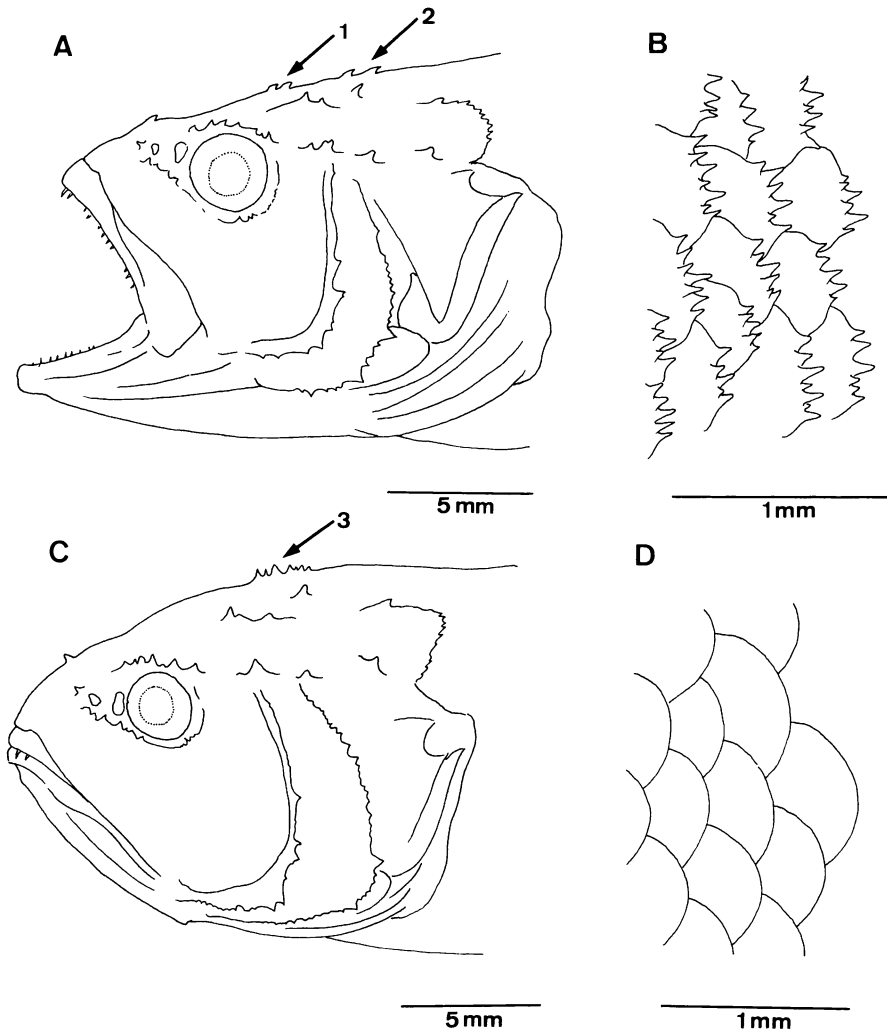


Fig. 2. Head and scales on nape of juvenile *Panna microdon* (A and B; USNM 119679, 45.7 mm SL) and *P. heterolepis* (C and D; BSKU 81967, 49.8 mm SL). Arrow 1—spines on supraorbital ridge; Arrows 2 and 3—spines on supraoccipital crest.

rior margin of eye.

Upper jaw with an outer row of well-spaced, enlarged teeth and an inner, narrow band of small, conical teeth, comprising 2 or 3 anterior rows, 5 or 6 posterior rows; anterior second or second and third enlarged teeth exposed upon lower lip when mouth closed. Lower jaw with an outer row of small, conical teeth and an inner row of enlarged teeth.

Eye small, diameter about half interorbital width. Anterior and posterior nostrils semicircular. Gill rakers slender, equal to or longer than gill filaments in young, slightly shorter than filaments adjacent to angle of gill arch in adults.

Head spine(s) (Fig. 2A) present (in specimens of 30 to 58 mm SL) on: ethmoid (1 spine), nasal (1), orbital edge of infraorbitals (jagged pattern), outer margin of frontal above eye (jagged pattern), supraorbital ridge of frontal (1 or 2), sphenotic-pterotic ridge (upper 2 or 3 and lower 2 or 3), parietal (1), supraoccipital crest (2 spines or weakly jagged pattern), posttemporal (upper 1 and lower 1 or 2), and inner and outer preopercular margins (jagged pattern, 2 spines at angle of outer margin sharp, pungent).

