



A new species of *Bregmaceros* (Gadiformes: Bregmacerotidae) from the eastern Pacific Ocean, with comments on *B. atlanticus* and *B. japonicus*

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Abstract

A new species of *Bregmaceros* is described based on a series of specimens from the eastern Pacific Ocean from near the Hawaiian Islands eastward to the California Current region. The new species bears considerable similarity in body shape and pigmentation to other overall darkly pigmented species with moderately high anal-fin counts (51–59 in *B. moseri*) and modified prehaemal anal-fin pterygiophores (*B. atlanticus* and *B. japonicus*). The form and occurrence of these modified pterygiophores among *Bregmaceros* species is discussed. The new species is distinguished from *B. atlanticus* and *B. japonicus* and other undescribed forms in the historical literature commonly referred to *Bregmaceros* “*mccllelandi*” based on its high precaudal (prehaemal) vertebral counts (15 or 16 vs. 13–15, typically 14) and associated elongation of the anterior portion of the body, and dark pigmentation concentrated dorsally on body and on head dorsal to nares anteriorly and operculum posteriorly but little or no pigment on lateral and ventral surfaces of head. The new species uniquely shares with these other species the modified prehaemal anal-fin pterygiophores and a lack of posterior bifurcation of the coelomic space otherwise present in the remaining species in the genus.

Key words: Bregmacerotidae, eastern Pacific Ocean, mesopelagic fishes, taxonomy

Introduction

The bregmacerotids have been the subject of several reviews, the most extensive being those of D’Ancona & Cavinato (1965) and Belyanina (1974). Houde (1984) recognized eight species, noting the existence of one additional undescribed species (*B. houdei* Saksena & Richards, 1986). There had been little consensus among authors as to the number of species in the single genus *Bregmaceros* and some authors had rather expansive views as to intraspecific variation and made some unjustified synonymizations. Based on the contents of both D’Ancona & Cavinato (1965) and Belyanina (1974) we infer that some of the species were placed into synonymy without examining the type specimens or presenting evidence in support of these actions. In particular, *B. mccllelandi* is a name that has been widely applied to various forms, very few of which compare well with that described initially by Thompson (1840) (Torii *et al.*, 2003a). A number of works have been published recently that provide information on some of the type material (Harold & Golani, 2016; Torii *et al.*, 2003b, c) and describe three new species (Ho *et al.*, 2020a, b; Torii *et al.*, 2004).

Fifteen of the 20 nominal species of *Bregmaceros* are valid according to Eschmeyer’s Catalog of Fishes (Fricke *et al.*, 2022), including the recent synonymization of *B. pescadorus* Shen, 1960 with *B. nectabanus* Whitley, 1941 by Ho *et al.* (2020b). We recognize the following as the valid species of *Bregmaceros*: *B. anchovia* Ho, Endo & Lee in Ho, Endo, Lee & Chu, 2020; *B. arabicus* D’Ancona & Cavinato, 1965; *B. atlanticus* Goode & Bean, 1886; *B. bathymaster* Jordan & Bollman, 1890; *B. cantori* Milliken & Houde, 1984; *B. cayorum* Nichols, 1952; *B. houdei* Saksena & Richards, 1986; *B. japonicus* Tanaka, 1908; *B. lanceolatus* Shen, 1960; *B. mccllelandi* Thompson, 1840; *B. nectabanus* Whitley, 1941; *B. neonectabanus* Masuda, Ozawa & Tabeta, 1986; *B. pseudolanceolatus* Torii, Javonillo & Ozawa, 2004; *B. rarisquamosus* Munro, 1950; and *B. retrodorsalis* Ho & Endo in Ho, Endo & Chu, 2020.

Two of the recognized species were described recently (*B. anchovia* and *B. retrodorsalis*) and the current description will bring the total to 16. We are aware of more undescribed species of *Bregmaceros*, but detailed study of the material and its analysis are yet to be completed. A review of the genus is planned but at this time we propose the single new species to make the name available now so as to contribute to stability of classification of these forms similar to *B. atlanticus* and *B. japonicus* in the Pacific Ocean.

In their review of the early stages of *Bregmaceros* from the California Current region, Stevens & Moser (1996) reported two species: *B. bathymaster* and the larvae of another form, *Bregmaceros* sp. (Stevens & Moser, 1996: 480–481, fig. Bregmacerotidae 2), that they stated represented an undescribed species (Hare *et al.*, 2006), a conclusion with which we concur, based on our examination of juvenile and adult material from the Hawaiian Islands vicinity and further east near the California Current. Based on meristic values presented by Stevens & Moser (1996: especially 13–15 precaudal vertebrae and 50–60 anal-fin rays), it appears that at least some of their specimens probably represent the species described here as new, but those with precaudal vertebral counts of 13 (and possibly 14) are a different, unidentified species.

Świdnicki (1991) described the osteology of four species of *Bregmaceros*, one of which was nominally *B. japonicus*. A number of the details presented by Świdnicki (1991), as well as the location at which it was collected, indicated that his “*B. japonicus*” is not that species but is actually the species described herein as new. We also note that the material of *B. maclellandi* reported by Świdnicki (1991) is not that species, but represents another undescribed member of the genus to be treated in another paper, and we refer to it herein provisionally as *Bregmaceros* sp. 5. The material upon which Świdnicki’s (1991) osteological descriptions of *B. japonicus* were based was collected at the same general latitude and longitude off Oahu as the type locality of the new species (see below), although not from a lot we have been able to examine.

