

Revision of the threadfin genus *Polydactylus* (Perciformes: Polynemidae) from the eastern Pacific Ocean

| | |
|------------------------------|---|
| 著者 | "MOTOMURA Hiroyuki, KIMURA Seishi, IWATSUKI Yukio" |
| journal or publication title | Ichthyological research |
| volume | 49 |
| number | 4 |
| page range | 358-366 |
| URL | http://hdl.handle.net/10232/21812 |

Revision of the threadfin genus *Polydactylus* (Perciformes: Polynemidae) from the eastern Pacific Ocean

Hiroyuki Motomura^{1✉}, Seishi Kimura², and Yukio Iwatsuki³

¹ Fish Division, Department of Zoology, National Science Museum (Natural History), 3-23-1 Hyakunin-cho, Shinjuku-ku, Tokyo 169-0073, Japan (e-mail: motomura@kahaku.go.jp)

² Fisheries Research Laboratory, Mie University, P.O. Box 11, Wagu, Shima, Mie 517-0703, Japan (e-mail: kimura-s@bio.mie-u.ac.jp)

³ Division of Fisheries Sciences, Faculty of Agriculture, Miyazaki University, 1-1 Gakuen-kibanadai-nishi, Miyazaki 889-2192, Japan (e-mail: yuk@cc.miyazaki-u.ac.jp)

Received: March 7, 2002 / Revised: July 5, 2002 / Accepted: July 10, 2002

Ichthyological Research

©The Ichthyological Society of Japan 2002

Ichthyol Res (2002) 49: 358–366

Abstract The taxonomy of the eastern Pacific species of *Polydactylus* was revised, resulting in the recognition of two species: *Polydactylus approximans* (Lay and Bennett, 1839), a senior synonym of *Polynemus californiensis* Thominot, 1886; and *Polydactylus opercularis* (Gill, 1863), a senior synonym of *Polynemus melanopoma* Günther, 1864. Redescriptions of the two species and comparisons with related congeners are presented. The type material status of *Polydactylus approximans* and the type locality of *Polydactylus opercularis* are also discussed.

Key words Revision · *Polydactylus approximans* · *Polydactylus opercularis* · Eastern Pacific

Four nominal species of the family Polynemidae, viz., *Polynemus approximans* Lay and Bennett, 1839, *Trichidion opercularis* Gill, 1863, *Polynemus melanopoma* Günther, 1864, and *Polynemus californiensis* Thominot, 1886, have been reported from the eastern Pacific Ocean. Of these, *Polynemus approximans* and *Trichidion opercularis* have been widely regarded as valid species, both having been regarded to belong to *Polydactylus* (Eschmeyer and Herald, 1983; Allen and Robertson, 1994; Schneider, 1995). Although these two species have been mentioned in numerous brief treatments of general classification and regional faunal studies (Hildebrand, 1946; Bussing and López S., 1994; Grove and Lavenberg, 1997; Chirichigno F. and Vélez D., 1998), they have at no time been reconsidered on the basis of type data and an appropriate range of non-type material. Furthermore, two other nominal species, *Polynemus californiensis* and *Polynemus melanopoma*, have not been reported since their original descriptions, except in a type catalog report of the former, resulting in the taxonomic status of the two species still not being clear.

Polynemus californiensis and *Polynemus melanopoma* are herein regarded as junior synonyms of *Polydactylus approximans* and *Polydactylus opercularis*, respectively, following examination of type and non-type material, representing wide distributional ranges. Redescriptions of the latter two are given here, along with a discussion of certain aspects of the type data of both.

Materials and Methods

Counts and measurements follow Hubbs and Lagler (1947) and Motomura et al. (2000b, 2002a). Counts of pectoral

filaments begin with the anteriormost (ventralmost) element. Standard and total lengths are expressed as SL and TL, respectively. 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). Institutional codes follow Leviton et al. (1985). The presence of a swimbladder in *Polydactylus approximans* and its absence in *Polydactylus opercularis* were confirmed from seven specimens [USNM 15129, 41393, 46488 (1 of 3 specimens), 46876, 47464, 65621, and 94015] and 15 specimens [USNM 50343 (2), 65622 (3), 79871, 177799 (1 of 2), 181287 (5), 181320, 200371, 367309 (1 of 18)], respectively, the abdomens of these fish having already been dissected. Osteological characters were confirmed from X-ray photos taken of 11 *Polydactylus approximans* [USNM 43265, 53517, 65621, 127892, 220698, 220779, 220784 (3); BMNH 1863.12.16.30, 1866.1.14.6] and 10 *Polydactylus opercularis* [USNM 177799 (2), 181287 (5), 367308 (2); BMNH 1864.1.26.321].

Genus *Polydactylus* Lacepède, 1803

Polydactylus plumierii, described as a new genus and species by Lacepède (1803), is presently regarded as a junior synonym of a western Atlantic species, *Polydactylus virginicus* (Linnaeus). Accordingly, the type species of *Polydactylus* is considered to be the same species as *Polydactylus virginicus* (Talwar and Jhingran, 1992; Castro-Aguirre et al., 1999).

Polydactylus differs from seven other valid polynemid genera (listed by Motomura and Iwatsuki, 2001a) in having the following combination of characters (Motomura et al., 2000a,b, 2001a,c,d,g,j, 2002b; Motomura and Iwatsuki,

2001b): dermal eye opening 1.3 or less in snout length (1.3 or more in *Parapolyneumus* and *Polyneumus*, see Feltes, 1993; Motomura and Sabaj, 2002; Motomura et al., 2002c); width of tooth band on upper and lower jaws wider than space separating tooth bands on opposing premaxilla (narrower in *Filimanus* and *Pentanemus*, see Feltes, 1991; Motomura et al., 2000c, 2001f,i); lip on anterior part of lower jaw either well or poorly developed (absent in *Eleutheronema*, see Motomura et al., 2002a); basisphenoid in contact with prootic (not in contact in *Filimanus* and basisphenoid absent in *Parapolyneumus* and *Polyneumus*, see Feltes, 1991, 1993; Motomura et al., 2001i); pectoral fin base including base of pectoral filaments less than upper jaw length (greater in *Galeoides*, see Feltes, 1993; Motomura et al., 2001b,e); anal fin soft rays less than 18 (more than 24 in *Pentanemus*, see Feltes, 1993); swimbladder absent or simple, not extending beyond anal fin origin (swimbladder with many appendages in *Leptomelanosoma*, see Motomura and Iwatsuki, 2001a, and swimbladder extending beyond anal fin origin in *Galeoides*, see Feltes, 1993; Motomura et al., 2001b).