Scale condition varies with growth. At 30 mm SL, scales mostly cycloid, except for a few scales on nape

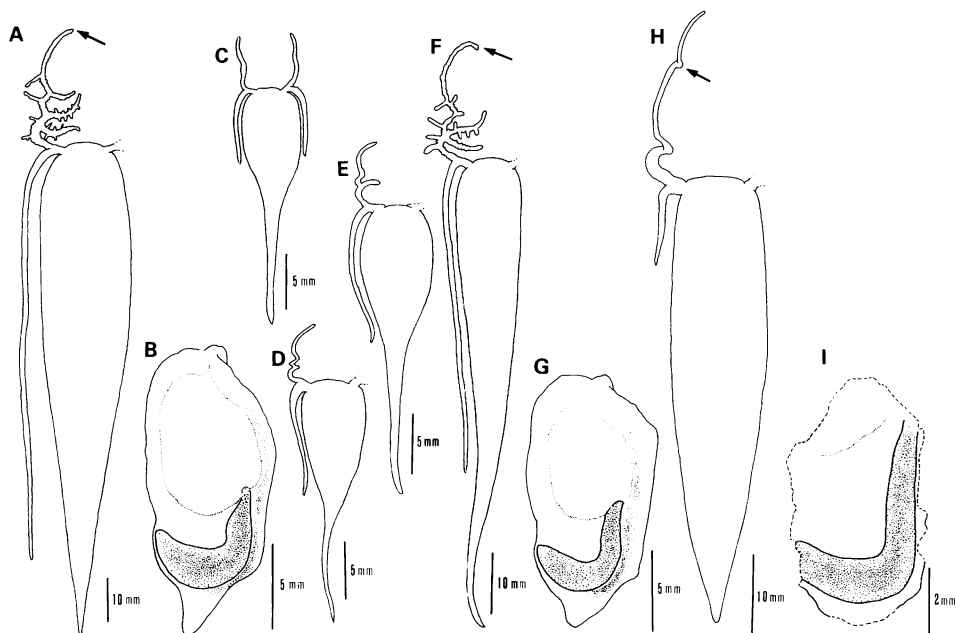


Fig. 3. Swimbladders and sagittae in 3 species of *Panna*. A) and B) *P. microdon*; BSKU 81972, 273.2 mm SL; C)–G) *P. heterolepis* (note growth changes of swimbladder appendages); C) BSKU 81968, 47.1 mm SL; D) BSKU 81969, 51.6 mm SL; E) BSKU 81970, 61.0 mm SL; F) and G) USNM 28879, 185.6 mm SL; H) and I) *P. perarmatus*; USNM 325509, 162.5 mm SL. Arrows indicate location of carotid foramen.

with 1 or 2 strong ctenii and those on lower part of caudal peduncle with several ctenii; at 37 mm SL, scales mostly cycloid, except for those on nape with 4 or 5 strong ctenii and on lower part of caudal peduncle with numerous ctenii; at 46 mm SL, scales on head, throat and middle of flanks cycloid, elsewhere ctenoid, those on nape with 4 to 8 strong ctenii (Fig. 2B); at 58 mm SL, scales on head and throat cycloid, elsewhere ctenoid, those on nape with 4 to 8 strong ctenii; at 170 mm SL and larger, scales on head and throat cycloid, those on body all usually ctenoid. No scales on soft parts of dorsal and anal fins, except on basal 2 or 3 rows. Lateral line scales larger than other body scales and covered with small, subsidiary scales.

Pectoral fins about 1.5 times longer than pelvic fins; first soft ray of pelvic fins with short filament. Second anal fin spine slender, its length about half of first anal fin soft ray. Caudal fin pointed.

Swimbladder (Fig. 3A) with tubular appendage anteriorly on each side, immediately dividing into a long, simple abdominal portion and a simple (in young) or branched (in adults) cephalic portion; anterior end of cephalic portion terminating on ca-

rotid foramen (refer Sasaki, 1989: fig. 72C). Sagitta (Fig. 3B) elongate with notched anterior rim and pointed, triangular posterior rim; sulcus head pear-shaped, sulcus tail sharply curved at about 90°.

Colour in alcohol.—Body brownish-gray on back and flanks, creamy-white below. Mouth lining pale; lining of gill cavity spotted with dark brown melanophores. Dorsal and caudal fins dusky, other fins pale.

Colour when fresh.—Body grayish above, silvery below; opercle with a bluish spot above; paired fins yellowish, median fins dusky, spinous dorsal blackish (Weber and de Beaufort, 1936).

Distribution. Although this species has been regarded as widespread, extending from Java west to India, it is restricted to the Western Pacific (see remarks under *Panna heterolepis*), the most westerly, confirmed record being from Perak, Malaysia (ca. 101°E). Elsewhere it occurs in Viet Nam, Gulf of Thailand (including rivers in Thailand), Borneo, eastern coasts of Sumatra and Java (Fig. 4). Because all four juvenile specimens were captured in rivers and estuaries, it is inferred that the species utilizes these habitats as a nursery ground.