Materials and methods

Specimen length is standard length (SL) in mm. Morphometric, meristic, and other characters were determined following the methods and terminology of Hubbs & Lagler (1958), with modifications by D’Ancona & Cavinato (1965) and Harold & Golani (2016). Counts of rays for the second dorsal fin, anal fin, pectoral fin, and pelvic fin are the total number of rays (rudimentary rays included). Number of rays in the caudal fin are reported as the total number of elements, including segmented and procurrent rays. Fin rays and counts of other serially repeating structures were determined from alcohol-preserved specimens, cleared and stained preparations, or from radiographic images. Two cleared and counter-stained specimens were prepared following Pottoff (1984) and Tyler & Van Dyke (1985), and, in addition to radiographs, were the basis of observations on osteological features. Cleared and stained specimens are indicated in the Material Examined section by the annotation “C&S” with the catalog number, number of specimens cleared and stained, and the range of their standard lengths. Osteological terminology specific to *Bregmaceros* species is based on Świdnicki (1991).

The number of rays in each fin is the total number, including both branched and rudimentary rays. Longitudinal scale count is the number of scales in a longitudinal series from the pectoral girdle to the posterior termination of the vertebral column (posterior margin of hypural plate); transverse scale count is the number of horizontal scale rows between the origins of the second dorsal fin and the anal fin; predorsal scale count is the number of lateral-line scales along the dorsum (anterior, elevated portion of the lateral line) between the occiput and the origin of the second dorsal fin. These scale counts are made with difficulty due to the deciduous nature of the scales and so they were determined only for a small number of the types.

Morphometric characters were measured with a digital Mitutoyo caliper and recorded in spreadsheet software. The following morphometric characters were determined: SL; preanal length, distance from snout (most anterior location on the premaxilla for all relevant morphometric characters) to anal-fin origin; prepectoral length, distance from snout to base of lateralmost pectoral-fin ray; prepelvic length, distance from snout to base of lateralmost pelvic-fin ray; predorsal length, distance from snout to origin of second dorsal fin; postdorsal length, distance from origin of second dorsal fin (D2) to posterior termination of vertebral column (mid-lateral posterior margin of hypural plate); dorsal fin to anal fin length, distance from origin of D2 to origin of anal fin; dorsal fin to pectoral fin length, distance from D2 to base of lateralmost pectoral fin ray; HL, head length, maximum distance between snout and bony posterior margin of gill cover; postorbital head length, maximum distance between bony posterior margins

of orbit and gill cover; orbital diameter, maximum horizontal distance through orbit; interorbital width, minimum distance across cranium between orbits; caudal-peduncle depth, minimum body depth at caudal peduncle; caudal-peduncle length, distance from base of posteriormost anal-fin ray to posterior termination of vertebral column; pectoral-fin length, distance from base to tip of longest pectoral-fin ray; pelvic-fin length, distance from base to tip of longest pelvic-fin ray; first dorsal-fin (D1) length, distance from base to tip of occipital dorsal-fin ray; second dorsal-fin length, distance from base to tip of longest fin ray of second dorsal fin; anal-fin length, distance from base to tip of longest anal-fin ray. Values of morphometric characters are reported as % SL, except those within the head (i.e., orbital length, postorbital length, and interorbital width) which are % HL. Snout length is not used due to difficulty in standardization (much of the anterior margin of the orbit is occupied by the enlarged curved margin of the lachrymal).

Observations on the holotype of *B. japonicus* are based on those reported by Masuda and Ozawa (1979). Abbreviations of terms used in material examined: mwo, meters of wire out; Sta., collection station. Material examined is listed by institutional acronym and catalog number; institutional abbreviations are as listed in Sabaj (2020, 2022).

Family Bregmacerotidae

Bregmaceros moseri Harold & Baltzegar, sp. nov.

(New common name: Gyre codlet)

(Figs. 1–6; Table 1)

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FIGURE 1. *Bregmaceros moseri*, sp. nov., holotype, 44.2 mm SL, USNM 325144, off Oahu, Hawaiian Islands.

Bregmaceros sp.: Stevens & Moser, 1996: 480–481, fig. Bregmacerotidae 2 (California Current and vicinity, early stages 2.2–14.0 mm).

Bregmaceros japonicus (non Tanaka): Świdnicki, 1991: 130 (description of osteology; specimens collected at or near type locality of *B. moseri*, 21°N, 158°20'W, Oahu, Hawaii, p. 146, 16 precaudal vertebrae).

Holotype. USNM 325144 (1 of 11 in lot originally, 44.2 mm), 21°00'N, 158°20'W (southwest of Oahu Is.), R/V *El Pescadero IV*, Field No. 71-6-24, 0049–0253 h, 17 Jun. 1971.

Paratypes. SIO 96-42 (2, 45.5–50.5 mm), 15°17'S, 112°00'W (southeast Pacific), EASTROPAC Expedition Sta. 75.133, 08 Mar. 1968. SIO 97-98 (4, 39.9–48.7 mm), 24°N, 139°W, R/V *David Starr Jordan* Cruise 7210, Sta. 24.139, 29 Oct. 1972. USNM 466574 (3, 22.3–40 mm), 0–270 m, 01°03' to 01°07'S, 158°00'W (south of the Line Islands), NORPAX-79 Expedition, R/V *Gyre* Sta. 79-5-10, 19 May 1979. USNM 466575 (8, 23.6–47.6 mm), 21°20' to 21°30'N, 158°20' to 158°30'W (off Oahu Is.), 0–80 m, coll. T.A. Clarke, Field No. 71-9-1, 1958–2135 h, 17 Sep. 1971. USNM 466576 (11, 32.2–43.2 mm; 2 C&S, 40.2–44.8 mm), collected with the holotype. USNM 466573 (3, 20.4–41.0 mm), 0–320 m, 01°52' to 01°58'S, 153°08' to 153°09'W, NORPAX-79 Expedition, R/V *Wecoma* Sta. 79-9-1, 0400–0558 h, 02 Sep. 1979.