Polydactylus is distributed from tropical to temperate areas worldwide: 14 species currently recognized as valid occurring in the Indo-Pacific (Motomura et al., 2000b, 2001a,c,d,g,i,j, 2002b; Motomura and Iwatsuki, 2001a,b), 2 species in the eastern Pacific (Allen and Robertson, 1994; Schneider, 1995; this study), 3 species in the western Atlantic (Randall, 1978; Robins and Ray, 1986), and 1 species in the eastern Atlantic (Allen, 1981; Njock, 1990).

Polydactylus approximans
(Lay and Bennett, 1839)

(English name: blue bobo)

(Spanish name: barbudo seis barbas)

(Figs. 1A, 1B, 2A)

Polyneumus approximans Lay and Bennett, 1839: 57 (type locality: San Blas and Mazatlán, west coast of Mexico, based on a brief sketch and description by Mr. Collie).

Polyneumus californiensis Thominot, 1886: 161 (type locality: California, USA).

Material examined. 58 specimens, 24–228 mm SL. BMNH 1863.12.16.30 (previously regarded as 1 of 2 syntypes of *Polyneumus approximans* Lay and Bennett, see Remarks), 107 mm SL, Panama; BMNH 1866.1.14.6 (previously regarded as 1 of 2 syntypes of *Polyneumus approximans* Lay and Bennett, see Remarks), 215 mm SL, Panama; CAS 2823, 122 mm SL, Bathing beach, Acapulco Bay, Guerrero, Mexico; CAS SU 6292, 186 mm SL, Lima, Bay of Callao, Peru; CAS SU 35305, 183 mm SL, Monterey Bay, California, USA; MNHN 1884-487 (holotype of *Polyneumus californiensis* Thominot), 179 mm SL, California, USA; USNM 15129, 123 mm SL, Panama; USNM 41393, 174 mm SL, Panama; USNM 43265, 143 mm SL, Guaymas, Gulf of California, Mexico; USNM 46488 (3 specimens), 78–91 mm SL, San Juan, Mexico; USNM 46876, 183 mm SL, Panama; USNM 47464, 225 mm SL, Mazatlán, Mexico; USNM 53517, 143 mm SL, Ecuador; USNM 65621, 152 mm SL, Panama; USNM 77637, 161 mm SL, Tumbes, Peru; USNM 79873 (2), 168–197 mm SL, Panama; USNM 82194, 61 mm SL, Chame, Panama; USNM 94015, 95 mm SL, Ecuador; USNM 94041, 112 mm SL, Panama; USNM 114468 (5), 181–228 mm SL, Guatemala; USNM 127891 (2), 122–188 mm SL, Puerto Pizarro, Peru;

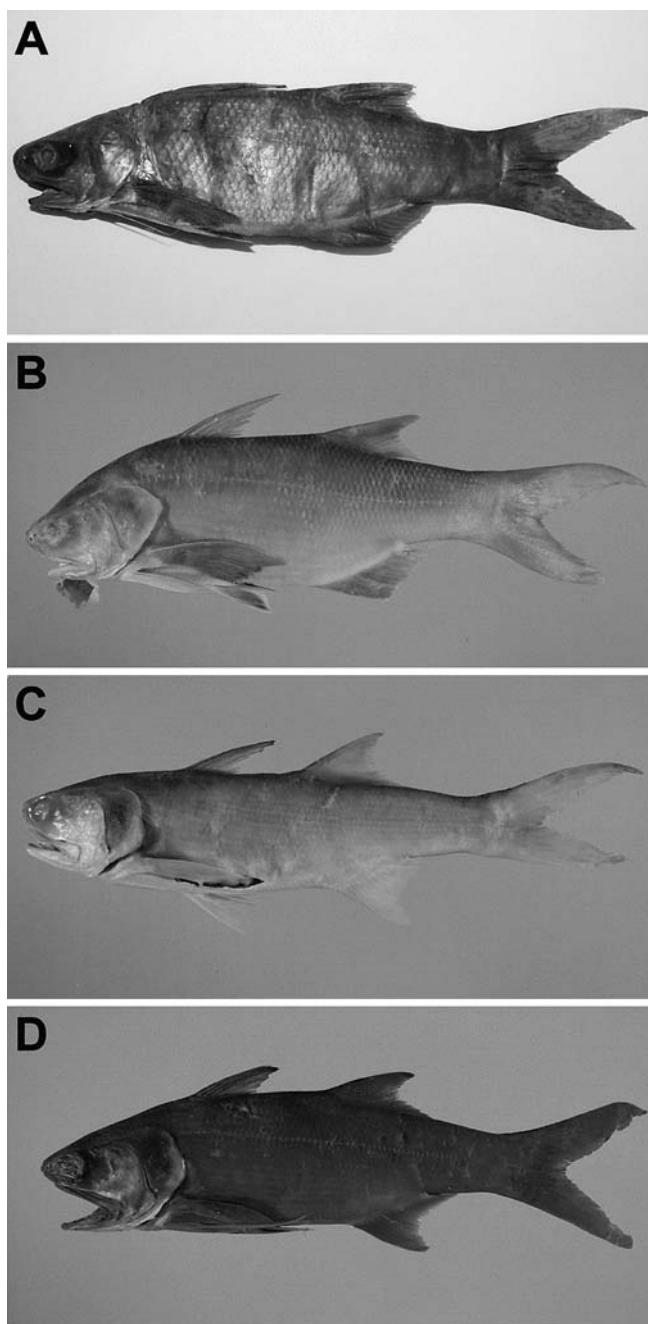


Fig. 1. *Polydactylus approximans* (A, B) and *Polydactylus opercularis* (C, D). **A** MNHN 1884-487 (holotype of *Polyneumus californiensis* Thominot), 179 mm SL, California. **B** BMNH 1866.1.14.6 (previously regarded as syntype of *Polyneumus approximans* Lay and Bennett), 215 mm SL, Panama. **C** BMNH 1864.1.26.321 (holotype of *Polyneumus melanopoma* Günther), 263 mm SL, Guatemala. **D** USNM 41054, 179 mm SL, Panama

USNM 127892, 165 mm SL, Puerto Pizarro, Peru; USNM 127893, 96 mm SL, Lobos de Tierra Island, Peru; USNM 177788 (1 of 8 specimens), 30 mm SL, off Nicaragua (11°58' N, 91°30' W); USNM 177789, 34 mm SL, off Oaxaca, Mexico (15°24' N, 97°20' W); USNM 177808 (3), 92–136 mm SL, San Blas, Nayarit, Mexico; USNM 181256, 24 mm SL, San Jose, Guatemala; USNM 181276 (1 of 7 specimens), 60 mm SL, Gulf of Nicoya, Costa Rica; USNM 181280 (1 of 3 specimens), 37 mm SL,