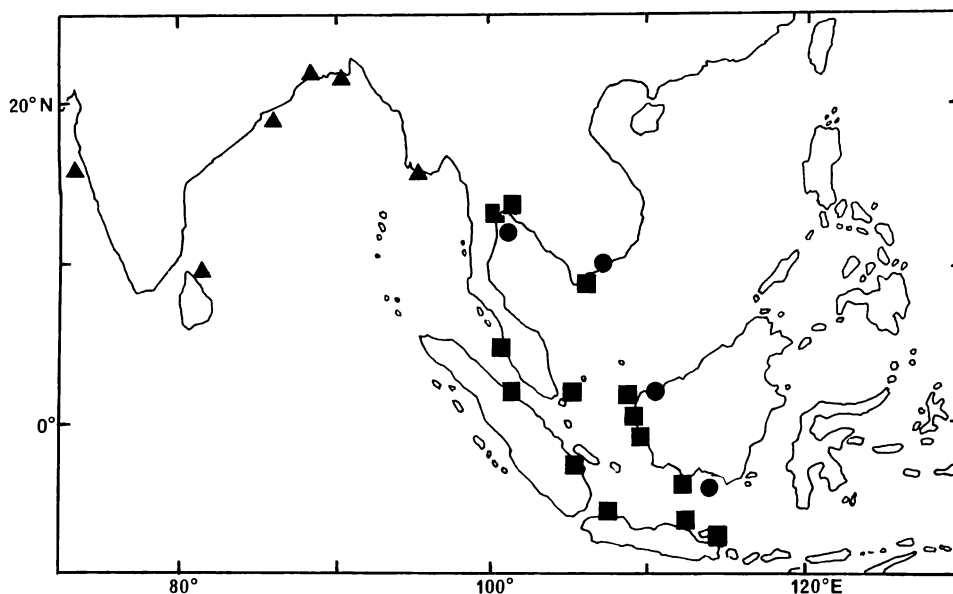


Fig. 4. Distribution of 3 species of *Panna*. ■, *P. microdon*; ▲, *P. heterolepis*; ●, *P. perarmatus*.

***Panna heterolepis* Trewavas**
(Figs. 2–6)

Sciaenoides microdon (not of Bleeker, 1849): Day, 1876: 194, pl. 45, fig. 2 (Bombay, Orissa).

Panna microdon (not of Bleeker, 1849): Mohan, 1969: 296, fig. 1C (India); Trewavas, 1977: 306 (in part); Mohan, 1983; SCIAEN Pan 1 (India); Sasaki, 1989: 6, figs. 9B, 22E, 60H, 71D (Bangladesh).

Panna heterolepis Trewavas, 1977: 308, fig. 6 (type locality: Calcutta).

Material examined. *Holotype*.—BMNH 1889.2.1.3137, 51.9 mm SL, Calcutta, F. Day. *Other material*.—BSKU 81966, 104.9 mm SL, BSKU 81967, 49.8 mm SL, BSKU 81968, 47.1 mm SL, BSKU 81969, 51.6 mm SL, BSKU 81970, 61.0 mm SL, Burma, 15°20'N, 96°24'E, off mouths of Irrawaddy, 26–27 m, 31 Mar. 1963, R/V *Anton Bruun*; USNM 28879, (14 specimens), 162.2–213.8 mm SL, Bangladesh; USNM 324164, (6), 64.7–103.2, Bangladesh, 21°43'N, 91°33'E, 15 m, 4 Apr. 1963, R/V *Anton Bruun*; USNM 324182, (32), 85.1–102.5 mm SL, Bangladesh, 21°52'N, 91°36'E, 11 m, 4 Apr. 1963, R/V *Anton Bruun*; USNM 324205, (1), 133.7 mm SL, USNM 324571, (4), 148.6–205.3 mm SL, Sri Lanka, Myliddy near Kankesanthurai, 18–19 Mar. 1970, T. Roberts; USNM 324552, (150+, 10 examined), 47.0–64.6 mm SL, data as for BSKU 81966; USNM 324553, (122, 10 examined), 107.2–137.6 mm SL, Bangladesh, 21°32'N, 91°29'E, 11 m, 4 Apr. 1963, R/V *Anton Bruun*.

Diagnosis. A species of *Panna* with the following combination of characters: dorsal fin rays VIII–X

(usually IX), 32–37; gill rakers 6–8 + 1 + 11–15; head length 28.2–34.7% SL; snout length 7.9–10.5% SL (23.8–31.5% HL); interorbital width 7.3–13.6% SL (25.0–40.6% HL); second anal spine length 6.0–13.8% SL (19.3–41.1% HL); spines absent on supra-orbital ridge of frontal in juveniles; transition from cycloid to ctenoid scales initiated at around 120 mm SL; all body scales, except on throat, ctenoid over 200 mm SL; scales absent on soft parts of dorsal and anal fins; lateral line scales covered with small, subsidiary scales; cephalic portion of swimbladder appendage terminating on carotid foramen of cranium.