Non-types. SIO 73-17 (1, 45.6 mm), 09°52.8'N, 113°50'W, R/V *Aries I*, 19 Nov. 1970. SIO 75-130 (6, 25.4–41.9 mm), 12°32'N, 118°54'W, Field No. J57-019, 26 Apr. 1990. SIO 92-57 (2, 43.2–48.2 mm), 06°06'N, 104°29'W, EASTROPAC Expedition Sta. 30.183, 14–15 Jul. 1967. SIO 97-112 (2, 44.7–47.9 mm), 21°45'N, 118°00'W, R/V *David Starr Jordan* Cruise 7210, Sta. 140.120, 0202 h, 08 Nov. 1972.

TABLE 1. Morphometric and meristic character values for *Bregmaceros moseri* as % SL or % HL based on the holotype, 12 paratypes, and 14 non-types.

	Holotype	Paratypes		Non-types	
		Range	Mean	Range	Mean
Standard length (mm)	44.2	33.7–50.5	43.3	29.2–48.2	39.7
% SL					
Preanal length	38.2	36.0–39.9	37.9	37.6–40.3	38.9
Prepectoral length	17.1	15.3–18.3	16.8	16.2–18.2	17.6
Prepelvic length	12.0	10.4–13.3	11.9	7.4–11.3	9.7
Predorsal length	42.6	38.6–44.4	40.3	38.2–42.5	40.2
Postdorsal length	61.1	55.5–64.1	59.7	57.4–61.6	60.0
Dorsal fin (D2) to anal fin	13.2	10.9–13.4	11.8	11.8–13.3	12.8
Dorsal fin (D2) to pectoral fin	28.4	20.8–26.3	23.9	20.7–23.4	22.3
Head length	16.2	14.2–17.2	15.7	14.4–17.7	16.4
Caudal-peduncle depth	5.1	4.3–5.4	4.9	5.0–5.7	5.3
Caudal-peduncle length	5.8	5.8–7.2	6.6	6.0–7.5	6.6
Pectoral-fin length	9.6	8.1–11.1	9.4	9.7–11.7	11.1
Pelvic-fin length	49.4	39.8–58.1	49.2	50.0–60.6	54.0
Dorsal-fin (D2) ray length	18.3	12.5–17.8	16.1	14.0–18.6	17.0
Anal-fin ray length	14.8	11.1–19.7	16.6	15.3–19.8	17.9
% HL					
Postorbital head length	60.2	50.9–61.3	56.4	51.6–62.4	56.2
Orbital length	24.7	20.7–25.8	23.0	19.4–22.8	21.2
Interorbital width	22.4	18.8–27.0	23.4	18.3–25.2	21.5
Meristic characters					
Dorsal-fin (D2) rays	54	50–56	53.3	51–56	54.0
Anal-fin rays	56	51–59	56.1	56–59	57.5
Pectoral-fin rays	16	16–21	18.8	18–20	18.8
Precaudal vertebrae	16	15–16	15.2	15–16	15.3
Caudal vertebrae	42	38–43	40.2	39–43	41.4
Total vertebrae	58	52–58	55.4	54–58	56.8
Total caudal-fin rays	36	34–37	35.5	34–37	35.4

Diagnosis. A species of *Bregmaceros* Thompson with high precaudal vertebral counts (15 or 16), as compared with typically 13 or 14 (but 15 in *B. anchovia*, 14–16 in *B. neonectabanus*, and 14 or 15 in *B. retrodorsalis*), high longitudinal and predorsal scale counts (89–91 and 21–26, respectively), and concentrated dark pigment along dorsum with ventral portion of head unpigmented, especially cheek, jaws, throat, operculum, and ventral of nares. Dentary teeth caniniform, greatest tooth length two to three times greater than that of premaxillary teeth. Premaxillary postmaxillary process absent.

Description. Description based on 26 specimens. Morphometric and meristic characters summarized in Table 1. Body shape and general arrangement and shapes of fins typical of species of *Bregmaceros*.

Maximum observed adult body size 50.5 mm SL. Body elongate anteriorly relative to other *Bregmaceros* species (predorsal length 38.2–44.4 % SL), compared with generally less than 40% in similar species, e.g., *B. atlanticus* (Fig. 2); particularly apparent in large number of small scales: longitudinal scales 89–91 (holotype, 91) and predorsal scales 21–26 (25). Precaudal vertebrae 15 or 16 (16). Slightly compressed. Maximum body depth located at about origin of D2. Dorsal profile of body horizontal from occiput to just anterior to D2, and slightly inflected at D2 origin; profile straight from that point posteriorly to posterior lobe of D2 where it is slightly convex. Ventral body profile slightly sinuous, with bases of anterior and posterior lobes of anal fin convex. Anteriormost well-developed anal-fin pterygiophore bilaterally divergent, as in *B. atlanticus* and *B. japonicus*. Caudal fin slightly

emarginate with 14 principal fin rays; dorsal and ventral procurrent fin rays each 11 to 13. Total caudal-fin rays 34–37.