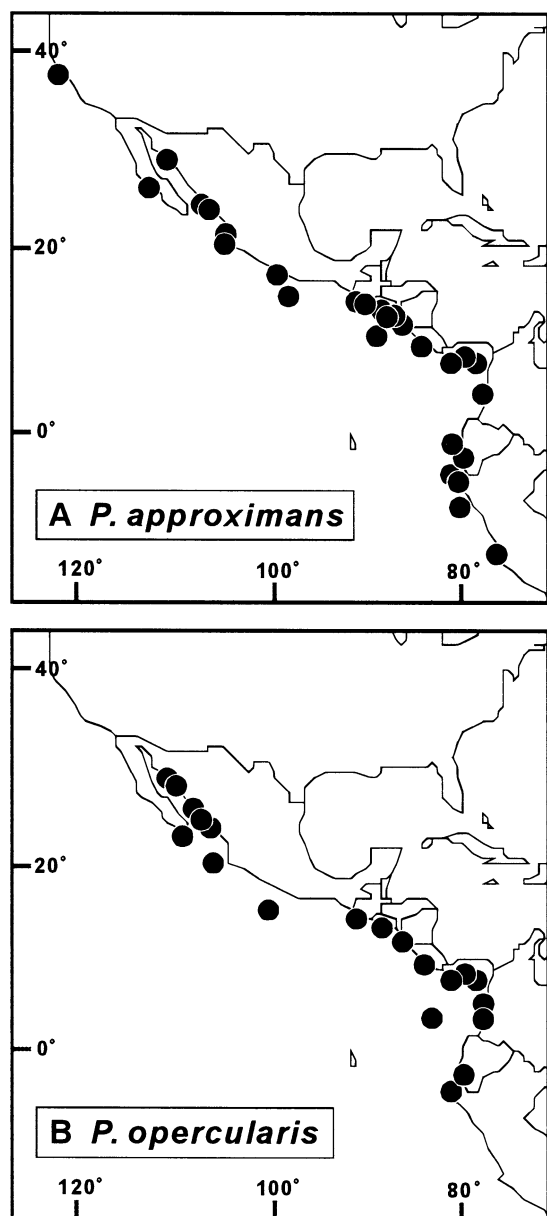


Fig. 2. Geographic distribution of **A** *Polydactylus approximans* and **B** *Polydactylus opercularis*, based only on specimens examined in this study

22.4 km south of Maria Cleofas Island, Marias Islands, Mexico; USNM 220698, 138 mm SL, Jiquilisco, El Salvador; USNM 220779, 201 mm SL, Jiquilisco, El Salvador; USNM 220784 (3), 136–148 mm SL, La Caramba, Jiquilisco Bay, El Salvador; USNM 290055 (2), 151–155 mm SL, Colombia; USNM 304426 (4), 56–82 mm SL, 8.32 km north of Mazatlán, Mexico; USNM 321984 (3), 101–138 mm SL, El Rompio, Panama; USNM 321985, 205 mm SL, Chitré, Panama; USNM 366749 (2), 109–133 mm SL, off Gulf of Fonseca, El Salvador; USNM 366761, 120 mm SL, off Gulf of Fonseca, El Salvador; USNM 366766, 75 mm SL, off Gulf of Fonseca, El Salvador.

Diagnosis. A species of *Polydactylus* with the following combination of characters: 6 (rarely asymmetrically 6 and 7, 2 of 58 specimens) pectoral filaments, longest filament not extending beyond level of posterior end of anal fin base; 56–

63 (mode 60) pored lateral line scales; lip on lower jaw well developed, dentary teeth restricted to dorsal surface; vomerine teeth present; maxilla not covered with scales; lateral line bifurcated on caudal fin membranes, extending to posterior margins of upper and lower caudal fin lobes; swimbladder present, small; body grayish, no stripes or spots.

Description. Counts and proportional measurements as percentages of SL of *Polydactylus approximans*, including the holotype of *Polynemus californiensis*, are given in Table 1. Characters given in the diagnosis of the species are not repeated here.

Body oblong, compressed; obtusely conical snout projecting strongly beyond upper jaw; occipital profile nearly straight in young, becoming somewhat concave with growth; adipose eyelid well developed; posterior margin of maxilla not reaching to or extending slightly beyond level of posterior margin of adipose eyelid; lip on upper jaw thin; teeth villiform in broad bands on vomer, palatines, and ectopterygoids; tooth plate on palatines wider than those on ectopterygoids; shape of vomerine tooth plate crescentic or elliptic; posterior margin of preopercle serrated; all first dorsal fin spine bases of similar thickness; first spine of first dorsal fin very small; third spine of first dorsal fin longest, posterior tip of third spine sometimes extending well beyond level of second dorsal fin origin; first spine of anal fin very small, third spine longest; bases of dorsal, pectoral, anal, and caudal fin covered with scales; all pectoral fin rays unbranched, posterior tip not reaching to or extending beyond level of posterior tip of pelvic fin; pectoral fin insertion well below midline of body; first pectoral filament shortest, just reaching to or extending slightly beyond level of pelvic fin origin; second to fourth pectoral filaments extending beyond level of pelvic fin origin; length of fifth pectoral filament variable, from not reaching level with posterior margin of pelvic fin to just reaching level with anal fin origin; sixth pectoral filament longest, just short of level of anal fin origin or reaching to near midpoint of anal fin base; poorly developed membranes present near base on dorsal margins of pectoral filaments; caudal fin deeply forked, upper and lower caudal fin lobes not filamentous; formula for configuration of supraneural bones, anterior neural spines, and anterior dorsal pterygiophores 0/0/0 + 2/1 + 1/1/1/1/1; 10 + 14 vertebrae.

Color when fresh.—Head and body gray dorsally, silver ventrally; anterior margins of first and second dorsal fins black, remaining parts dusky; pectoral fin dusky; base of pectoral filaments white, becoming blackish on posterior tips; base and posterior margin of pelvic fin white, remaining parts dusky; posterior margin of anal fin white, remaining parts dusky; margins of caudal fin black, remaining parts dusky.

Color of preserved specimens.—Head and body brown dorsally, pale yellowish-silver ventrally; first and second dorsal, anal, and caudal fins uniformly pale yellow; intensity of pectoral fin pigmentation variable from dense black to translucent; pectoral filaments pale yellow; base of pelvic fin pale yellow, posterior margin of pelvic fin white or translucent, remaining parts grayish-black.