Description. Dorsal fin rays VIII–X (usually IX), 32–37; anal fin rays II, 6–7; pectoral fin rays 18–21; lateral line scales 47–51; scales above lateral line 12–17, below lateral line 14–22; gill rakers 6–8 + 1 + 11–15; vertebrae 10 + 15 or 11 + 14, last well-developed pleural rib on 11th or 12th vertebra, first anal proximal radial between 12th and 13th vertebrae. Proportions as % SL (data on 47.0–99.9 mm SL specimens first, those on 101.3–213.8 mm SL specimens in parentheses): head length 30.8–34.7 (28.2–32.0); body depth 22.7–27.6 (19.5–24.9); body width 10.6–15.3 (11.0–15.7); caudal peduncle length 23.6–28.0 (22.5–27.9); caudal peduncle depth 8.0–11.9 (7.0–11.6); snout length 7.9–10.5 (7.9–9.3); eye diameter 4.1–5.4 (3.6–5.0); interorbital width 9.4–13.6 (7.3–10.0); upper jaw length 14.7–17.7 (11.9–15.0);

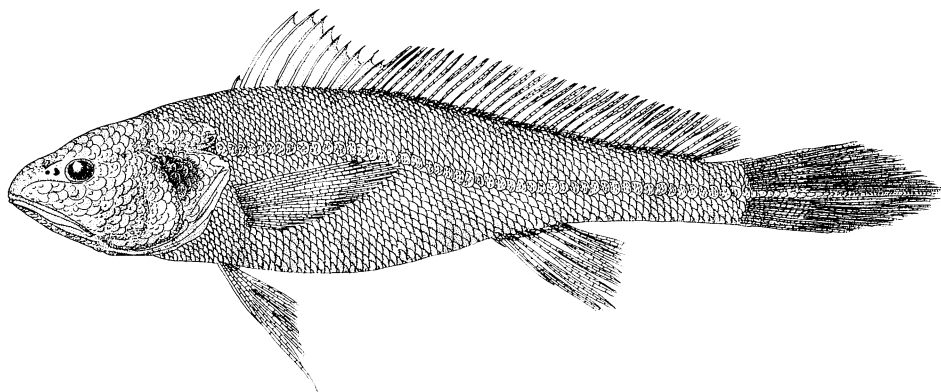


Fig. 5. *Panna heterolepis*, BSKU 81966, 104.9 mm SL.

lower jaw length 16.3–18.9 (14.7–16.6); pectoral fin length 21.1–27.2 (17.1–25.0); pelvic fin length 16.1–22.1 (15.1–18.7); second dorsal fin spine length 9.8–12.0 (8.7–9.9); third dorsal fin spine length 12.1–13.5 (9.6–13.2); fourth dorsal fin spine length 9.5–12.1 (8.0–11.8); fifth dorsal fin spine length 9.5–10.0 (6.9–11.2); second anal fin spine length 8.5–13.8 (6.0–10.3); gill raker length 3.5–6.0 (2.5–4.3); gill filament length 2.1–4.6 (2.7–4.1). Proportions as % HL (specimen order as above): snout length 23.8–31.5 (26.0–30.0); eye diameter 12.8–16.4 (11.7–16.7); interorbital width 30.0–40.6 (25.0–32.6); upper jaw length 44.4–53.2 (40.7–50.0); lower jaw length 51.7–56.3 (49.8–55.7); second anal fin spine length 27.0–41.1 (19.3–33.8); gill raker length 11.1–17.7 (8.3–14.1); gill filament length 8.7–14.1 (8.5–13.4). Proportions as % eye diameter (specimen order as above): gill raker length 75.0–122.7 (58.1–100.0); gill filament length 59.5–95.5 (58.7–95.9).

Body slender, cylindrical; snout long, pointed, equal to interorbital width. Snout pores three upper and five marginal, outer pair of marginal pores in a slight notch. Mental pores three pairs, anterior pair small, at front of chin separated by symphysis.

Mouth terminal, strongly (45° to 50° in young) to moderately (20° to 30° in adults) oblique; maxillary extending backward below or slightly beyond posterior margin of eye.

Upper jaw with an outer row of well-spaced, enlarged teeth and an inner, narrow band of small, conical teeth, comprising 2 to 4 anterior rows, 6 to 8 posterior rows; anterior second and third enlarged teeth exposed upon lower lip when mouth closed. Lower jaw with an outer row of small, conical teeth and an inner row of enlarged teeth.

Eye small, diameter about half interorbital width.

Anterior nostril semicircular, posterior nostril oblong. Gill rakers slender, generally longer than gill filaments in young, equal to or shorter than filaments adjacent to angle of gill arch in adults (Fig. 6).

Head spine(s) (Fig. 2C) present (up to about 100 mm SL) on: ethmoid (1 spine), nasal (1), orbital edge of infraorbitals (jagged pattern), outer margin of frontal above eye (jagged pattern), sphenotic-pterotic ridge (upper 2 or 3 and lower 2 or 3), parietal (1), supraoccipital crest (jagged pattern), posttemporal (upper 1 or 2 and lower 1 or 2), and inner and outer preopercular margins (jagged pattern); 2 spines at angle of outer margin sharp, pungent).

Scale condition varies with growth. The largest specimen with only cycloid scales was 138 mm SL; the smallest specimen with ctenoid scales was 123 mm SL, scales on nape and lower part of caudal peduncle being ctenoid, elsewhere cycloid; at 205 mm SL and larger, scales on head and throat cycloid, elsewhere ctenoid. No strong ctenii develop throughout ontogeny. No scales on soft parts of dorsal and anal fins, except on basal two or three rows. Lateral line scales larger than other body scales and covered with small, subsidiary scales.

Pectoral fins about 1.5 times longer than pelvic fins; first soft ray of pelvic fins with short filament. Second anal fin spine slender, its length about half of first anal fin soft ray. Caudal fin pointed.