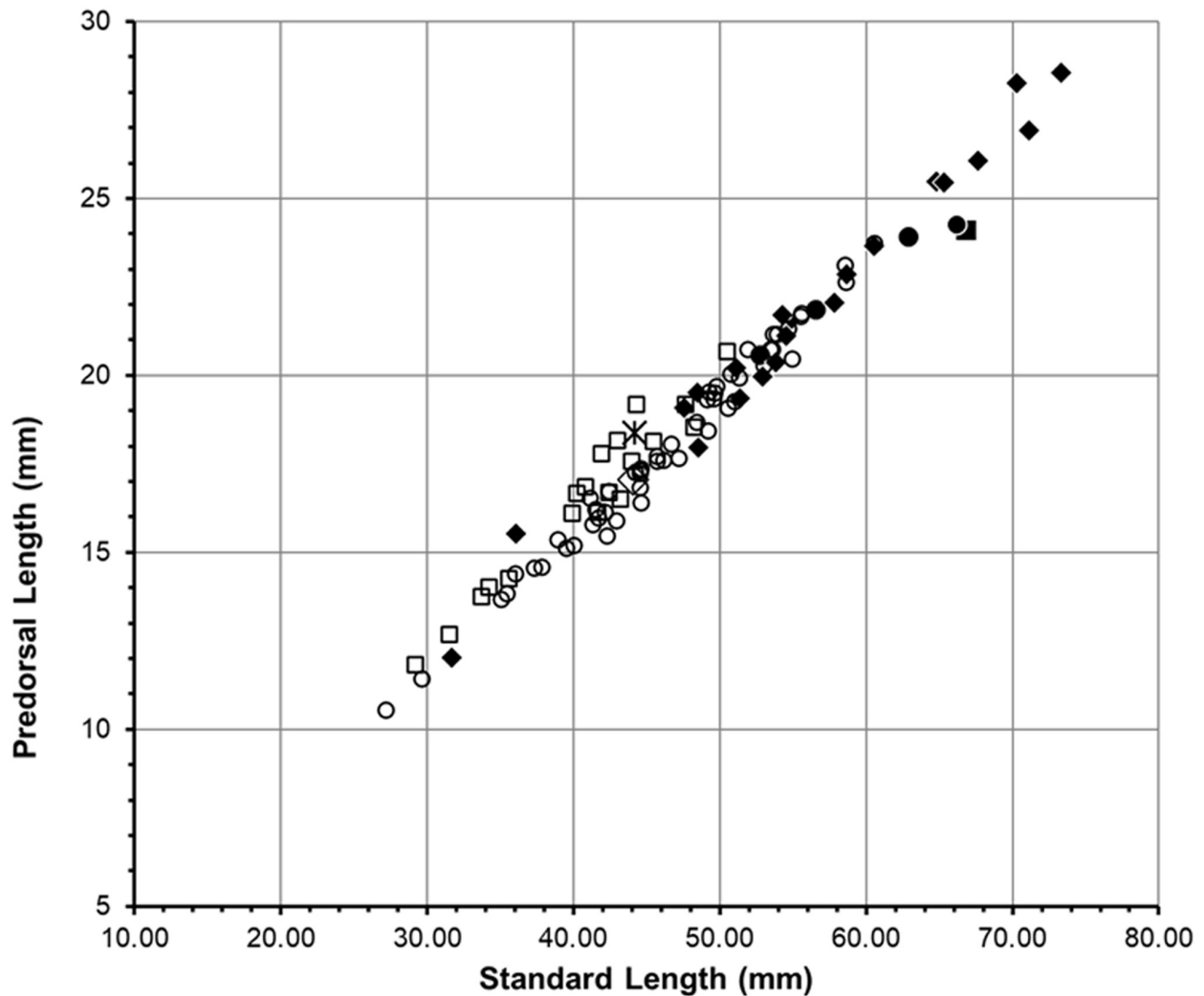


FIGURE 2. Scatterplot of untransformed predorsal length versus standard length (mm) for *Bregmaceros atlanticus* holotype, open diamond; *B. atlanticus* non-types, solid diamonds; *Bregmaceros* cf. *atlanticus* (Indian Ocean), open circles; *B. japonicus* holotype, solid square; *B. japonicus* paratypes, solid circles; *B. moseri* holotype, asterisk; *B. moseri* paratypes and non-types, open squares.

Head small, 14.2–17.7 % SL. Snout slightly rounded and short, approximately equal in length to that of orbit. Adipose eyelid narrow, covering posterodorsal one quarter of eye. Nares located at level of dorsal half of orbit, separated from orbit by large lachrymal dorsal process. Upper jaw slightly shorter than lower; posterior tip of maxilla ventral to posterior 2/3 of eye. Premaxillary ascending process broad and lacking postmaxillary process (see description and figures for *B. japonicus*, Świdnicki, 1991: 139–140, fig. 8B); premaxillary teeth biserial, outer-row teeth larger than inner, continuous along premaxilla and with 34 to 38 conical teeth in series. Maxillary teeth absent. Dentary teeth biserial: outer-row teeth 20 to 27, conical, slightly shorter than those of premaxilla; inner-row teeth 12 to 14, recurved, about 2 to 3 times larger than outer-row teeth and those of premaxilla. Vomer with oblique row of 2 or 3 conical teeth on lateral processes. Palatine teeth absent. Photographs of cleared and stained specimen (USNM 466576, 40.2 mm) depict positions of modified opercular structure (Fig. 3A) and that of modified anal-fin pterygiophores (Fig. 3B) as described and illustrated below. Opercle elongate ventrally and broadly pointed, anterior margin broadly convex, posterior margin concave and bearing elongate posterodorsal spine or rod-like process with single termination (not branched as in *B. maclellandi sensu stricto*, Torii *et al.*, 2003a; *B. anchovia*, Ho *et al.*, 2020b) (Fig. 4A). Gill rakers reduced, as small dentigerous plates. Prehaemal anal-fin pterygiophore

modifications: in specimen 4 (USNM 466576, 44.8 mm), second anal-fin pterygiophore (i.e., first well-developed anal-fin pterygiophore) proximally divergent as broadly triangular transverse blade, first (anteriormost) anal-fin pterygiophore with similar albeit much smaller transverse blade with horizontal dorsal margin adhering via connective tissue to central portion of second (Fig. 4B). In the other cleared and stained specimen (40.2 mm), which has three prehaemal anal-fin pterygiophores, anteriormost and shortest is somewhat unmodified, but second and third have transverse blade-like processes. Remaining proximal anal-fin pterygiophores lack such bilateral modification.