Table 1. Counts and measurements of eastern Pacific *Polydactylus* species, expressed as percentages of standard length

| | <i>Polydactylus approximans</i> | | <i>Polydactylus opercularis</i> | |
|---|--|---|---|---|
| | Holotype of <i>Polynemus californiensis</i> MNHN 1884-487 | Non-types of <i>Polydactylus approximans</i> <i>n</i> = 57 | Holotype of <i>Polynemus melanopoma</i> BMNH 1864.1.26.321 | Non-types of <i>Polydactylus opercularis</i> <i>n</i> = 53 |
| Standard length (mm) | 179 | 24–228 | 263 | 19–309 |
| Counts | | | | |
| Dorsal fin rays | VIII-I, 12 | VIII-I, 11–13 | VIII-I, 12 | VIII-I, 11–13 |
| Anal fin rays | III, 14 | III, 13–15 | III, 13 | III, 12–14 |
| Pectoral fin rays | 15 | 14–16 | 16 | 14–16 |
| Pectoral filaments | 6 | 6–7 | 9 | 8–9 |
| Pelvic fin rays | I, 5 | I, 5 | I, 5 | I, 5 |
| Pored lateral line scales | 58 | 56–63 | 71 | 66–74 |
| Scales above/below lateral line | 8/12 | 7–8/11–13 | 9/12 | 7–10/12–15 |
| Gill rakers | 12 + 17 = 29 | 11–14 + 15–18 = 26–31 | 16 + 19 = 35 | 13–18 + 17–20 = 31–37 |
| Measurements | | | | |
| Head length | 29 | 28–35 (31) | 32 | 29–33 (31) |
| Body depth at 1st dorsal fin origin | 27 | 25–32 (30) | 26 | 25–29 (27) |
| Body depth at 2nd dorsal fin origin | 29 | 29–34 (32) | 25 | 25–29 (27) |
| Body width at pectoral fin base | 12 | 10–16 (13) | 12 | 12–16 (13) |
| Snout length | 4 | 5–6 (5) | 5 | 4–6 (5) |
| Dermal eye opening | 6 | 6–7 (6) | 5 | 5–7 (6) |
| Orbit diameter | 7 | 7–8 (7) | 7 | 5–8 (7) |
| Interorbital width | 8 | 7–8 (7) | 7 | 7–8 (7) |
| Postorbital length | 17 | 16–21 (19) | 22 | 19–22 (20) |
| Upper jaw length | 13 | 13–15 (14) | 18 | 16–18 (17) |
| Depth at posterior margin of premaxilla | 4 | 3–4 (3) | 4 | 3–4 (3) |
| Pre-1st dorsal fin length | 35 | 36–40 (38) | 36 | 34–37 (35) |
| Pre-2nd dorsal fin length | 62 | 63–68 (65) | 61 | 61–63 (62) |
| Preanal fin length | 58 | 57–64 (64) | 68 | 61–68 (65) |
| Pelvic fin origin to anal fin origin | 22 | 20–27 (23) | 31 | 23–31 (27) |
| Second dorsal fin base length | 15 | 14–17 (15) | 15 | 14–16 (15) |
| Anal fin base length | 23 | 20–23 (22) | 16 | 16–18 (16) |
| Longest pectoral fin length | 25 | 24–32 (28) | 22 | 20–24 (22) |
| Longest pectoral filament length | 34 | 35–48 (41) | 32 | 30–41 (36) |
| Pectoral fin base length | 10 | 9–12 (10) | 10 | 9–10 (9) |
| Longest pelvic fin ray length (1st) | 16 | 16–17 (16) | 16 | 14–17 (16) |
| Longest 1st dorsal fin spine length (3rd) | 22 ^a | 16–26 (23) | 19 | 17–21 (19) |
| Second dorsal fin spine length | — | 7–11 (9) | 7 | 6–8 (7) |
| Longest 2nd dorsal fin ray length (2nd) | 20 ^a | 22–26 (24) | 19 | 18–21 (19) |
| Longest anal fin spine length (3rd) | 8 | 6–10 (9) | 6 | 6–8 (7) |
| Longest anal fin ray length (2nd) | 18 | 17–22 (20) | 18 | 16–20 (18) |
| Caudal peduncle length | 22 | 21–26 (23) | 22 | 21–23 (22) |
| Caudal peduncle depth | 15 | 14–16 (15) | 12 | 11–13 (12) |
| Upper caudal fin lobe length | 35 ^a | 37–43 (40) | 35 ^a | 31–38 (35) |
| Lower caudal fin lobe length | 33 ^a | 35–40 (37) | 31 ^a | 30–36 (33) |

Means in parentheses include type data

^aTip slightly broken

Distribution and habitat. *Polydactylus approximans* is currently known from the eastern Pacific Ocean, where it ranges from Monterey Bay, California, USA, to Callao, Peru (Fig. 2A), being relatively common in the Central American region in latitudes between 5° and 20° N. Grove and Lavenberg (1997) reported a single small example (LACM W53–178) collected from the Galápagos Islands, the species normally being considered to occur rarely around the

islands. Although Pequeño (1989) listed *Polydactylus approximans* and *Polydactylus opercularis* from Chile, such records remain unsubstantiated.

Although the species generally inhabits muddy or sandy bottoms in coastal waters and estuaries, larvae and juveniles (less than ca. 40 mm SL) sometimes occur at the water surface several hundred kilometers offshore (Grove and Lavenberg, 1997). Most of the collection data available indi-

cate that the specimens were taken from depths less than 30 m.

Remarks. *Polydactylus approximans* was originally described as *Polynemus approximans* by Lay and Bennett (1839), on the basis of a brief sketch and description by Mr. Collie. Eschmeyer (1998) questioned the status of two syntypes of *Polynemus approximans*, registered as BMNH 1863.12.16.30 and BMNH 1866.1.14.6 (see Fig. 1B), the original description of the species giving no indication of type specimens. Although the type locality of the species was given as San Blas and Mazatlán, west coast of Mexico (Lay and Bennett, 1839), the collection data of the two BMNH specimens indicated they had been collected from Panama. Furthermore, according to Lay and Bennett (1839), Mr. Collie investigated the anatomy of the stomach, pyloric caeca, and intestine of the species. Although the abdomen of one of the two BMNH specimens (BMNH 1866.1.14.6) has been cut, the slit is very small and not sufficient for observation of the internal organs. Moreover, the specimen used for the sketch by Mr. Collie measured ca. 178 mm (probably TL) and 25 mm wide (Lay and Bennett, 1839), whereas BMNH 1863.12.16.30 and BMNH 1866.1.14.6 are 107 mm SL (caudal fin lobe tip damaged but ca. 141 mm TL) and 11 mm wide, and 215 mm SL (ca. 293 mm TL) and 30 mm wide, respectively. Accordingly, we conclude that the two BMNH specimens of *Polydactylus approximans* are not type material of *Polynemus approximans*, the original specimens most likely having been lost.

According to the original description, *Polynemus approximans* was characterized by having six pectoral filaments and grayish body color, characteristics consistent with those of specimens considered here as *Polydactylus approximans*. Although Lay and Bennett (1839) quoted the absence of a swimbladder in the species from the brief description by Mr. Collie, the presence of a swimbladder was confirmed by our examination of seven USNM specimens (see Materials and Methods). The swimbladder was apparently overlooked by Mr. Collie due to its very small size (length ca. 13% of SL).

