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# Review of seven-spined *Polynemus* species (Perciformes: Polynemidae) with designation of a neotype for *Polynemus paradiseus* Linnaeus, 1758

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**Abstract** A taxonomic review of seven-spined *Polynemus* species recognizes two species as valid: *P. hornadayi* Myers, 1936, currently known only from western Sarawak, Kalimantan, Malaysia, and *P. paradiseus* Linnaeus, 1758, distributed from India to Thailand and regarded as a senior synonym of *P. aureus* Hamilton, 1822, *P. longifilis* Cuvier in Cuvier and Valenciennes, 1829, *P. risua* Hamilton, 1822, and *P. toposui* Hamilton, 1822. *Polynemus hornadayi* differs from *P. paradiseus* in having a strongly protruded occipital profile (vs. nearly straight in the latter), lower counts of anal fin soft rays (mode 11 vs. 12) and gill rakers (26 vs. 32 or 33), higher counts of pectoral fin rays (18 vs. 17), scales above and below the lateral line (11 and 18 vs. 7 and 11, respectively), and pored lateral line scales (94 vs. 70), the fifth pectoral filament longest (vs. sixth), the fourth pectoral filament longer (extending well beyond the posterior central margin of the caudal fin vs. not reaching posterior central margin), a longer pectoral fin ray (posterior tip of pectoral fin reaching to midpoint of anal fin base vs. not reaching), a deeper maxilla posterior margin (mean 5% of SL vs. 4% of SL), and a well-developed swimbladder (vs. absent).

**Key words** Review · *Polynemus hornadayi* · *Polynemus paradiseus* · Neotype

Species of the family Polynemidae generally have 8 spines in the first dorsal fin (Motomura et al., 1999, 2000a–c, 2001a–j, 2002; Motomura and Iwatsuki, 2001a,b). Examination of all known available type material and original species descriptions, and also a wide range of non-type specimens, disclosed that six nominal species belonging to the genus *Polynemus* are characterized by 7 spines in the first dorsal fin. They are *P. aureus* Hamilton, 1822, *P. hornadayi* Myers, 1936, *P. longifilis* Cuvier in Cuvier and Valenciennes, 1829, *P. paradiseus* Linnaeus, 1758, *P. risua* Hamilton, 1822, and *P. toposui* Hamilton, 1822.

Apart from numerous brief treatments in general fish classification and regional faunal studies, *Polynemus* species with 7 spines in the first dorsal fin have never been reviewed on the basis of type and non-type materials representing wide distributional ranges. Thus, considerable taxonomic confusion has resulted.

*Polynemus paradiseus*, the oldest available name for the family, was originally described from Bengal, India, on the basis of a figure and description by Edwards (1743–1751), and has been recognized as a valid species (Menon, 1974; Menon and Babu Rao, 1984). Four nominal species, viz., *P.*

*aureus*, *P. longifilis*, *P. risua*, and *P. toposui*, are herein regarded as junior synonyms of *P. paradiseus*.

A rare species, *P. hornadayi*, originally described from Sarawak, Malaysia, has also been subsequently regarded as valid (Kottelat and Lim, 1995; Randall and Lim, 2000). However, the species has never been described in detail since the original description. Only brief accounts have been published in general classificatory works and regional faunal studies.

Both species of *Polynemus* characterized by 7 spines in the first dorsal fin. *Polynemus hornadayi* and *P. paradiseus* are herein redescribed as valid on the basis of type and non-type materials representing wide distributional ranges. In addition, a neotype is designated for *P. paradiseus*.

## Methods

Counts and measurements follow Hubbs and Lagler (1947) and Motomura et al. (2000b, 2002). Counts of pectoral filaments begin with the anterior (ventralmost) element. Standard length is expressed as SL. Terminology of the

supraneural bones follows Mabee (1988), and the formula for configuration of the supraneural bones, anterior neural spines, and anterior dorsal fin pterygiophores follows Ahlstrom et al. (1976). Presence of a swimbladder in *Polynemus hornadayi* was confirmed from USNM 321610 (8 of 10 specimens), the abdomens of these fish having already been dissected. The neotype (NRM 47529) and all 4 MUFS specimens of *P. paradiseus* were also dissected and the absence of a swimbladder was confirmed. Osteological characters were confirmed from X-ray photos taken of all specimens of each species. Institutional codes follow Leviton et al. (1985), with additional institutional abbreviations as follows: Division of Fisheries Sciences, Faculty of

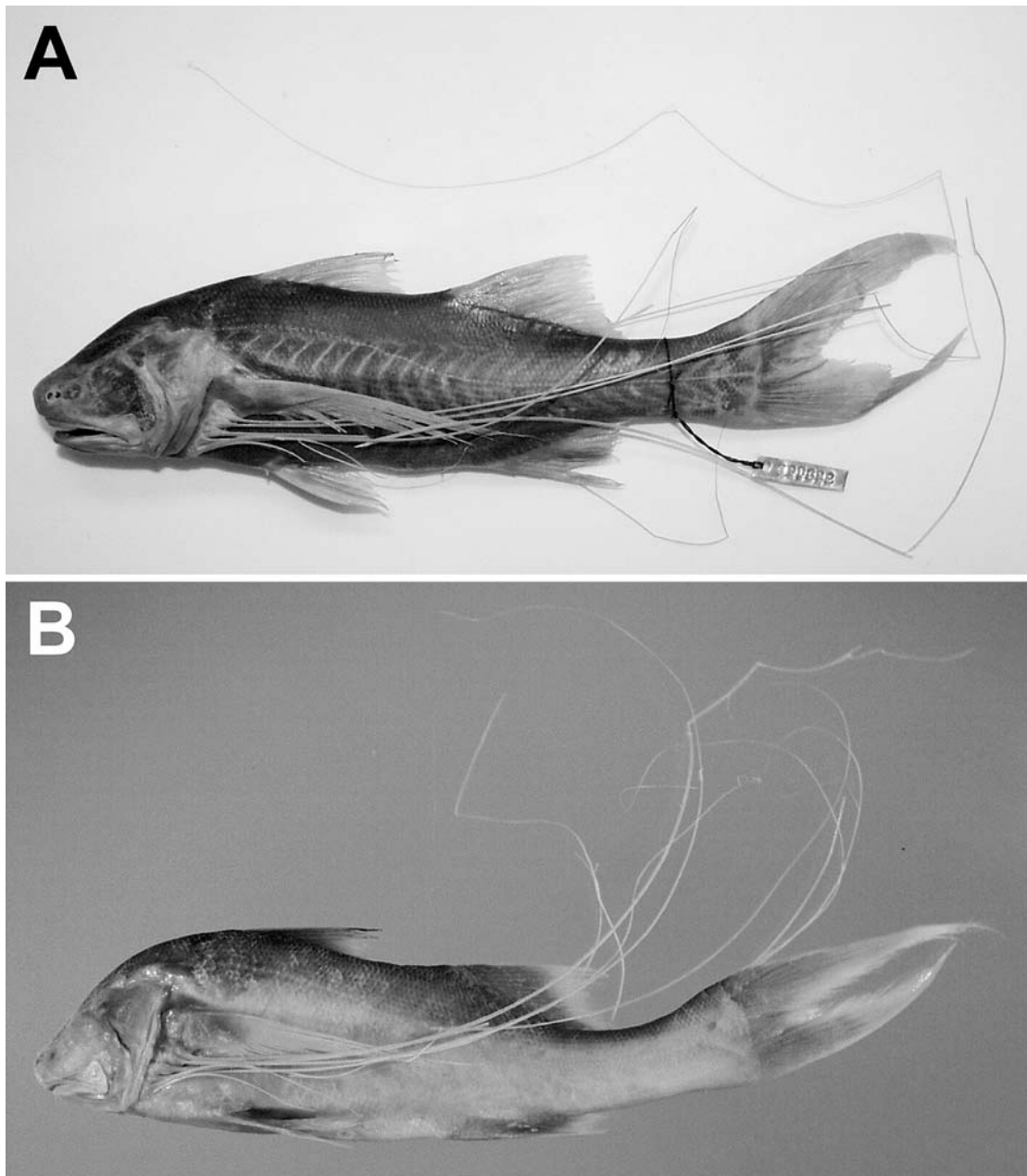
Agriculture, Miyazaki University, Japan (MUFS) and Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore (ZRC, formerly NMS). Comparative materials for this study are listed in Motomura et al. (1999, 2000a–c, 2001a–j, 2002) and Motomura and Iwatsuki (2001a,b).