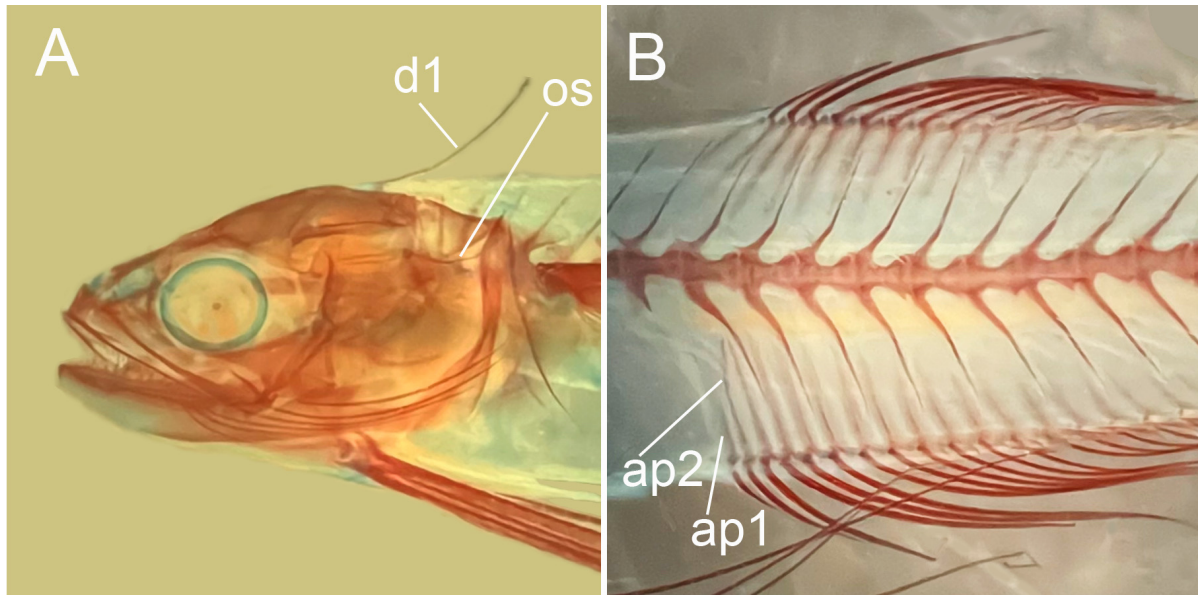


FIGURE 3. Cleared and stained preparations of *B. moseri*, USNM 466576, 40.2 mm, left lateral views. A, occipital first dorsal fin and location of opercle; B, modified pterygiophores at anterior base of anal fin. Abbreviations: ap1=anal-fin proximal pterygiophore 1; ap2=anal-fin proximal pterygiophore 2; d1=single ray of occipital first dorsal fin; os, opercular spine or rod-like process. Not to scale.

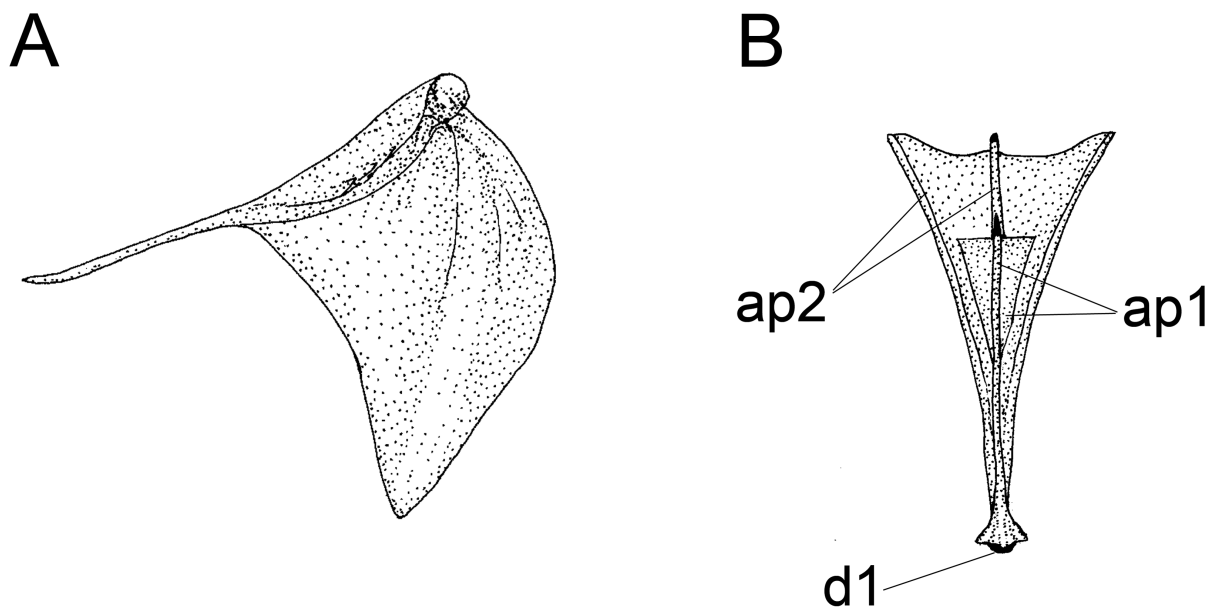


FIGURE 4. Osteological characters of *B. moseri*, USNM 466576, 44.8 mm. A, opercle, right lateral view; B, prehaemal anal-fin pterygiophores, anterior view. Abbreviations: ap1=anal-fin proximal pterygiophore 1; ap2=anal-fin proximal pterygiophore 2; d1=anal-fin distal pterygiophore 1. Not to scale.