Polynemus californiensis was originally described by Thominot (1886) from California, USA, on the basis of a single specimen (MNHN 1884-487, 179 mm SL; Fig. 1A). The only subsequent reference to the species was by Blanc and Hureau (1971), who listed it as the same species with *Polydactylus approximans* in the type catalogue of the Muséum national d'Histoire naturelle, giving neither reasons nor an indication of materials examined. The holotype of *Polynemus californiensis* has the following characters: lip on lower jaw well developed, dentary teeth restricted to dorsal surface; maxilla not covered with scales; lateral line bifurcated on caudal fin membranes, extending to posterior margins of upper and lower caudal fin lobes. These characters, and meristics and proportional measurements (listed in Table 1) agreed well with those of specimens considered here as *Polydactylus approximans* (see Table 1). Accordingly, *Polynemus californiensis* is herein regarded as a junior synonym of *Polydactylus approximans*.

Polydactylus opercularis (Gill, 1863)

(English name: yellow bobo)

(Spanish name: barbudo nueve barbas)

(Figs. 1C, 1D, 2B)

Trichidion opercularis Gill, 1863: 168 (type locality: west coast of Central America, probably Cape San Lucas, Baja California, Mexico; see Remarks).

Polynemus melanopoma Günther, 1864: 148 (type locality: San José, Guatemala).

Material examined. 54 specimens, 19–309 mm SL. BMNH 1864.1.26.321 (holotype of *Polynemus melanopoma* Günther), 263 mm SL, San José, Guatemala; CAS SU 51242, 136 mm SL, off Chira Islands, Gulf of Nicoya, Costa Rica; CAS SU 51252, 31 mm SL, Jalisco, Mexico; USNM 41054, 179 mm SL, Panama; USNM 41218, 85 mm SL, Panama; USNM 50343 (2 specimens), 210–236 mm SL, Panama; USNM 65622 (3), 109–187 mm SL, Panama; USNM 76811, 215 mm SL, Panama; USNM 79870, 270 mm SL, Panama; USNM 79871, 264 mm SL, Panama; USNM 79878, 132 mm SL, Panama; USNM 119740, 137 mm SL, Guaymas, Gulf of California, Mexico; USNM 127890, 309 mm SL, off Puerto Pizarro, Peru; USNM 177799 (2), Sinaloa, Gulf of California, Mexico; USNM 177800, Sonora, Gulf of California, Mexico; USNM 181254 (1 of 2 specimens), 19 mm SL, off Guerrero, Mexico (16°6' N, 100°19' W); USNM 181257, 27 mm SL, Malpelo Island, Colombia; USNM 181262 (2), 47–48 mm SL, south of Corinto, Nicaragua; USNM 181287 (5), 140–160 mm SL, Topolobampo, Gulf of California, Mexico; USNM 181320, 208 mm SL, San Blas, Nayarit, Gulf of California, Mexico; USNM 200371, 267 mm SL, Tumbes, Peru; USNM 367307 (3), 202–246 mm SL, Gulf of Panama, Panama; USNM 367308 (2), 158–185 mm SL, south of Buenaventura, Colombia; USNM 367166, 174 mm SL, off Punta Ampala, Gulf of Fonseca, El Salvador; USNM 367309 (18), 159–252 mm SL, Punta Coco, Colombia.

Diagnosis. A species of *Polydactylus* with the following combination of characters: 9 (rarely 8, 2 of 54 specimens; asymmetrically 8 and 9, 1 of 54 specimens) pectoral filaments; 66–74 (mode 70) pored lateral line scales; anterior parts of lower jaw with villiform teeth extending onto lateral surface, adjacent portion of lip poorly developed in larger specimens; vomerine teeth present; maxilla covered with small deciduous scales; lateral line unbranched, extending to upper end of lower caudal fin lobe; swimbladder absent; body, especially fins, yellowish, no stripes or spots.

Description. Counts and proportional measurements as percentages of SL of *Polydactylus opercularis*, including the holotype of *Polynemus melanopoma*, are given in Table 1. Characters given in the diagnosis of the species are not repeated here.

Body oblong, compressed; obtusely conical snout projecting strongly beyond upper jaw; occipital profile nearly straight throughout life; adipose eyelid well developed; posterior margin of maxilla extending well beyond level of posterior margin of adipose eyelid; lip on upper jaw thin; teeth villiform in broad bands on vomer, palatines, and ectopterygoids; tooth plate on palatines wider than those on ectopterygoids; shape of vomerine tooth plate nearly square; posterior margin of preopercle serrated; all first dorsal fin spine bases of similar thickness; first spine of first dorsal fin very small; third spine of first dorsal fin longest, posterior tip of third spine not reaching to level of second

dorsal fin origin; first spine of anal, fin very small, third spine longest; bases of dorsal, pectoral, anal, and caudal fin covered with scales; all pectoral fin rays unbranched, posterior tip not reaching to level of posterior tip of pelvic fin; pectoral fin insertion well below midline of body; first pectoral filament shortest, not reaching to or extending slightly beyond level of posterior tip of pelvic fin; lengths of second to ninth pectoral filaments similar, extending beyond level of posterior tip of pelvic fin or level of anal fin origin, sometimes not reaching to level of posterior tip of pelvic fin; entire well-developed membranes present on dorsal margins of pectoral filaments; caudal fin deeply forked, upper and lower caudal fin lobes not filamentous; formula for configuration of supraneural bones, anterior neural spines, and anterior dorsal pterygiophores $/0/0+1/2/1 + 1/1/1/1/1/$; $10 + 14$ vertebrae.

Color when fresh.—Head and body pale green dorsally, silver ventrally; posterior margins of first and second dorsal fins dark yellow, remaining parts dusky; pectoral fin dusky; base of pectoral filaments white, becoming yellow on posterior tips; posterior tip of pelvic fin yellow, remaining parts white; base of anal fin white, remaining parts vivid yellow; lower caudal fin lobe dark yellow, upper lobe dusky.

Color of preserved specimens.—Head and body brown dorsally, yellowish-silver ventrally; first and second dorsal, pectoral, anal, and caudal fins uniformly pale yellow; pectoral filaments white.

Distribution and habitat. *Polydactylus opercularis* is currently known from the eastern Pacific Ocean (Fig. 2B), where it ranges from northern Los Angeles Harbor, California, USA, to off Paita, Peru (Hildebrand, 1946), being relatively rare north of Baja California, Mexico. The record from off Paita, Peru, was based on a single juvenile specimen (12 mm total length; Hildebrand, 1946). The species generally inhabits muddy or sandy bottoms in coastal waters and estuaries, but also occurs along sandy beaches (Allen and Robertson, 1994). Most of the collection data available indicate that the specimens were taken from depths less than 46 m.