Swimbladder (Fig. 3C–F) with tubular appendage anteriorly on each side, immediately dividing into a long, simple abdominal portion and a simple (in young; Fig. 3C–E) or branched (in adults; Fig. 3F) cephalic portion; anterior end of cephalic portion terminating on carotid foramen (refer Sasaki, 1989: fig. 72C). Sagitta (Fig. 3G) elongate with notched

anterior rim and pointed, triangular posterior rim; sulcus head pear-shaped, sulcus tail sharply curved at about 90°.

Colour in alcohol.—Body light brown. Mouth lining pale; lining of gill cavity spotted with a few, dark brown melanophores. Dorsal fin dusky, spinous portion blackish; pectoral, pelvic and anal fins pale; caudal fin dark brown, progressively darker posteriorly.

Colour when fresh.—Body brown, becoming paler on flanks and belly; fins yellow, dorsal and anal fins with darker margin (Mohan, 1983).

Distribution. Coasts of Burma, Bangladesh, India, and Sri Lanka (Fig. 4). Material from the west coast of India (Bombay) (Day, 1876) (not seen by me) was characterized by 9 dorsal fin spines and possession of cycloid body scales at about 75 mm SL. Due to the lack of material from the west coast of the Malay Peninsula along 6° to 16°N, it is unknown whether the two species are allopatric or partially sympatric.

Remarks. Trewavas (1977) described *Panna*

heterolepis from a single, small (52 mm SL) specimen from Calcutta, differentiating it from *P. microdon* (Bleeker) by the following characters: mouth angle very oblique (vs less oblique), 7+1+15 gill rakers (vs 5+1+10) and cycloid scales (vs ctenoid). However, because the smallest available specimen of *P. microdon* (from Borneo) at that time measured 126 mm SL, the validity of the above characters was questionable on the basis of ontogeny. The increased number of specimens available for the present study made possible a re-evaluation of the identity of *P. heterolepis*.

Trewavas (1977) was correct in considering gill raker counts and scale condition to be diagnostic for *Panna heterolepis*. However, these characters, along with the mouth angle, vary with growth, necessitating a modification of the species' diagnosis. At the same time, the analyses of ontogenetic changes demonstrated that *P. microdon* and *P. heterolepis* replace each other geographically.

Trewavas (1977) gave the distribution of *Panna microdon* as "Coasts of India, Burma, Malay Peninsula, Sumatra and eastwards to Borneo and Vietnam." However, *P. microdon* is here considered to

Table 1. Frequency distribution of upper and lower gill raker counts in *Panna microdon* and *P. heterolepis*. Statistical significance ($p < 0.05$) of differences for each size class evaluated by Mann-Whitney U-test. n.c., no comparisons; n.s., not significant

Size class (mm SL)	Upper gill rakers					Lower gill rakers							
	5	6	7	8	(<i>p</i>) \bar{x}	9	10	11	12	13	14	15	(<i>p</i>) \bar{x}
< 50.0	($p < 0.005$)					($p < 0.005$)							
<i>P. microdon</i>	1	2	—	—	5.7	1	—	2	—	—	—	—	10.3
<i>P. heterolepis</i>	—	1	12	2	7.1	—	—	—	—	4	8	3	13.9
50.0–99.9	(n.s.)					(n.s.)							
<i>P. microdon</i>	1	—	—	—	5.0	—	1	—	—	—	—	—	10.0
<i>P. heterolepis</i>	—	2	60	—	7.0	—	—	4	21	25	8	4	12.8
100.0–149.9	(n.c.)					(n.c.)							
<i>P. microdon</i>	—	—	—	—	—	—	—	—	—	—	—	—	—
<i>P. heterolepis</i>	—	3	44	1	7.0	—	—	2	28	16	2	—	12.4
150.0–199.9	($p < 0.001$)					($0.01 < p < 0.025$)							
<i>P. microdon</i>	7	1	—	—	5.1	2	5	1	—	—	—	—	9.9
<i>P. heterolepis</i>	—	5	3	—	6.4	—	2	5	1	—	—	—	10.9
200.0–249.9	($0.01 < p < 0.025$)					($p = 0.01$)							
<i>P. microdon</i>	2	1	—	—	5.3	—	3	—	—	—	—	—	10.0
<i>P. heterolepis</i>	—	2	6	—	6.8	—	—	4	4	—	—	—	11.5
250.0+	(n.c.)					(n.c.)							
<i>P. microdon</i>	2	—	—	—	5.0	2	—	—	—	—	—	—	9.0
<i>P. heterolepis</i>	—	—	—	—	—	—	—	—	—	—	—	—	—