***Polynemus hornadayi* Myers, 1936**

(English name: Hornaday's paradise fish)

(Figs. 1, 2, 3A,B, 6A, 7, 8; Tables 1, 3–5)

*Polynemus hornadayi* Myers, 1936: 376, fig. 1 [type locality: Ensengi River (tributary of Sadong River), Sarawak, Kalimantan, Malaysia].



**Fig. 1.** *Polynemus hornadayi* Myers, 1936. **A** Holotype, USNM 100632, 193 mm SL, Ensengi River (emptying into Sadong River), Sarawak, Kalimantan, Malaysia. **B** Non-type specimen, USNM 321610, 178 mm SL, Sunday Dayak market at Kuching, Sarawak, Kalimantan, Malaysia

**Table 1.** Counts and measurements of *Polynemus hornadayi*, including the holotype, paratypes, and non-type specimens, expressed as percentages of standard length

	Holotype USNM 100632	Paratypes <i>n</i> = 9	Non-type specimens <i>n</i> = 16
Standard length (mm)	193	109–146	94–201
<b>Counts</b>			
Dorsal fin rays	VII–I, 15	VII–I, 15–16	VII–I, 14–16
Anal fin rays	II, 12	II–III, 11–12	II–III, 11–12
Pectoral fin rays	18	16–18	17–19
Pectoral filaments	7	7	7
Pelvic fin rays	I, 5	I, 5	I, 5
Pored lateral line scales	92	90–99	90–103
Scales above/below lateral line	11/19	8–12/18–20	10–12/16–21
Gill rakers	10 + 16 = 26	10–11 + 16–17 = 26–28	10–11 + 16–17 = 26–28
<b>Measurements (means)</b>			
Head length	28	27–28	26–29 (28)
Body depth at 1st dorsal fin origin	25	24–25	24–30 (26)
Body depth at 2nd dorsal fin origin	25	22–25	23–27 (25)
Body width at pectoral fin base	13	12–14	13–17 (14)
Snout length	7	6–7	6–7 (7)
Dermal eye opening	1	1–2	1–2 (1)
Orbit diameter	3	2–3	2 (2)
Interorbital width	9	9	9–10 (9)
Postorbital length	20	20	18–21 (20)
Upper jaw length	15	13–15	13–16 (14)
Depth at posterior margin of maxilla	5	5	4–5 (5)
Pre-1st dorsal fin length	35	34–35	34–39 (36)
Pre-2nd dorsal fin length	60	59–62	58–63 (60)
Preanal fin length	63	59–64	58–63 (61)
First dorsal fin origin to anal fin origin	41	38–41	38–43 (40)
Pelvic fin origin to anal fin origin	30	27–31	27–32 (29)
Second dorsal fin base length	20	18–20	19–22 (20)
Anal fin base length	15	13–16	12–17 (14)
Longest pectoral fin length	43	40–42	39–47 (42)
Longest pectoral filament length (5th)	Damaged	Damaged	323–339 (331)
Pectoral fin base	15	13–15	14–15 (14)
Longest pelvic fin ray length (1st)	18	18–19	19–22 (20)
Longest 1st dorsal fin spine length (2nd)	Damaged	18–20	19–20 (20)
Second dorsal fin spine length	7	7–9	7–9 (8)
Longest 2nd dorsal fin ray length (2nd)	19 <sup>a</sup>	22–24	21–25 (23)
Longest anal fin spine length (2nd or 3rd)	8	7–10	6–10 (9)
Longest anal fin ray length (2nd)	21	19–22	20–24 (22)
Caudal peduncle length	25	25–28	26–31 (27)
Caudal peduncle depth	11	10–11	10–11 (11)
Upper caudal fin lobe length	Damaged	43	41–46 (44)
Lower caudal fin lobe length	36 <sup>a</sup>	40–43	37–46 (41)

Means in parentheses include data of type specimens

<sup>a</sup>Slightly damaged at tip

**Holotype.** USNM 100632, 193 mm SL, Ensengi River (tributary of Sadong River), Sarawak, Kalimantan, Malaysia, 2 Oct. 1877, collected by W.T. Hornaday.

**Paratypes.** 9 specimens, 109–146 mm SL. BMNH 1935.8.29.31, 142 mm SL, same data as holotype; USNM 35719 (8 specimens), 109–146 mm SL, same data as holotype.

**Other material.** 16 specimens, 94–201 mm SL. MCZ 313497, 126 mm SL, Sungai River at Kota Samarahan (about 20 km southeast of Kuching), Sarawak, Kalimantan, Malaysia; NMS at ZRC 2883 (3), 121–201 mm SL, Stambak Saribas, Sarawak, Kalimantan, Malaysia;

USNM 321610 (10), 166–188 mm SL, Sunday Dayak market at Kuching, Sarawak, Kalimantan, Malaysia; ZRC 39739, 94 mm SL, Sungai River at Kota Samarahan, Sarawak, Kalimantan, Malaysia; ZRC 46032, 173 mm SL, Kapit, Rajang River, Sarawak, Kalimantan, Malaysia.