Remarks. *Polydactylus opercularis* was originally described by Gill (1863) (as *Trichidion opercularis*) on the basis of a single specimen, which has apparently been lost. Although Gill (1863) gave no detailed locality for the holotype, the type locality having since been widely regarded only as “west coast of Central America,” Hildebrand (1946) noted the type locality of the species as Cape San Lucas, Baja California, Mexico. Because the holotype had been held in the National Museum of Natural History, Smithsonian Institution, Washington, DC, USA (see Gill, 1863: 162), the collections to which Hildebrand had considerable access (see Hildebrand, 1946: 6), there is every possibility that he had taken the information from a label stored with the holotype before its loss. Accordingly, the type locality of *Trichidion opercularis* is most likely Cape San Lucas, Baja California, Mexico.

According to the original description, *Trichidion opercularis* was characterized by having eight pectoral filaments and the anal fin tinged with orange, characteristics consistent with those of specimens considered here as

Polydactylus opercularis. Subsequently, Günther (1864) described *Polynemus melanopoma* as a new species from San José, Guatemala, on the basis of a single specimen (BMNH 1864.1.26.321, 263 mm SL; Fig. 1C). The taxonomic status of that species has remained unquestioned to date, the species having apparently been overlooked by subsequent researchers. Our examination of the holotype of *Polynemus melanopoma* and the specimens considered here as *Polydactylus opercularis* showed that they represented a single species (see Table 1). Accordingly, the former is herein regarded as a junior synonym of *Polydactylus opercularis*.

Seale and Bean (1907) overlooked Gill's (1863) *Trichidion opercularis* and described *Polydactylus opercularis* as a new species on the basis of a single specimen (USNM 57844, 124 mm SL) from Zamboanga, Mindanao, Philippines. Jordan and Richardson (1910) recognized this designation as a secondary homonym, thereby providing the replacement name, *Polydactylus sealei*, for Seale and Bean's *Polydactylus opercularis*. Although Jordan and Richardson (1910) considered Gill's *Trichidion opercularis* and Seale and Bean's *Polydactylus opercularis* as belonging to the same genus (*Polydactylus*), the former and latter are presently regarded as valid species, *Polydactylus opercularis* and *Filimanus sealei*, respectively (Feldes, 1991; this study).

Comparisons

Comparisons of *Polydactylus approximans* with related congeners. *Polydactylus approximans* and six Indo-Pacific *Polydactylus* species, *Polydactylus longipes* Motomura, Okamoto and Iwatsuki, *Polydactylus malagasyensis* Motomura and Iwatsuki, *Polydactylus nigripinnis* Munro, *Polydactylus persicus* Motomura and Iwatsuki, *Polydactylus sexfilis* (Valenciennes), and *Polydactylus sextarius* (Bloch and Schneider), are characterized by having 6 pectoral filaments (Motomura et al., 2000a, 2001a,g; Motomura and Iwatsuki, 2001b; Motomura and Senou, 2002). However, *Polydactylus approximans* is distinguished from the other six species by having a bifurcated lateral line (unbranched in the latter). The lateral line condition of *Polydactylus approximans* is also found in an Indian Ocean species, *Polydactylus bifurcus* Motomura, Kimura and Iwatsuki, and all three currently recognized western Atlantic species, *Polydactylus octonemus* (Girard), *Polydactylus oligodon* (Günther), and *Polydactylus virginicus* (Linnaeus) (see Motomura et al., 2001d: fig. 3A). *Polydactylus approximans* differs from the above four species in having usually 6 pectoral filaments (5 in *Polydactylus bifurcus*, usually 7 in *Polydactylus oligodon* and *Polydactylus virginicus*, and usually 8 in *Polydactylus octonemus*; Motomura et al., 2001d).

Polydactylus approximans has a scale-less maxilla, that character also being found in the three western Atlantic species and an eastern Atlantic species, *Polydactylus quadrifilis* (Cuvier), other congeners (distributed in the Indo-Pacific and eastern Pacific) having the maxilla with deciduous scales, the size and number of scales being both intra- and interspecifically variable.

Comparisons of *Polydactylus opercularis* with related congeners. *Polydactylus opercularis* is easily distinguished from its congeners by having usually 9 pectoral filaments (usually 4–8 filaments in the latter; see Motomura et al., 2000a,b, 2001a,c,d,g,j, 2002b; Motomura and Iwatsuki, 2001b; Motomura and Senou, 2002; this study). The pectoral filaments in a western Atlantic species, *Polydactylus octonemus*, although usually 8, infrequently number 9, thereby overlapping with *Polydactylus opercularis*, which has 8 pectoral filaments on rare occasions (Table 2). However, *Polydactylus octonemus* differs from the latter in having lower pored lateral line scale counts [mode 59 (range 56–64) vs. 70 (66–74) in the latter], well-developed lower jaw lips throughout life (lips on anterior parts of lower jaws poorly developed in larger specimens), and a swimbladder (absent).

The condition of the lower jaw lips and teeth (anterior parts of lower jaw with villiform teeth extending onto lateral surface, adjacent portion of lip poorly developed) found in larger *Polydactylus opercularis* is unique among the genus, although the condition is also found in all stages of *Leptomelanosoma indicum* (Shaw), distributed in the Indo-West Pacific (Motomura and Iwatsuki, 2001a), and in larger *Parapolyneumus verekeri* (Saville-Kent), occurring in southern New Guinea and northern Australia (Feltes, 1993).

Polydactylus opercularis lacks a swimbladder, such condition being found also in three Indo-West Pacific species, *Polydactylus multiradiatus* (Günther), *Polydactylus nigripinnis*, and *Polydactylus siamensis* Motomura, Iwatsuki and Yoshino (Motomura et al., 2001c, 2002b). *Polydactylus opercularis* can be easily distinguished from the others by having 9 pectoral filaments (5 in *Polydactylus siamensis*, 6 in *Polydactylus nigripinnis*, and 7 in *Polydactylus multiradiatus*; see Motomura et al., 2001c, 2002b).

Comparisons between eastern Pacific *Polydactylus*. *Polydactylus approximans* can be easily distinguished from *Polydactylus opercularis* by having lower counts of pectoral filaments [6 on each side (rarely asymmetrically 6 and 7) or sometimes 5 on each side, according to Grove and Lavenberg (1997) vs. 9 on each side (rarely 8 on each side or asymmetrically 8 and 9) in the latter], pored lateral line scales [56–63 (mode 60) vs. 66–74 (70)], scale rows above and below the lateral line [7 or 8 (7) and 11–13 (12) vs. 7–10 (8) and 12–15 (13), respectively] and gill rakers [upper series 11–14 (13), lower 15–18 (17), and total 26–31 (30) vs. 13–18 (16), 17–20 (19), and 31–37 (34), respectively], and higher counts of anal fin soft rays [13–15 (14) vs. 12–14 (13)] (see Table 2).