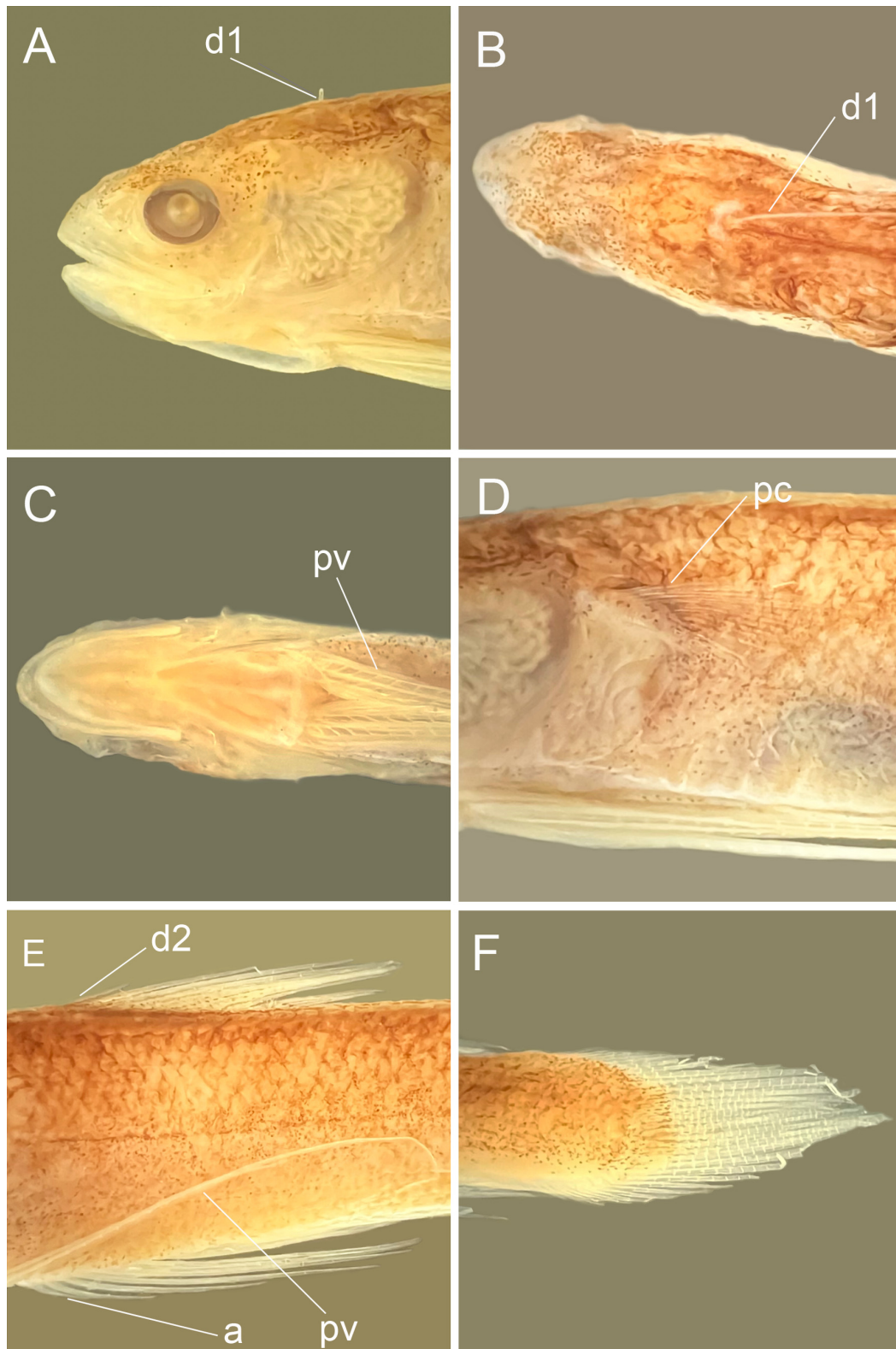


FIGURE 5. Pigmentation patterns and other features of *B. moseri*, holotype USNM 325144, 44.2 mm, except Fig. 5B (paratype, USNM 466576, 37.0 mm). A, lateral and dorsal surfaces of head with position of base of damaged anterior dorsal-fin ray shown; B, dorsal surface of head showing concentration of small chromatophores above eyes and posterior portion of snout, and proximal portion of intact occipital dorsal-fin ray; C, ventral surfaces of head and pelvic fins; D, lateral view of thoracic region, including left pectoral fin; E, lateral view of body trunk at anterior bases of second dorsal and anal fins; F, lateral view of caudal peduncle and fin. Abbreviations: a=anterior base of anal fin; d1=anterior (first/occipital) dorsal-fin ray, d2=posterior (second) dorsal fin, pc=pectoral fin, pv=pelvic fin. Not to scale.