**Diagnosis.** A species of *Polynemus* with the following combination of characters: 7 first dorsal fin spines; 14–16 (mode 15) dorsal fin soft rays; 7 pectoral filaments, fifth longest and fourth extending well beyond posterior central

margin of caudal fin; 16–19 (18) pectoral fin rays; 2 or 3 (3) anal fin spines; 11 or 12 (11) anal fin soft rays; 90–103 (94) pored lateral line scales; 8–12 (11) scale rows above lateral line, 16–21 (18) below; 10 or 11 (10) upper series gill rakers, 16 or 17 lower, 26–28 (26) total; occipital profile strongly protruding; vomer with villiform teeth; pectoral fin long [mean 42% (range 39–47%) of SL], posterior tip reaching to midpoint of anal fin base; posterior portion of maxilla deep [5% (4–5%) of SL]; swimbladder present, large.

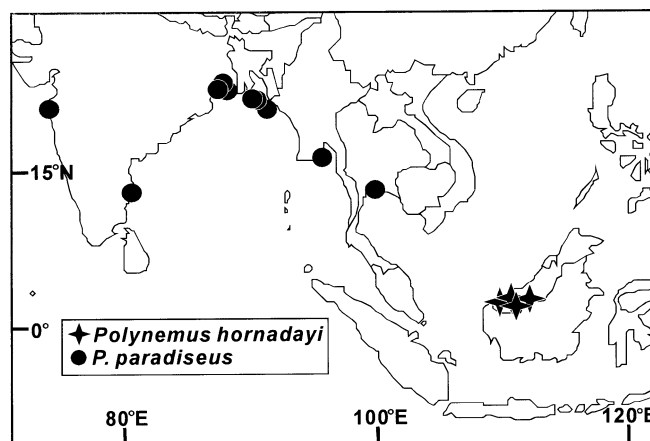
**Description.** Counts and proportional measurements as percentages of SL of the holotype and other material of *Polynemus hornadayi* are given in Table 1. Characters given in the species diagnosis are not repeated here. Data for the holotype are presented first, followed by other material data (if different) in parentheses.

Body oblong, compressed; maxilla covered with scales; lip on lower jaw well developed; posterior margin of preopercle serrated; posterior margin of maxilla extending well beyond level of posterior margin of adipose eyelid; teeth villiform in broad bands on palatines and ectopterygoids; all pectoral fin rays unbranched, inserted near body midline; fifth to seventh pectoral filaments (fifth longest) longer than total length (filaments tips easily damaged); fourth pectoral filament slightly longer than standard length (same or slightly shorter); third pectoral filament reaching to near level of posterior end of anal fin base (same or reaching between levels of origin and posterior end of anal fin base); second pectoral filament not reaching to level of anal fin origin; first pectoral filament shortest, not reaching to level of posterior tip of pelvic fin; all first dorsal fin spine bases of similar thickness; lateral line simple, extending from upper end of gill opening to middistal margin of caudal fin membrane; formula for configuration of supraneural bones, anterior neural spines, and anterior dorsal pterygiophores /0/0+1/1+1/1/1/1/1/ (same or /0/0+1/1/1+1/1/1/1/1/); 10 + 15 vertebrae.

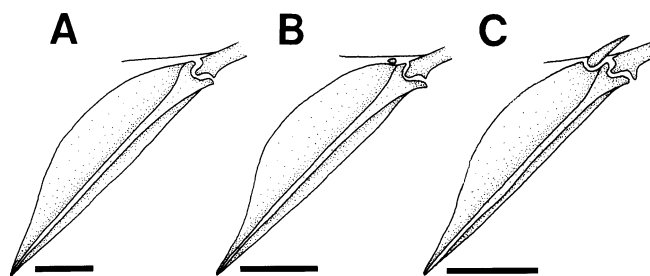
**Color of preserved specimens.**—Head and body grayish-black dorsally, pale yellowish-silver ventrally (body uniformly grayish-black in older preserved specimens, including holotype); membranes of first dorsal fin translucent, spines pale yellow; bases of second dorsal, pectoral, pelvic, anal, and caudal fins pale yellow, posterior margins of these fins translucent; pectoral filaments uniformly whitish-yellow.

**Distribution.** *Polynemus hornadayi* is currently known only from three rivers, the Ensengi, Rajang, and Sungai Rivers, in western Sarawak, Kalimantan, Malaysia (Fig. 2). The species inhabits only freshwater regions of these rivers, having never been recorded from the estuarine areas behind the river mouths.

**Remarks.** *Polynemus hornadayi* Myers, 1936 was described as a new species on the basis of 11 specimens (holotype and 10 paratypes) from the Ensengi River, a tributary of the Sadong River, Sarawak, Kalimantan, Malaysia. One and 8 paratypes are now registered as BMNH 1935.8.29.31 and USNM 35719, respectively, the remaining paratype apparently having been lost.



**Fig. 2.** Localities of specimens of *Polynemus hornadayi* (stars) and *P. paradiseus* (circles) examined in this study



**Fig. 3.** First pterygiophore of first dorsal fin in *Polynemus hornadayi* (A USNM 321610, 170 mm SL; B MCZ 313497, 126 mm SL), and *P. dubius* (C URM-P 13930, 136 mm SL). Bars 5 mm

In the original description of *Polynemus hornadayi*, Myers (1936) described the species as having 94–97 pored lateral line scales, 8–9 scale rows above the lateral line, and 12 and 15 gill rakers in the upper and lower series, respectively. However, reexamination of the holotype and 9 paratypes in this study revealed that the types actually have 90–99 pored lateral line scales, 8–12 scale rows above the lateral line, and 10–11 and 16–17 gill rakers in the upper and lower series, respectively.

*Polynemus hornadayi* and *P. paradiseus* Linnaeus, 1758 (below) both have 7 first dorsal fin spines, whereas all other polynemid species have 8 spines (Motomura et al., 1999, 2000a–c, 2001a–j, 2002; Motomura and Iwatsuki, 2001a,b; Fig. 3). However, radiographs of *P. hornadayi* indicate that 4 of 26 specimens have a grain of oval bone (diameter less than ca. 1 mm) buried under the subcutaneous tissue in front of the first dorsal fin spine and associated with the first pterygiophore (Fig. 3B). Although the anteriormost dorsal fin spine of other polynemid species is also small, the spine is conventionally “spine-shaped” (not oval) with a dorsally exposed tip (Motomura et al., 2001b; fig. 4; Fig. 3C). The oval bone associated with the first pterygiophore in some *P. hornadayi* is considered to represent the final stages of degeneration from an original spine precursor.

***Polynemus paradiseus* Linnaeus, 1758**

(English name: paradise threadfin)

(Figs. 2, 4, 5, 6B, 7, 8; Tables 2, 3–5)

*Polynemus paradiseus* Linnaeus, 1758: 317 [original locality: Bengal, India, based on the figure (see Fig. 5) and description of Edwards (1743–1751); type locality (of newly designated neotype): Gariahat, Calcutta, West Bengal, India].

*Polynemus risua* Hamilton, 1822: 228, 381 (type locality: vicinity of Lukhipur, India).

*Polynemus toposui* Hamilton, 1822: 232, 381 (type locality: estuary of Ganges River, West Bengal, India; original drawing reproduced in Hora, 1929: pl. 16, fig. 1).