In addition to these meristic characters, *Polydactylus approximans* differs from *Polydactylus opercularis* in having the following distinct morphological characters: lip on lower jaw well developed, dentary teeth restricted to dorsal surface (anterior parts of lower jaw with villiform teeth extending onto lateral surface, adjacent portion of lip poorly developed in larger *Polydactylus opercularis*); maxilla scale less (covered with small deciduous scales); lateral line bifurcated on caudal fin membranes, extending to posterior margins of upper and lower caudal fin lobes (lateral line

Table 2. Frequency distributions of selected meristic characters of eastern Pacific *Polydactylus* species

| | Dorsal fin soft rays | | | Anal fin soft rays | | | Pectoral fin rays | | | Pectoral filaments (right/left side) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|---------------------------------|----|----|--------------------|----|----|-------------------|----|----|--------------------------------------|-----|-----|-----|-----|-----|-------------------|----|----|----|----|----|----|----|----|----|----|----|---|---|---|-------------------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| | 11 | 12 | 13 | 12 | 13 | 14 | 15 | 14 | 15 | 16 | 6/6 | 6/7 | 8/8 | 8/9 | 9/9 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>P. approximans</i> | 3 | 54 | 1 | — | 16 | 37 | 5 | 5 | 45 | 8 | 56 | 2 | — | — | — | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>P. opercularis</i> | 6 | 45 | 3 | 3 | 48 | 2 | — | 6 | 40 | 8 | — | — | 2 | 1 | 51 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Pored lateral line scales | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 56 | 57 | 58 | 59 | 60 | 61 | 62 | 63 | — | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | | | | | | | | | | | | | | | | | | |
| <i>P. approximans</i> | 2 | 4 | 9 | 13 | 15 | 8 | 3 | 1 | — | — | — | — | — | — | — | — | — | — | 45 | 10 | — | — | — | 11 | 42 | 2 | — | — | | | | | | | | | | | | | | | | | |
| <i>P. opercularis</i> | — | — | — | — | — | — | — | — | — | 2 | 5 | 8 | 8 | 20 | 7 | 3 | — | 1 | 4 | 38 | 11 | 1 | — | — | 8 | 43 | 2 | 1 | | | | | | | | | | | | | | | | | |
| | Scales above/below lateral line | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Upper gill rakers | | | | | | | | | | | | | | | Lower gill rakers | | | | | | | | | | | | | | | Total gill rakers | | | | | | | | | | | | | | |
| | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 15 | 16 | 17 | 18 | 19 | 20 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | | | | | | | | | | | | | | | | | | | |
| <i>P. approximans</i> | 8 | 21 | 25 | 3 | — | — | — | — | 1 | 11 | 33 | 12 | — | — | 1 | 3 | 9 | 14 | 20 | 10 | — | — | — | — | — | — | — | — | — | — | | | | | | | | | | | | | | | |
| <i>P. opercularis</i> | — | — | 1 | 6 | 20 | 22 | 3 | 1 | — | — | — | 1 | 12 | 29 | 11 | — | — | — | — | 2 | 2 | 10 | 14 | 13 | 9 | 3 | | | | | | | | | | | | | | | | | | | |

^a Anal fin ray counts based on 53 specimens

unbranched, extending to upper end of lower caudal fin lobe); swimbladder present (absent).

Comparative material examined. All from Atlantic Ocean. *Polydactylus octonemus*: ANSP 22900 (syntype of *Polynemus octonemus* Girard), 62 mm SL; USNM 739 (2 syntypes of *Polynemus octonemus* Girard), 62–79 mm SL; USNM 15074 (holotype of *Trichidion octofilis* Gill), 166 mm SL; USNM 48883, 164 mm SL; USNM 93603 (2 specimens), 86–102 mm SL; USNM 155666, 126 mm SL; USNM 156107 (2), 73–113 mm SL; USNM 156112 (3 of 4 specimens), 73–114 mm SL; USNM 156119, 135 mm SL. *Polydactylus oligodon*: BMNH 1848.1.12.890 (paralectotype of *Polynemus oligodon* Günther; stuffed specimen), 146 mm SL; USNM 19961, 292 mm SL; USNM 120740, 135 mm SL; USNM 364370 (4), 111–113 mm SL. *Polydactylus quadrifilis*: ISH (at ZMH) 298-1959, 214 mm SL; MNHN 756 (holotype of *Polynemus quadrifilis* Cuvier; lacking caudal fin and half of caudal peduncle), 380 mm from anterior tip of snout to posterior end of remaining peduncle; MNHN 1906-0212, 189 mm SL; MNHN 1967-0789 (2), 181–231 mm SL; MNHN 1978-0355, 129 mm SL; MNHN 1979-0483, 147 mm SL; MNHN 1991-0918 (2), 128–132 mm SL; MNHN 1999–1104, 92 mm SL; MNHN 1999–1110, 74 mm SL; USNM 193684, 328 mm SL; USNM 320435, 153 mm SL. *Polydactylus virginicus*: MNHN 5504 (syntype of *Polynemus americanus* Cuvier), 141 mm SL; MNHN A. 3028 (syntype of *Polynemus americanus* Cuvier), 157 mm SL; MNHN A. 3031 (syntype of *Polynemus americanus* Cuvier), 121 mm SL; MSNG 6695 (holotype of *Polynemus antillarum* Perugia), 84 mm SL; USNM 9835, 155 mm SL; USNM 41324 (1 of 13 specimens), 149 mm SL; USNM 50145, 190 mm SL; USNM 79872 (2), 149–182 mm SL; USNM 79875, 186 mm SL; USNM 79877, 140 mm SL; USNM 156875, 189 mm SL; USNM 185186, 110 mm SL; USNM 185330, 136 mm SL; USNM 185454, 152 mm SL; USNM 186064 (3), 122–138 mm SL; USNM 290237, 157 mm SL; USNM 367193, 146 mm SL; USNM 367194, 167 mm SL. Comparative materials from Indo-Pacific are listed in Motomura et al. (2000a–c, 2001a–j, 2002a–c), Motomura and Iwatsuki (2001a,b), Motomura and Senou (2002), and Motomura and Sabaj (2002).

Acknowledgments We are grateful to the following persons and institutions for specimen loans and providing references: M.H. Sabaj (ANSP); J. Maclaine (BMNH); W.N. Eschmeyer, T. Iwamoto, D. Catania, and J. Fong (CAS); P. Pruvost and G. Duhamel (MNHN); S.L. Jewett, J.T. Williams, L. Palmer, S.J. Raredon, S. Smith, and K. Hoshino (USNM), and H. Wilkens (ZMH). We also thank Y. Motomura (Hiratsuka, Japan) for her assistance and G.S. Hardy (Ngunguru, New Zealand), who read the initial manuscript and offered helpful comments. This study was supported in part by a grant awarded to the first author by Research Fellowships of the Japan Society for the Promotion of Science for Young Scientists (Tokyo, Japan).