Color in Preservative.—Dorsum, including dorsal portion of head, covered by diffuse moderately dark brown ground pigment (Fig. 5A, B) with scattered larger, dark chromatophores posterior to head and over dorsal half of body. Dorsal surface of head covered by scattered dark chromatophores except above eye and over pineal window where pigment cells are much more broadly scattered. Dark pigment also located directly posterior to eye but most of operculum, cheek, jaws, and ventral surfaces of head nearly unpigmented (Fig. 5C); approximately 10 to 20 widely scattered small dark chromatophores on lower part of cheek or on upper jaw in some specimens (Fig. 5A). Lateral portion of snout directly below nares unpigmented. Ventral half of body over abdomen and posterior to caudal-fin base covered with numerous, minute dot-like chromatophores. Dorsal and ventral margins of scale pockets along upper half of body darkly pigmented, giving overall appearance of reticulation (Fig. 5D, E). Minute dot-like chromatophores present from below second lobe of dorsal fin to caudal-fin base (Fig. 5F), and in some specimens longitudinal alignment of that pigment producing three or four fine parallel lines.

Anterior lobe of dorsal fin with large, dark brown chromatophores scattered over basal two thirds, remainder of fin unpigmented. Anal and pelvic fins unpigmented. Pectoral fin with large, dark brown chromatophores along medial and lateral portions of its base, and associated with basal one half of most rays; lateral three or four rays unpigmented. Diffuse, dark pigmentation present in recess medial to pectoral-fin base. Caudal fin with diffuse, dark brown pigment confined to basal one half of principal rays; procurrent rays unpigmented. Internal pigmentation not apparent in cleared specimens.

Juveniles as small as 22 mm SL examined had general pigmentation pattern similar to that described above but lack delineation of scales. Flanks largely unpigmented except for series of stellate chromatophores scattered over abdomen. A 14.0 mm juvenile illustrated by Stevens & Moser (1996: fig. Bregmacerotidae 2) likely to represent *B. moseri* shows uniform covering of dark chromatophores, including caudal peduncle.

Distribution.—Known only from the east central to eastern Pacific, including as far west as the Hawaiian Islands, to the south near the Line Islands, and eastward to the vicinity of the California Current (Fig. 6). There is little information available relating to the vertical distribution of *B. moseri*, but it is probably upper mesopelagic: maximum tow depths 80 m (1958–2135 h), 270 m (times not available), and 320 m (0400–0558 h).

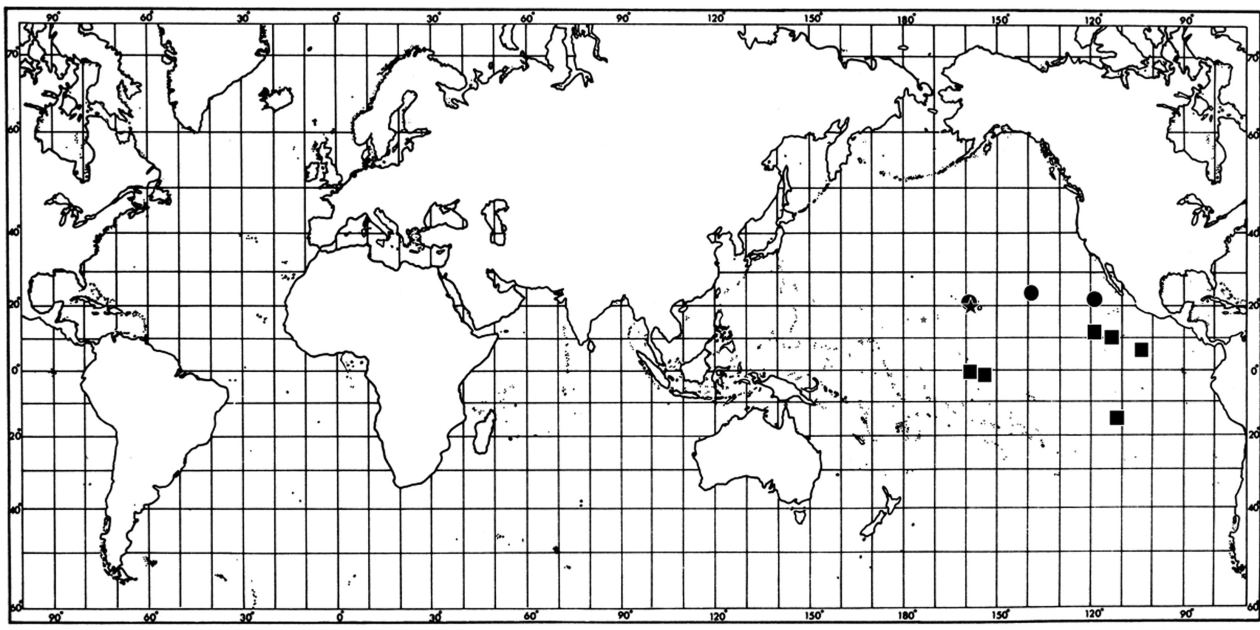


FIGURE 6. Map showing geographic positions of collections of *Bregmaceros moseri*. Solid star, type locality; solid circles, paratypes; solid squares, non-types.

Etymology.—The specific epithet *moseri* is based on the late H. Geoffrey Moser, who contributed hugely to our understanding of the biodiversity of mid-water fishes. In the *Early Stages of Fishes in the California Current Region*, Stevens & Moser (1996) referred to larval and post-metamorphic juveniles that, based on the data provided, are probably early stages of *B. moseri*.