*Polynemus aureus* Hamilton, 1822: 232, 381 (type locality: Calcutta, West Bengal, India).

*Polynemus longifilis* Cuvier in Cuvier and Valenciennes, 1829: 365 [type locality: Pondicherry and Ganges River, India; Manila, Philippines (probably erroneous, see Distribution)].

**Neotype.** NRM 47529, 198 mm SL, Gariahat, Calcutta, West Bengal, India, 24 Mar. 2000, collected by H. Motomura and Y. Iwatsuki.

**Other material.** 41 specimens, 72–182 mm SL. AMNH 217854 (3 specimens), 134–144 mm SL, San Pya fish market, Yangon, Myanmar; ANSP 11498 (2), 135–147 mm SL, Indonesia; ANSP 85770, 101 mm SL, Mumbai, Maharashtra, India; ANSP 87575, 137 mm SL, Mumbai, Maharashtra, India; MCZ 16313 (4), 131–147 mm SL, Thailand; MHNG 148.24 (syntype of *Polynemus longifilis* Cuvier in Cuvier and Valenciennes, 1829), 134 mm SL, Ganges River, West Bengal, India; MNHN 2200 (3 syntypes of *P. longifilis*), 141–157 mm SL, Ganges River, West Bengal, India; MNHN A. 3045 (syntype of *P. longifilis*), 115 mm SL, Manila, Philippines (locality probably erroneous, see Distribution); MNHN A. 4803 (dried syntype of *P. longifilis*), 154 mm SL, Pondicherry, India; MUFS 19051–19052 (2), 154–166 mm SL, Gariahat, Calcutta, West Bengal, India; MUFS 19065–19066 (2), 150–155 mm SL, Namkhana, West Bengal, India; NRM 3483, 110 mm SL, West Bengal, India; SMF 439

(syntype of *P. longifilis*), 124 mm SL, Ganges River, West Bengal, India; USNM 343563 (3 of 12), 108–113 mm SL, Yangon fish market, Myanmar; USNM 363714 (2), 100–107 mm SL, off Myanmar (21°00' N, 91°59' E); USNM 363715 (4), 93–124 mm SL, off Bangladesh (21°43' N, 91°33' E); USNM 363716 (6), 116–126 mm SL, off Bangladesh (21°32' N, 91°29' E); URM-P 10846, 182 mm SL, Hooghly River, West Bengal, India; URM-P 10905, 72 mm SL, Hooghly River, West Bengal, India; URM-P 29087, 145 mm SL, Bangkok, Thailand.

**Diagnosis.** A species of *Polynemus* with the following combination of characters: 7 first dorsal fin spines; 14–15 (mode 15) dorsal fin soft rays; 7 pectoral filaments, sixth longest and fourth not reaching to posterior central margin of caudal fin; 15–18 (17) pectoral fin rays; 2 anal fin spines; 11–13 (12) anal fin soft rays; 66–71 (70) pored lateral line scales; 6 or 7 (7) scale rows above lateral line, 10–12 (11) below; 12–14 (13) upper series gill rakers, 17–20 (20) lower, 30–34 (32 or 33) total; occipital profile nearly straight; vomer with villiform teeth; pectoral fin short [mean 33% (range 30–35%) of SL]; posterior tip of pectoral fin reaching to (or just short of) level of anal fin origin [but in juveniles (less than ca. 100 mm SL) extending slightly beyond anal fin origin]; posterior portion of maxilla shallower [4% (3–4%) of SL]; swimbladder absent.

**Description.** Counts and proportional measurements as percentages of SL of the neotype and other material of *Polynemus paradiseus*, and syntypes of *P. longifilis* are given in Table 2. Characters given in the species diagnosis are not repeated here. Data for the neotype are presented first, followed by other material data (if different) in parentheses.

Body oblong, compressed; maxilla covered with scales; lip on lower jaw well-developed; posterior margin of preopercle serrated; posterior margin of maxilla extending



**Fig. 4.** Neotype of *Polynemus paradiseus* Linnaeus, 1758 (NRM 47529, 198 mm SL, Gariahat, Calcutta, West Bengal, India)

**Table 2.** Counts and measurements of the neotype and non-type specimens of *Polynemus paradiseus*, and syntypes of *P. longifilis*, expressed as percentages of standard length

	Neotype of <i>P. paradiseus</i> NRM 47529	Syntypes of <i>P. longifilis</i> <i>n</i> = 7 <sup>a</sup>	Non-type specimens of <i>P. paradiseus</i> <i>n</i> = 34
Standard length (mm)	198	115–157	72–182
<b>Counts</b>			
Dorsal fin rays	VII–I, 15	VII–I, 15	VII–I, 14–15
Anal fin rays	II, 12	II, 12	II, 11–13
Pectoral fin rays	16	16–18	15–18
Pectoral filaments	7	7	7
Pelvic fin rays	I, 5	I, 5	I, 5
Pored lateral line scales	70	67–70	66–71
Scales above/below lateral line	7/12	6–7/10–12	6–7/10–12
Gill rakers	13 + 20 = 33	12–14 + 18–20 = 30–34	12–14 + 17–20 = 30–34
<b>Measurements (means)</b>			
Head length	25	25–26	24–27 (26)
Body depth at 1st dorsal fin origin	26	20–24	20–28 (24)
Body depth at 2nd dorsal fin origin	27	22–23	21–28 (24)
Body width at pectoral fin base	15	12–13	11–16 (14)
Snout length	6	6	6–7 (6)
Dermal eye opening	1	2	1–2 (2)
Orbit diameter	2	2–3	2–3 (2)
Interorbital width	8	9	8–10 (9)
Postorbital length	18	17–18	17–19 (18)
Upper jaw length	13	13–15	13–15 (14)
Depth at posterior margin of maxilla	4	3–4	3–4 (4)
Pre-1st dorsal fin length	34	34–35	30–36 (34)
Pre-2nd dorsal fin length	58	57–59	57–61 (58)
Preanal fin length	61	57–63	56–61 (59)
First dorsal fin origin to anal fin origin	39	35–37	35–41 (37)
Pelvic fin origin to anal fin origin	30	27–33	25–31 (28)
Second dorsal fin base length	20	19–21	18–21 (20)
Anal fin base length	17	14–16	15–17 (16)
Longest pectoral fin length	33	30–34	30–35 (33)
Longest pectoral filament length (6th)	181 <sup>b</sup>	171–243	181–248 (208)
Pectoral fin base	12	11–13	13–14 (13)
Longest pelvic fin ray length (1st)	17 <sup>c</sup>	14–16	15–18 (16)
Longest 1st dorsal fin spine length (2nd)	18	14–18	17–20 (18)
Second dorsal fin spine length	6	7–8	5–8 (7)
Longest 2nd dorsal fin ray length (2nd)	18	20–21	18–24 (21)
Longest anal fin spine length (2nd)	7	7–8	7–10 (8)
Longest anal fin ray length (2nd)	17	17–19	17–22 (19)
Caudal peduncle length	27	25–28	26–29 (28)
Caudal peduncle depth	12	9–11	9–12 (10)
Upper caudal fin lobe length	36	39–44	39–49 (44)
Lower caudal fin lobe length	33	35–40	33–47 (40)