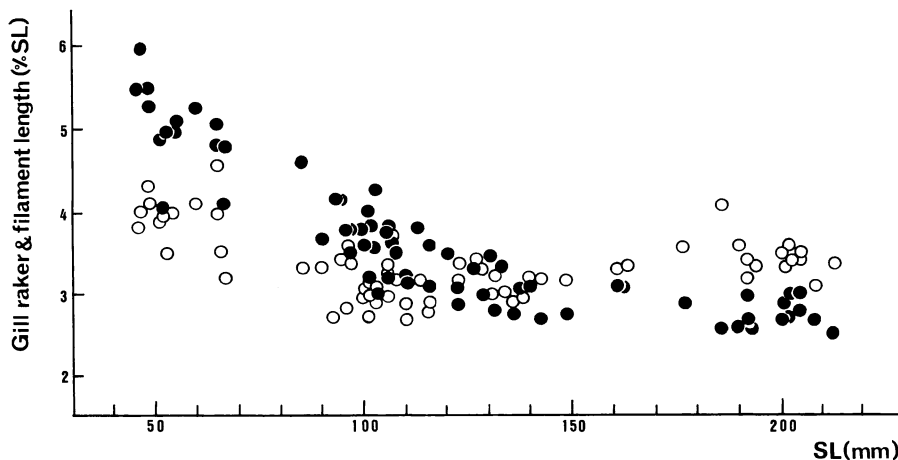


Fig. 6. Relationship between gill raker and filament length versus standard length in *Panna heterolepis*. ●, gill raker length; ○, gill filament length.

be restricted to the Western Pacific as the “*P. microdon*” of India is *P. heterolepis*. This geographic division and subsequent analysis of specimens revealed four characters that supported the recognition of two, geographically replaced species. Table 1 shows the number of gill rakers in the groups of specimens from the Bay of Bengal (*P. heterolepis*) and the Western Pacific (*P. microdon*). Specimens were also grouped into six size classes at intervals of 50 mm so that growth changes can be compared (see below). In the size classes where comparisons were possible (all, except for 100.0–149.9 mm SL class), the Western Pacific specimens had significantly fewer numbers of gill rakers in both upper and lower limbs compared with those from the Bay of Bengal.

Trewavas (1977) diagnosed *P. heterolepis* as having 7+1+15 gill rakers. That count, however, reflected the small size of the holotype. As shown in Table 1, a decrease in gill raker number on the lower limb with growth is evident in *P. heterolepis* (<50.0 mm SL vs 50.0–99.9, $p < 0.001$; 50.0–99.9 vs 100.0–149.9, $0.02 < p < 0.05$; 100.0–149.9 vs 150.0–199.9, $p < 0.001$; Mann-Whitney U-test). Hence Trewavas’ diagnosis is here modified to 6–8+1+11–15 gill rakers. Although there is a partial overlap between the two species, the counts can be useful for their separation, especially when the standard lengths of the specimens concerned are considered.

The decrease in gill raker numbers is probably related to the negative allometry of gill raker lengths (Fig. 6; $r = -0.724$, $n = 68$, $p < 0.01$). Gill rakers were generally longer than the filaments in specimens less than 100 mm SL. However, gill rakers become

shorter than the filaments in specimens more than 150 mm SL. Subsequently, the lowermost 1 to 3, shortened gill rakers transform into flat, denticulate plates. Because, following Trewavas (1977) and Sasaki and Kailola (1988), such plates are excluded from gill raker counts, a decrease in gill raker numbers results. To include such plates in the counts is unwise, since fusion of the former apparently occurs (judging from an elongate plate frequently observed immediately in front of the lowermost, short gill raker). It is possible that the relatively long gill rakers are functional for feeding upon planktonic organisms during the juvenile and young stages, their gradual decrease in length accompanying a transition to a diet of benthic organisms.

Head spination also changes with ontogeny. Various kinds and numbers of spines tend to develop on the head of sciaenid larvae and juveniles (including juveniles of *Panna*), although little is known about the distribution of these features within the family. Yamada (1973) showed that differences in head spination could be used to separate two pairs of very similar species—*Larimichthys crocea* and *L. manchurica*, and *Collichthys lucidus* and *C. niveatus*. Similarly, *P. microdon* and *P. heterolepis* are distinguished by their head spination: one or two spines are present on the supraorbital ridge of the frontal in *P. microdon* (Fig. 2A, Arrow 1), and are absent in *P. heterolepis* (Fig. 2C). Although the upper edge of the supraoccipital crest tends to develop two spines or is weakly jagged in *P. microdon* (Fig. 2A, Arrow 2), compared with the strongly jagged pattern in *P. heterolepis* (Fig. 2C, Arrow 3), it is unwise to apply

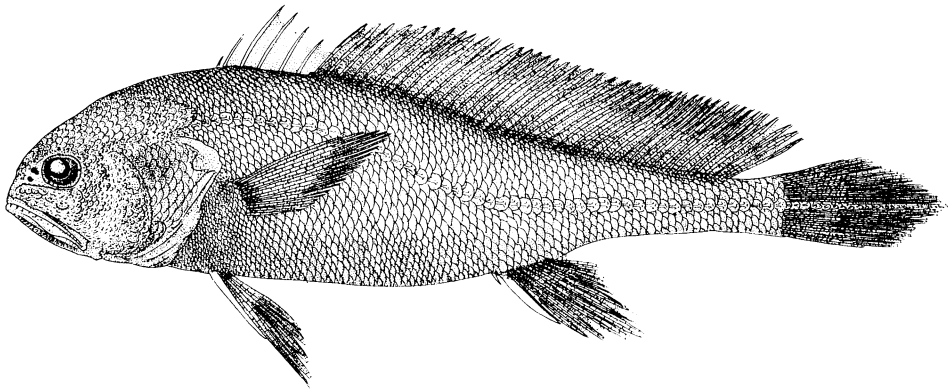


Fig. 7. *Panna perarmatus*, USNM 325509, 162.5 mm SL.

this character until variation in *P. microdon* is better understood.