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 north-west Atlantic. *Bull Mar Sci* 26:285–402
- Allen GR (1981) Polynemidae. In: Fischer W, Bianchi G, Scott WB (eds) FAO species identification sheets for fishery purposes: eastern central Atlantic. Fishing area 34 and 47 (in part), vol 3. FAO, Ottawa, pp 1–2 + “POLYN Gal 1” to “POLYN Polyd 4”
- Allen GR, Robertson DR (1994) Fishes of the tropical eastern Pacific. Crawford House, Bathurst
- 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
- Bussing WA, López S MI (1994) Demersal and pelagic inshore fishes of the Pacific coast of lower central America. An illustrated guide. *Rev Biol Trop (Spec Publ)*:1–164
- Castro-Aguirre JL, Espinosa Pérez HS, Schmitter-Soto JJ (1999) Ictiofauna estuarino-Lagunar y vicaria de México. Colección Textos Politécnicos, Balderas
- Chirichigno F N, Vélez D J (1998) Clave para identificar los peces marinos del Perú (Segunda edición, revidada y actualizada). Instituto del Mar del Parú, Callao
- Eschmeyer WN (ed) (1998) Catalog of fishes, vol 1. Introductory materials, species of fishes, A–L. California Academy of Sciences, San Francisco
- Eschmeyer WN, Herald ES (1983) A field guide to Pacific coast fishes of North America from the Gulf of Alaska to Baja California. Peterson field guide series. Houghton Mifflin, Boston
- Feltes RM (1991) Revision of the polynemid fish genus *Filimanus*, with the description of two new species. *Copeia* 1991:302–322
- Feltes RM (1993) *Parapolyneumus*, a new genus for the polynemid fish previously known as *Polynemus verekeri*. *Copeia* 1993:207–215
- Gill TN (1863) Descriptive enumeration of a collection of fishes from the western coast of Central America, presented to the Smithsonian Institution by Captain John M. Dow. *Proc Acad Nat Sci Phila* 15:162–174
- Grove JS, Lavenberg RJ (1997) The fishes of the Galápagos Islands. Stanford University Press, Stanford
- Günther A (1864) Report of a collection of fishes made by Messrs. Dow, Godman, and Salvin in Guatemala. *Proc Zool Soc Lond* 1864:144–154
- Hildebrand SF (1946) A descriptive catalog of the shore fishes of Peru. *Bull US Natl Mus* (189):i–xi + 1–530
- Hubbs CL, Lagler KF (1947) Fishes of the Great Lakes region. *Bull Cranbrook Inst Sci* (26):i–xi + 1–186
- Jordan DS, Richardson RE (1910) Check-list of the species of fishes known from the Philippine Archipelago, publ no 1. Dept. of the Interior, Bureau of Science, Manila
- Lacepède BGE (1803) Histoire naturelle des poissons, vol 5. Plassan, Paris
- Lay GT, Bennett ET (1839) Fishes. In: Beechey FW (ed) The zoology of Captain Beechey's voyage/compiled from the collections and notes made by Captain Beechey, the officers and naturalist of the expedition, during a voyage to the Pacific and Behring's Straits performed in His Majesty's ship Blossom, under the command of Captain F. W. Beechey in the years 1825–28. Henry G Bohn, London, pp 41–75
- 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
- Mabee PM (1988) Supraneural and predorsal bones in fishes: development and homologies. *Copeia* 1988:827–838
- 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, Sabaj MH (2002) A new subspecies, *Polynemus melanochir dulcis*, from Tonle Sap Lake, Cambodia, and redescription of *P. m. melanochir* Valenciennes in Cuvier and Valenciennes, 1831 with designation of a neotype. *Ichthyol Res* 49:181–190

- Motomura H, Senou H (2002) Record of *Polydactylus sexfilis* (Perciformes: Polynemidae) from Hachijo-jima, Izu Islands, Japan with comments on morphological changes with growth and speciation of related species. *Bull Kanagawa Pref Mus (Nat Sci)* (31):27–31
- 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 Cent 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 with English abstract). *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 with English abstract). *Japan J Ichthyol* 46:41–47
- 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* 48:203–206
- 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 (2002a) Revision of the Indo-West Pacific polynemid fish genus *Eleutheronema* (Teleostei: Perciformes). *Ichthyol Res* 49:47–61
- Motomura H, Johnson JW, Iwatsuki Y (2002b) A taxonomic assessment and redescription of *Polydactylus multiradiatus* (Günther, 1860), with a synopsis of other Australian species in the genus (Perciformes: Polynemidae). *Austral J Zool* 50 (in press)
- Motomura H, Kullander SO, Yoshino T, Iwatsuki Y (2002c) Review of seven-spined *Polynemus* species (Perciformes: Polynemidae) with designation of a neotype for *P. paradiseus* Linnaeus, 1758. *Ichthyol Res* 49:307–317
- Njock JC (1990) Polynemidae. In: Quéro J-C, Hureau J-C, Karrer C, Post A, Saldanha L (eds) Check-list of the fishes of the eastern tropical Atlantic, vol 3. UNESCO, Paris, pp 865–867
- Pequeño G (1989) Peces de Chile. Lista sistemática revisada y comentada. *Rev Biol Mar* 24:1–132
- Randall JE (1978) Polynemidae. In: Fischer W (ed) FAO species identification sheets for fishery purposes: western central Atlantic. Fishing area 31, vol 1. FAO, Rome, pp 1–2 + “POLYN Polyd 1” to “POLYN Polyd 3”
- Robins CR, Ray GC (1986) A field guide to Atlantic coast fishes of North America. Peterson field guide series. Houghton Mifflin, Boston
- Schneider M (1995) Polynemidae. In: Fischer W, Krupp F, Schneider W, Sommer C, Carpenter KE, Niem VH (eds) Guía FAO para la identificación de especies para los fines de la pesca: Pacífico centro-oriental, vol 3. FAO, Rome, pp 1386–1387
- Seale A, Bean BA (1907) On a collection of fishes from the Philippine Islands, made by Major Edgar A. Mearns, surgeon, U.S. Army, with descriptions of seven new species. *Proc US Natl Mus* 33:229–248
- Talwar PK, Jhingran AG (1992) Inland fishes of India and adjacent countries, vol 2. Balkema, Rotterdam
- Thomiot A (1886) Sur quelques poissons nouveaux appartenant à la collection du Muséum d'Histoire Naturelle. *Bull Soc Philomath Paris Ser 7* 10:161–168