Means in parentheses include data of type specimens

<sup>a</sup> Including a dried specimen (MNHN A. 4803)

<sup>b</sup> Slightly damaged at tip

<sup>c</sup> Measurement made on right side of the body

well beyond level of posterior margin of adipose eyelid; teeth villiform in broad bands on palatines and ectopterygoids; all pectoral fin rays unbranched, inserted near body midline; fifth to seventh pectoral filaments (sixth longest), longer than total length (filament tips easily damaged); fourth pectoral filament reaching near level of posterior base of anal fin (same or just reaching to caudal fin base); third pectoral filament not reaching to level of

anal fin origin (same or just reaching); second pectoral filament not reaching to level of posterior tip of pelvic fin (same or extending slightly beyond); first pectoral filament shortest, not reaching to level of posterior tip of pelvic fin; all first dorsal fin spine bases of similar thickness; lateral line simple, extending from upper end of gill opening to middistal margin of caudal fin membrane; formula for configuration of supraneural bones, anterior neural spines,

and anterior dorsal pterygiophores /0/0+1/1/1+1/1/1/1/; 10 + 15 vertebrae.

**Color when fresh.**—Based on neotype (NRM 47529, 198mm SL): head and body grayish-black dorsally, yellow ventrally; anterior parts of first and second dorsal fins grayish-black, other parts pale yellow; pectoral and pelvic fins uniformly vivid yellow; base of pectoral filaments vivid yellow, becoming whitish-yellow on posterior tips; anal fin uniformly yellow; posterior margin of caudal fin yellow, other parts grayish-black.

**Color of preserved specimens.**—Head and body grayish-black dorsally, pale yellowish-silver ventrally (body uniformly white in older preserved specimens); membranes between first and third spines of first dorsal fin dense black, membranes of other parts white; first to third spines of first dorsal fin grayish-black, other spines pale yellow; anterior margin and base of second dorsal fin dark yellow and posterior margin pale yellow; pectoral fin pale yellow or translucent (intensity of pectoral fin pigmentation variable, rarely posterior parts of pectoral fin dense black (pigmentation lacking in neotype with no pigmentation)); bases of pectoral filaments whitish-yellow, becoming grayish-black on posterior tips (grayish-black on tips of pectoral filaments often lost in older preserved specimens); pelvic and anal fins uniformly pale yellow; posterior margin of caudal fin whitish-yellow, other parts pale yellow.

**Distribution and habitat.** *Polynemus paradiseus* is currently known from the eastern Indian to the western Pacific Ocean, where it ranges over continental shelves from western India to Thailand (based on specimens examined during this investigation; see Fig. 2). Two specimens (ANSP 11498, 135–147mm SL) collected (probably pre-1900) from Indonesia by H.C. Wood, lacked detailed locality and other collection data. An Indonesian distribution of the species therefore needs reconfirmation and, accordingly, has been omitted from the distribution map (Fig. 2). Furthermore, Blanc and Hureau (1971) indicated in the type catalogue of Muséum National d'Histoire Naturelle that a syntype of *P. longifilis* (MNHN A. 3045, 115mm SL) had been collected from Manila, Philippines. However, because *P. longifilis* (= *P. paradiseus*, see Remarks) has currently been recorded only from continental shelf areas, including India, Bangladesh, Myanmar, and Thailand, the Philippines locality of the syntype is likely to have been erroneous.

The available collection data indicated that *P. paradiseus* specimens had been collected from fresh, estuarine, and offshore waters (from depths of less than 25 m). Although *P. paradiseus* is known to regularly enter freshwater (limited to spawning season only; David, 1954), the species is considered to be more heavily dependent on marine and brackish habitats, compared with other congeners that generally inhabit completely freshwater basins (Motomura et al., 2001j).

**Remarks.** *Polynemus paradiseus* Linnaeus, 1758, one of three of the oldest available names in the family Polynemidae, was described on the basis of a figure (Fig. 5) and description given by Edwards (1743–1751), who briefly described the figured fish (collected from Bengal, India by Dr. Mead) as the “Mango-Fish.” The specimen used for

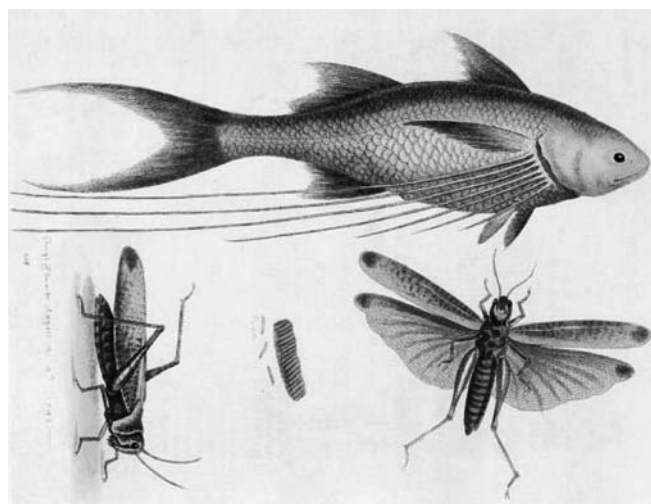


Fig. 5. Drawing of the “Mango-Fish” of Edwards (1743–1751)

Edwards’ figure and description apparently no longer exists. However, Edwards’ figure (Fig. 5) clearly indicates 7 spines in the first dorsal fin and 7 pectoral filaments, the uppermost 3 extending beyond the posterior tips of the caudal fin lobes and fourth pectoral filament not extending beyond the caudal fin base. The characters of the specimens considered here as *P. paradiseus* agree well with those shown on the figure.

Subsequently, Hamilton (1822) described three new species with 7 pectoral filaments, *Polynemus risua*, *P. toposui*, and *P. aureus*, all from India, but gave no indication of any type specimens. In fact, Hamilton’s (1822) monograph of the Gangetic fishes is based only on drawings and field notes. He did not preserve any specimens of the species he described, including the types of the aforementioned three species (Hora, 1929). According to their original descriptions (Hamilton, 1822), all three species were characterized by having 7 long pectoral filaments and 7 first dorsal fin spines, but differed from each other in the numbers of dorsal fin soft rays (17 in *P. risua*, 16 in *P. toposui*, and 15 in *P. aureus*), pectoral fin rays (17, 16, and 17, respectively), and anal fin rays (including spines; 15, 16, and 14, respectively). However, these fin ray numbers are almost wholly within the range of intraspecific variation found during the present study (see Tables 2, 3), based on a large number of specimens. The diagnostic characters of 7 long pectoral filaments and 7 first dorsal fin spines given in the original descriptions (supported by the collection locality) of these species are consistent with those of *P. paradiseus*. Accordingly, *P. risua*, *P. toposui*, and *P. aureus* are herein regarded as junior synonyms of *P. paradiseus*.