The timing of the transition in scale type from cycloid to ctenoid differs significantly between *P. microdon* (early) and *P. heterolepis* (late). In the former, such a transition is initiated at small size, ctenoid scales already being present on the nape and lower part of caudal peduncle at 30 mm SL, and completed at around 60 mm SL. On the other hand, in *P. heterolepis* it is initiated at around 120 mm SL and completed at around 200 mm SL. Although Trewavas (1977) included "cycloid scales" in the diagnosis of *P. heterolepis*, such is valid only in specimens up to about 120 mm SL.

Lastly, the number of dorsal fin spines was modally 10 ($\bar{x}=9.8$) in *P. microdon*, but 9 ($\bar{x}=9$) in *P. heterolepis* ($p < 0.001$, Mann-Whitney U-test).

Mohan (1969) proposed *Panna* as a new genus to accommodate *Otolithus microdon* Bleeker, designating it as the type species. In itself, this action was correct. However, Mohan's diagnosis of the genus was based on his misidentification of the then undescribed *P. heterolepis* as *P. microdon*. This does not fall into the category "Misidentified type species," as defined by Art. 70 (b) (I.C.Z.N. 1985), because Mohan simply misidentified his specimens, and consequently nomenclatural problems do not arise. Because *P. microdon* and *P. heterolepis* share identical morphology of the swimbladder and otolith, the diagnosis of the genus is unaffected.

Panna perarmatus (Chabanaud)
(Figs. 3, 4, 7)

Sciaenoides perarmatus Chabanaud, 1926: 266 (type locali-

ty: Gulf of Thailand and Viet Nam).

Panna perarmata: Weber and de Beaufort, 1936: 498, fig. 101 (Kumai, Borneo).

Otolithoides perarmatus: Trewavas, 1977: 304 (on types).

Material examined. *Syntypes*.—MNHN 8998, (1 specimen), 177.6 mm SL, MNHN A.4214, (4), 151.2–183.4 mm SL, MNHN A.42125, (1), 439.6 mm SL, Viet Nam, July 1874. *Other material*.—USNM 325509, (1), 162.5 mm SL, Sarawak, Borneo, 31 May 1967, W. C. Hai.

Diagnosis. A species of *Panna* with the following combination of characters: dorsal fin rays VI–VII, 42–44; gill rakers 7+1+12–14; head length 23.2–27.3% SL; snout length 5.2–6.3% SL (21.0–24.2% HL); interorbital width 7.2–9.1% SL (30.5–36.7% HL); second anal fin spine length 10.2–11.5% SL (37.2–45.8% HL); scales cycloid on head, ctenoid on body (juvenile condition and transition period unknown); soft parts of dorsal and anal fins with small cycloid scales; lateral line scales without subsidiary scales; cephalic portion of swimbladder appendage extending to level of palate passing over carotid foramen.

Description. Dorsal fin rays VI–VII, 42–44; anal fin rays II, 7–8; pectoral fin rays 19–20; lateral line scales 48–52; scales above lateral line 12–13, below lateral line 12–14; gill rakers 7+1+12–14; vertebrae 12+13, last well-developed pleural rib on 12th vertebra, first anal proximal radial between 13th and 14th vertebrae. Proportions as % SL (data on 151–184 mm SL specimens first, those on 440 mm SL specimen in parentheses): head length 24.9–27.3 (23.2); body depth 24.1–26.3 (22.8); body width 8.4–10.8 (10.4); caudal peduncle length 26.8–31.1 (30.9); caudal peduncle depth 5.3–6.2 (5.1); snout

length 5.5–6.3 (5.2); eye diameter 4.6–6.0 (3.3); interorbital width 8.0–9.1 (7.2); upper jaw length 12.5–13.7 (11.1); lower jaw length 12.9 (13.9–14.5); pectoral fin length 16.4–22.8 (19.7); pelvic fin length 16.1–19.1 (15.8); second dorsal fin spine length 8.5 (spine broken); third dorsal fin spine length 9.0–9.9 (spine broken); fourth dorsal fin spine length 8.4–8.6 (spine broken); fifth dorsal fin spine length 7.4–7.7 (spine broken); second anal fin spine length 10.2–11.5 (10.6); gill raker length 3.1–3.5 (2.8); gill filament length 2.7–3.5 (2.6). Proportions as % HL (specimen order as above): snout length 21.0–24.2 (22.2); eye diameter 18.2–23.5 (14.3); interorbital width 30.5–36.7 (30.8); upper jaw length 49.2–51.8 (47.9); lower jaw length 52.1–56.3 (55.4); second anal fin spine length 37.2–44.0 (45.8); gill raker length 11.3–14.0 (12.2); gill filament length 10.2–13.6 (11.2). Proportions as % eye diameter (specimen order as above): gill raker length 56.2–73.8 (85.0); gill filament length 52.9–70.0 (77.6).