Although Fricke (1999) believed *P. longifilis* to be a junior synonym of *Polydactylus plebeius* (Broussonet, 1782), being widely distributed in the Indo-Pacific (Motomura et al., 2001c), the syntypes of the former clearly differ from examples of the latter, including the neotype, in having 7 pectoral filaments (longer than SL vs. 5, shorter than SL in the latter) and the orbit diameter smaller than the posterior depth of the maxilla (vs. larger) (see Motomura et al.,



**Table 3.** Frequency comparison of dorsal fin soft ray, anal fin spine and soft ray, and pectoral fin ray numbers in seven-spined *Polynemus* species

		Dorsal fin soft rays			Anal fin spines		Anal fin soft rays			Pectoral fin rays				
		14	15	16	2	3 <sup>a</sup>	11	12	13	15	16	17	18	19
<i>P. hornadayi</i>	<i>n</i> = 26	1	17 <sup>b</sup>	8	10	16 <sup>b</sup>	22	4 <sup>b</sup>	—	—	1	10	14 <sup>b</sup>	1
<i>P. paradiseus</i>	<i>n</i> = 40	8	32 <sup>b</sup>	—	40 <sup>b</sup>	—	1	38 <sup>b</sup>	1	2	17 <sup>b</sup>	18	3	—

<sup>a</sup>First of 3 spines vestigial, confirmed by radiograph

<sup>b</sup>Includes holotype of *P. hornadayi* or neotype of *P. paradiseus*

**Table 4.** Frequency comparison of scales above and below lateral line and pored lateral line scale numbers in seven-spined *Polynemus* species

		Scales above/below lateral line																	
		6	7	8	9	10	11	12	/	10	11	12	—	16	17	18	19	20	21
<i>P. hornadayi</i>	<i>n</i> = 24	—	—	1	2	7	11 <sup>a</sup>	3	—	—	—	—	2	2	10	6 <sup>a</sup>	3	1	—
<i>P. paradiseus</i>	<i>n</i> = 28	6	22 <sup>a</sup>	—	—	—	—	—	6	19	3 <sup>a</sup>	—	—	—	—	—	—	—	—

		Pored lateral line scales																		
		66	67	68	69	70	71	—	90	91	92	93	94	95	96	97	98	99	—	103
<i>P. hornadayi</i>	<i>n</i> = 25	—	—	—	—	—	—	—	3	2	2 <sup>a</sup>	2	5	2	3	1	3	1	—	1
<i>P. paradiseus</i>	<i>n</i> = 33	2	4	8	7	11 <sup>a</sup>	1	—	—	—	—	—	—	—	—	—	—	—	—	—

<sup>a</sup>Includes holotype of *P. hornadayi* or neotype of *P. paradiseus*

**Table 5.** Frequency comparison of gill raker numbers in seven-spined *Polynemus* species

		Upper limb					Lower limb					Total								
		10	11	12	13	14	16	17	18	19	20	26	27	28	29	30	31	32	33	34
<i>P. hornadayi</i>	<i>n</i> = 26	19 <sup>a</sup>	7	—	—	—	13 <sup>a</sup>	13	—	—	—	12 <sup>a</sup>	8	6	—	—	—	—	—	—
<i>P. paradiseus</i>	<i>n</i> = 40	—	—	17	19 <sup>a</sup>	4	—	1	8	14	17 <sup>a</sup>	—	—	—	8	7	11	11 <sup>a</sup>	3	—

<sup>a</sup>Includes holotype of *P. hornadayi* or neotype of *P. paradiseus*

2001c). Examination of the syntypes of *P. longifilis* showed them to correspond closely with the specimens considered here as *P. paradiseus*. Accordingly, *P. longifilis* is also regarded as a junior synonym of *P. paradiseus*. The meristic and morphological characters of the types of *P. longifilis* are included in Table 2.

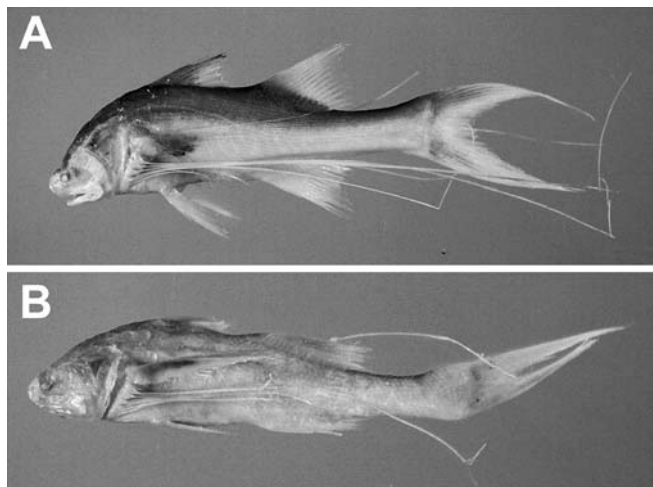
The proposal of a neotype for *P. paradiseus* is herein justified as being necessary to avoid taxonomic confusion, owing to the similarity of that species to other congeners. *Polynemus paradiseus* was originally described from Bengal, India (detailed locality not given; Edwards, 1743–1751; Linnaeus, 1758). A specimen (NRM 47529, 198 mm SL) collected from Gariahat, Calcutta, West Bengal, India is herein proposed as the neotype for the species. Accordingly, Gariahat, Calcutta becomes the type locality of *P. paradiseus* under Article 76.3 (ICZN, 1999).

**Comparison.** *Polynemus hornadayi* and *P. paradiseus* are clearly distinguished from other members of the family Polynemidae, including other congeners, by having 7 dorsal fin spines (vs. 8 in the latter). At a glance, the two species can be easily distinguished from each other by the shape of the

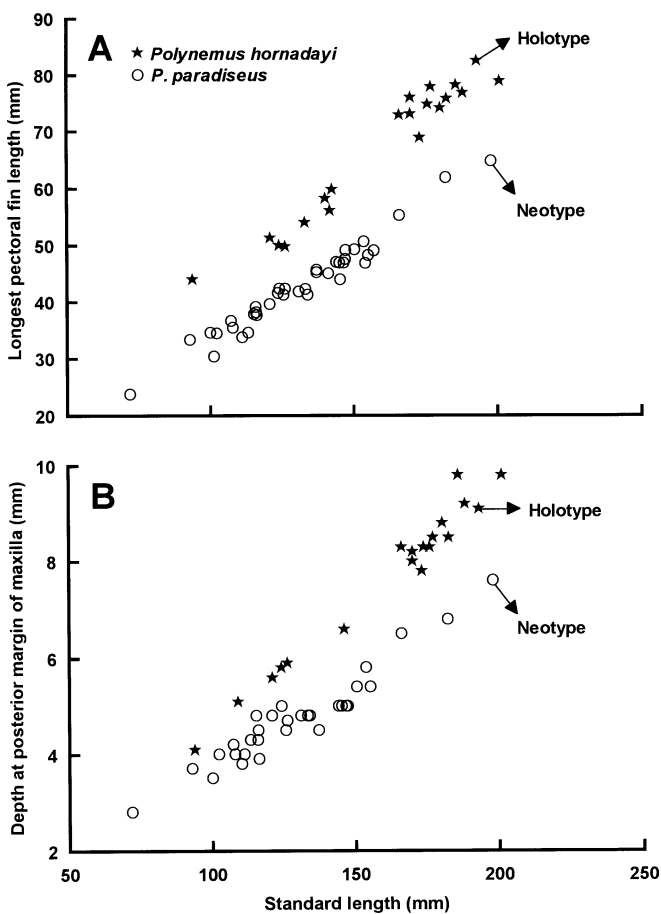
occipital profile, that of *P. hornadayi* protruding strongly whereas that of *P. paradiseus* is nearly straight throughout life (Figs. 1, 4, 6).

In meristic characters, *P. hornadayi* differs from *P. paradiseus* in having lower counts of anal fin soft rays [mode 11 (range 11–12) vs. 12 (rarely 11 or 13) in the latter; see Table 3] and gill rakers [26 (26–28) vs. 32 or 33 (30–34); Table 5], and higher counts of pectoral fin rays [18 (16–19) vs. 17 (15–18); Table 3], scales above and below the lateral line [11 (8–12) and 18 (16–21) vs. 7 (6 or 7) and 11 (10–12), respectively; Table 4], and pored lateral line scales [94 (90–103) vs. 70 (66–71); Table 4].

While *P. hornadayi* is similar to *P. paradiseus* in having 7 pectoral filaments (Tables 1, 2), in the former the fifth pectoral filament is the longest [mean 331% (range 323–339%) of SL; see Table 1] and the fourth filament extends well beyond the posterior central margin of the caudal fin, whereas in the latter the sixth filament is the longest [208% (181–248%) of SL; Table 2] and the fourth filament fails to reach the posterior central margin of the caudal fin. The pectoral fin of *P. hornadayi* is also relatively longer than that

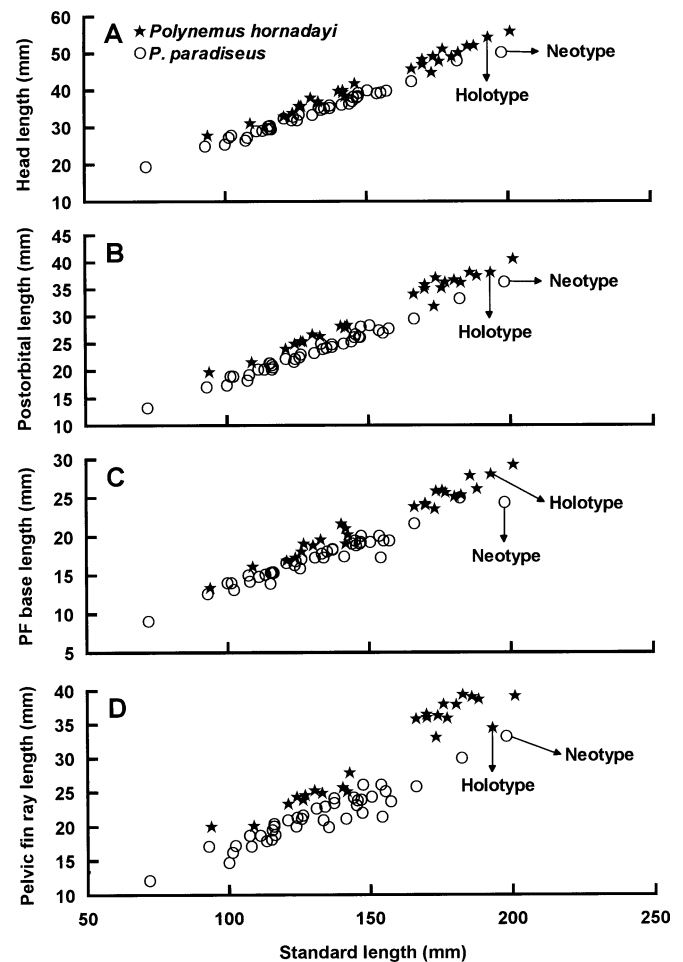


**Fig. 6.** Juveniles of *Polynemus hornadayi* (A ZRC 39739, 94 mm SL) and *P. paradiseus* (B URM-P 10905, 72 mm SL)



**Fig. 7.** Relationships of **A** pectoral fin length and **B** depth at posterior margin of maxilla to standard length in *Polynemus hornadayi* (stars) and *P. paradiseus* (circles)

of *P. paradiseus* [posterior tip of pectoral fin reaching to midpoint of anal fin base, 42% (39–47%) of SL vs. not reaching, 33% (30–35%) of SL, respectively; Tables 1, 2, Fig. 7A]. Furthermore, the posterior margin of the maxilla of *P.*



**Fig. 8.** Relationships of **A** head length, **B** postorbital length, **C** pectoral fin (PF) base length, and **D** pelvic fin ray length to standard length in *Polynemus hornadayi* (stars) and *P. paradiseus* (circles)

*hornadayi* is deeper than that of *P. paradiseus* [5% (4–5%) of SL vs. 4% (3–4%) of SL, respectively; Tables 1, 2, Fig. 7B], *P. hornadayi* also tending to have a slightly longer head [28% (26–29%) of SL], postorbital [20% (18–21%) of SL], and pectoral fin base [14% (14–15%) of SL], and greater pelvic fin ray lengths [20% (19–22%) of SL] than *P. paradiseus* [27% (24–27%), 18% (17–19%), 13% (13–14%), and 16% (15–18%) of SL, respectively], although the proportional length measurements overlapped between the two species (Tables 1, 2, Fig. 8).

Internally, *P. hornadayi* differs from *P. paradiseus* in having a well-developed swimbladder (absent in the latter). Furthermore, the former frequently has a vestigial anal fin spine buried under subcutaneous tissue (62%, 16 of 26 specimens), such being absent in *P. paradiseus* (see Table 3).