Body oblong, steeply tapering to long, slender caudal peduncle; snout short, very steep, about half interorbital width. Snout pores three upper and five marginal, outer pair of marginal pores in a slight notch. Mental pores two pairs, anterior pair small, at front of chin separated by symphysis; second pair slit-like immediately behind angle of chin.

Mouth terminal, strongly oblique (about 30°); maxillary extending backward slightly beyond posterior margin of eye.

Upper jaw with an outer row of well-spaced, enlarged teeth and an inner band of small, conical teeth, comprising 1 or 2 anterior rows, 4 or 5 posterior rows; enlarged teeth along anterior half of upper jaw exposed upon lower lip when mouth closed. Lower jaw with an outer row of small, conical teeth and an inner row of well-spaced, enlarged teeth.

Eye small in 440 mm SL specimen, moderately large in specimens 151–183 mm SL. Anterior and posterior nostrils ovate. Gill rakers slender, as long as gill filaments adjacent to angle of gill arch.

Scales cycloid on head, ctenoid on body; scales on throat minute; small, cycloid scales cover soft parts of dorsal and anal fins; lateral line scales without subsidiary scales.

Pectoral fins about 1.5 times longer than pelvic fins; first soft ray of pelvic fins with short filament. Pelvic and second anal fin spines stiff, progressively thickening with growth owing to hyperostosis. Caudal fin rhomboidal.

Swimbladder (Fig. 3H) with tubular appendage anteriorly on each side arising from anterior end and immediately dividing into a short abdominal portion and a long cephalic portion; cephalic portion extending forward to level of palate, passing as a loop over carotid foramen (Fig. 3H, Arrow). Growth changes in branching pattern of appendages unknown. Sagitta (Fig. 3I) badly eroded, but deeply curved nature of sulcus tail apparent.

Colour in alcohol.—Body brownish. Mouth lining pale; lining of gill cavity spotted with a few melanophores. Pectoral axil slightly dusky; membrane of fins dark brown.

Colour when fresh.—Unknown.

Distribution. Viet Nam, Gulf of Thailand and Borneo (Fig. 4).

Remarks. Trewavas (1977) placed this species in *Otolithoides* without examining the swimbladder and otolith. However, the swimbladder of the species is characterized by a pair of tube-like appendages originating at the anterior portion, unlike the condition in *Otolithoides* in which the appendages originate from the posterior portion. Furthermore, each appendage is divided at its root into a forward-directed cephalic portion and backward-directed abdominal portion. This pattern is seen only in *Panna*. Furthermore, the sulcus tail of the sagitta is deeply curved, as in *Panna*, whereas in *Otolithoides* it is nearly straight. Hence, *Sciaenoides perarmatus* Chabanaud is here recognized as the third species of *Panna*, with which it shows general agreement, although differing from all other sciaenid species in having the cephalic portion extending forward to the level of the palate.

Key to species of *Panna*

- 1a. Dorsal fin rays VI–VIII, 42–44 .. *P. perarmatus*
- 1b. Dorsal fin rays VIII–X, 32–37
- 2a. Dorsal fin spines IX–X (usually X); gill rakers 5–6 + 1 + 9–11; one or two spines on supraorbital ridge of frontal in juveniles; transition in body scales from cycloid to ctenoid takes place in individuals between approximately 30–60 mm SL
- 2b. Dorsal fin spines VIII–X (usually IX); gill rakers 6–8 + 1 + 11–15; supraorbital ridge smooth in juveniles; transition in body scales

from cycloid to ctenoid takes place in individuals between approximately 120–200 mm SL
*P. heterolepis*

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インド西太平洋産ニベ科魚類 *Panna* の再検討

佐々木邦夫

ニベ科魚類の1属である *Panna* は鰾の前部から1対の2叉に分岐する付属枝が発するなどの特徴を示し、その分布はインド西岸からインドネシアのジャワ島に渡る。従来、本属には上記の海域に広く分布する *P. microdon* (Bleeker) とカルカッタ産の体長 51.9 mm のホロタイプのみから知られる *P. heterolepis* Trewavas の2種が含まれると考えられてきた。稚魚を含む多数の標本を観察した結果、*P. microdon* は西太平洋に限って出現すること、さらに *P. heterolepis* はインド洋に分布する唯一の本属魚類であることが判明した。両種は酷似するが、背鰭棘数、鰓耙数、稚魚の頭部に発達する棘の状態および個体発生における円鱗から楕鱗への移行のタイミングが相違することで区別ができる。Trewavas (1977) が *Otolithoides* に含めたインドシナーボルネオ産の *Sciaenoides perarmatus* Chabanaud の鰾と耳石を観察した結果、本種も *Panna* の特徴を示すことが明らかになった。従って、*Panna* には3種が含まれる。

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