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### Literature Cited

- Ahlstrom EH, Butler JL, Sumida BY (1976) Pelagic stromateoid fishes (Pisces, Perciformes) of the eastern Pacific: kinds, distributions, and early life histories and observations on five of these from the northwest Atlantic. *Bull Mar Sci* 26:285–402
- Blanc M, Hureau J-C (1971) Catalogue critique des types de poissons du Muséum national d'Histoire naturelle. (Suite) (Mugiliformes et Polynémiformes). *Bull Mus Natl Hist Nat (Sér 3) Zool* (15):673–734
- Cuvier G, Valenciennes A (1829) Histoire naturelle des poissons, vol 3. Levrault, Paris
- David A (1954) A preliminary survey of the fish and fisheries of a five-mile stretch of the Hooghly River near Barrackpore. *Indian J Fish* 1:231–250
- Edwards G (1743–1751) Natural history of uncommon birds, and of some other rare and undescribed animals, quadrupedes, reptiles, fishes, insects, etc., in 4 parts. College of Physicians, London
- Fricke R (1999) Fishes of the Mascarene Islands (Réunion, Mauritius, Rodriguez). An annotated checklist with descriptions of new species. Koeltz Köenigstein
- Hamilton F (1822) An account of the fishes found in the River Ganges and its branches. Archibald Constable, London
- Hora SL (1929) An aid to the study of Hamilton Buchanan's "Gangetic Fishes." *Mem Indian Mus* 9:1–192
- Hubbs CL, Lagler KF (1947) Fishes of the Great Lakes region. *Bull Cranbrook Inst Sci* (26):i–xi + 1–186
- Kottelat M, Lim KKP (1995) Freshwater fishes of Sarawak and Brunei Darussalam: a preliminary annotated check-list. *Sarawak Mus J* 48:227–256
- Leviton AE, Gibbs RH Jr, Heal E, Dawson CE (1985) Standards in herpetology and ichthyology: Part I. Standard symbolic codes for institutional resource collections in herpetology and ichthyology. *Copeia* 1985:802–832
- Linnaeus C (1758) *Systema naturae*, 10th edn, vol 1. Laurentii Salvii, Holmiae
- Mabee PM (1988) Supraneural and predorsal bones in fishes: development and homologies. *Copeia* 1988:827–838
- Menon AGK (1974) Polynemidae. In: Fischer W, Whitehead PJP (eds) FAO species identification sheets for fishery purposes: eastern Indian Ocean and western central Pacific. *Fishing Area* 57 and 71. Vol 3. FAO, Rome, pp 1–2 + "POLYN Eleu 1" to "POLYN Poly 5"
- Menon AGK, Babu Rao M (1984) Polynemidae. In: Fischer W, Bianchi G (eds) FAO species identification sheets for fishery purposes: western Indian Ocean. *Fishing Area* 51. Vol 3. FAO, Rome, pp 1–2 + "POLYN Eleu 1" to "POLYN Poly 7"
- Motomura H, Iwatsuki Y (2001a) A new genus, *Leptomelanosoma*, for the polynemid fish previously known as *Polydactylus indicus* (Shaw, 1804) and a redescription of the species. *Ichthyol Res* 48:13–21
- Motomura H, Iwatsuki Y (2001b) Review of *Polydactylus* species (Perciformes: Polynemidae) characterized by a large black anterior lateral line spot, with descriptions of two new species. *Ichthyol Res* 48:337–354
- Motomura H, Iwatsuki Y, Yoshino T, Kimura S (1999) A record of a polynemid fish, *Polydactylus sextarius*, from southern Japan (Perciformes: Polynemidae) (in Japanese). *Japan J Ichthyol* 46:57–61
- Motomura H, Burhanuddin AI, Iwatsuki Y (2000a) Distributional implications of a poorly known polynemid fish, *Polydactylus sexfilis* (Pisces: Perciformes), in Japan. *Bull Fac Agric Miyazaki Univ* 47:115–120
- Motomura H, Iwatsuki Y, Kimura S, Yoshino T (2000b) Redescription of *Polydactylus macrochir* (Günther, 1867), a senior synonym of *P. sheridani* (Macleay, 1884) (Perciformes: Polynemidae). *Ichthyol Res* 47:327–333
- Motomura H, Satapoomin U, Iwatsuki Y (2000c) A new record of the threadfin, *Filimanus perplexa* Feltes, 1991 (Perciformes: Polynemidae) from the Andaman Sea, Thailand. *Phuket Mar Biol Center Res Bull* 63:17–20
- Motomura H, Iwatsuki Y, Kimura S (2001a) Redescription of *Polydactylus sexfilis* (Valenciennes in Cuvier and Valenciennes, 1831), a senior synonym of *P. kuru* (Bleeker, 1853) with designation of a lectotype (Perciformes: Polynemidae). *Ichthyol Res* 48:83–89
- Motomura H, Iwatsuki Y, Kimura S (2001b) A poorly known polynemid fish, *Polynemus astrolabi* Sauvage, 1881, a junior synonym of *Galeoides decadactylus* (Bloch, 1795). *Ichthyol Res* 48:197–202
- Motomura H, Iwatsuki Y, Yoshino T (2001c) A new species, *Polydactylus siamensis*, from Thailand and redescription of *P. plebeius* (Broussonet, 1782) with designation of a neotype (Perciformes: Polynemidae). *Ichthyol Res* 48:117–126
- Motomura H, Kimura S, Iwatsuki Y (2001d) *Polydactylus bifurcus*, a new species of threadfin from Lombok Island, Indonesia (Perciformes: Polynemidae). *Ichthyol Res* 48:299–305
- Motomura H, Mikschi E, Iwatsuki Y (2001e) *Galeoides* Günther, 1860, a monotypic genus of the family Polynemidae (Perciformes). *Cybium* 25:269–272
- Motomura H, Okamoto M, Ida H, Iwatsuki Y (2001f) A rare threadfin (Perciformes: Polynemidae), *Filimanus hexanema*, from Indonesia (in Japanese). *IOP Diving News* 12:5–7
- Motomura H, Okamoto M, Iwatsuki Y (2001g) Description of a new species of threadfin (Teleostei: Perciformes: Polynemidae), *Polydactylus longipes*, from Mindanao Island, Philippines. *Copeia* 2001:1087–1092
- Motomura H, Senou H, Iwatsuki Y (2001h) A record of a threadfin, *Eleutheronema tetradactylum*, from Aomori Prefecture, northern Japan, and description of a newly-recognized diagnostic character for the species (Perciformes: Polynemidae) (in Japanese). *Japan J Ichthyol* 48:41–47
- Motomura H, Seshagiri Rao BV, Ratnamala B, Iwatsuki Y (2001i) *Polydactylus konadaensis* Mishra and Krishnan, 1993, a junior synonym of *Filimanus xanthonema* (Valenciennes in Cuvier and Valenciennes, 1831) (Perciformes: Polynemidae). *Ichthyol Res* 48:230–206
- Motomura H, van Oijen MJP, Isbrücker IJH, Iwatsuki Y (2001j) Redescription of a rare threadfin (Perciformes: Polynemidae), *Polydactylus macrophthalmus* (Bleeker, 1858), with designation of a

- lectotype and notes on distributional implications. *Ichthyol Res* 48:289–294
- Motomura H, Iwatsuki Y, Kimura S, Yoshino T (2002) Revision of the Indo-West Pacific polynemid fish genus *Eleutheronema* (Teleostei: Perciformes). *Ichthyol Res* 49:47–61
- Myers GS (1936) A new polynemid fish collected in the Sadong River, Sarawak by Dr. William T. Hornaday. *J Wash Acad Sci* 26:376–382
- Randall JE, Lim KKP (2000) A checklist of the fishes of the South China Sea. *Raffles Bull Zool Suppl* (8):569–667