Remarks and Discussion.—*Bregmaceros moseri* is most similar to *B. atlanticus*, *B. japonicus*, and another

widely distributed undescribed form. That undescribed species (“*Bregmaceros* sp. 5” herein), with higher anal-fin ray counts (59–67) than other species of *Bregmaceros*, has been frequently misidentified as *B. maclellandi*, in particular D’Ancona & Cavinato (1965), who took a rather expansive view of the variation in that species. These species are all rather darkly pigmented in comparison with most others in *Bregmaceros*. In particular, the dorsum pigment is rather dark and usually exhibits a reticulate appearance due to the delineation of the exposed margins of scales by small dark chromatophores. The new species is distinguished from *B. atlanticus* and *B. japonicus* by the high longitudinal scale counts in *B. moseri* (87–91) compared with 71–87 in *B. japonicus* (Nakabo, 2002) and 71–81 in *B. atlanticus* (present study), its high precaudal/prehaemal vertebral counts (15 or 16 in *B. moseri* versus typically 14 and occasionally 15 in *B. atlanticus* and 14 in *B. japonicus*), and the generally unpigmented lower lateral and ventral surfaces of the head in *B. moseri* versus the presence of widespread dark chromatophores in those areas of *B. atlanticus* and *B. japonicus*.

These three species all have an opercle bearing an unbranched elongate posterior rod-like process, a feature also present in *B. cayorum* and *B. rarisquamosus*, according to Torii *et al.*, (2003c), *B. bathymaster* and *B. houdei*, as described and illustrated by Świdnicki (1991), and also in *B. cantori* and *B. neonectabanus*, based on original data. The remaining species of *Bregmaceros* have a branched opercular termination. The three putatively related species, *B. atlanticus*, *B. japonicus*, and *B. moseri*, also have bilaterally divergent prehaemal anal-fin pterygiophores that, together with associated body-wall musculature and connective tissue, represent a unique structural complex situated immediately posterior to the coelomic cavity. According to Świdnicki’s (1991: 155) description, the anterior/prehaemal pterygiophores (“radials”) have a convex anterior margin and the upper (i.e., proximal) end is widened laterally, but it is not specified which of the species he examined in making that description nor did he report an anatomical dichotomy in anterior pterygiophore structure within the genus. Apart from *B. atlanticus*, *B. japonicus* (*s. str.*), and *B. moseri*, all other species of *Bregmaceros* have unmodified equivalent pterygiophores (e.g., *B. houdei* in Świdnicki, 1991: fig. 17C) and also elongate posterior branches of the coelomic cavity extending posteriorly on either side of the anal-fin proximal pterygiophores, which are observed to bear posterior portions of the gonads in some species. The posterior portion of the left ovary is apparently observable in *B. anchovia* through the body wall (Ho *et al.* 2020b: fig. 3E), an observation that is consistent with our own of other species of *Bregmaceros* we have dissected (e.g., *B. bathymaster*, *B. cantori*, *B. lanceolatus*, and *B. pseudolanceolatus*). We infer the presence of the divergent anal-fin proximal pterygiophore feature, based upon outgroup comparison to an array of gadiforms, to be a likely synapomorphy of a clade within *Bregmaceros* containing *B. atlanticus*, *B. japonicus*, *B. moseri*, and a number of other undescribed species bearing this feature (e.g., “*Bregmaceros* sp. 5”). Other gadiforms examined include *Euclichthys polynemus* McCulloch (Euclichthyidae), *Microgadus proximus* (Girard) and *Pollachius virens* (Linnaeus) (Gadidae), *Nezumia bairdii* (Goode & Bean) (Macrouridae), *Merluccius bilinearis* (Mitchill) (Merlucciidae), *Muraenolepis marmorata* Günther (Muraenolepididae), *Phycis chesteri* (Goode & Bean) and *Urophycis regia* (Walbaum) (Phycidae), *Raniceps raninus* (Linnaeus) (Ranicipitidae), and *Steindachneria argentea* Goode & Bean (Steindachneriidae). Of these gadiforms, *Steindachneria argentea* also has a bilaterally expanded anterior anal-fin pterygiophore but it differs in anatomical details from that of *Bregmaceros* species. Also, based on published phylogenetic studies of the Gadiformes (e.g., Markle, 1989; Howes, 1991; Roa-Varón *et al.*, 2021), *Steindachneria* is not closely related to the Bregmacerotidae and therefore the anatomical similarity is likely to be non-homologous.

Among these related species, *B. moseri* is most similar to *B. atlanticus* and *B. japonicus*, especially with the pigmentation pattern described above and meristic values that include anal-fin ray counts fewer than 60. Nevertheless, neither of those two species have precaudal vertebral counts of 15 or 16 or dark pigment on the head restricted for the most part to the dorsal/dorsolateral surfaces and with largely unpigmented snout, cheek, and lower part of the operculum. *Bregmaceros atlanticus* and *B. japonicus* both exhibit more general and diffuse head pigmentation dorsally and laterally without a marked ventral border. Belyanina (1974) set *B. japonicus* as a junior synonym of *B. atlanticus* and reported records of the species from the eastern Pacific. Some of those records may represent *B. moseri*, but the characteristic features of the new species, such as head pigmentation pattern and high precaudal vertebral counts, were not reported.

The osteological description of “*B. japonicus*” provided by Świdnicki (1991) is based on material from off Hawaii which is evidently the new species, *B. moseri*. Świdnicki’s (1991) descriptions and illustrations of the osteology are a most valuable source of information on the new species. His *B. “japonicus”* exhibits the rather high precaudal vertebral count and lack of a premaxillary postmaxillary process, both of which confirm our conclusion.

The latitude and longitude (21°N, 158°20'W) at which his “*B. japonicus*” material was collected (NMNH No. 71-6-36, inferred to be an *El Pescadero IV* station number) is the same (verbatim but rounded off) as the type locality of *B. moseri* (*El Pescadero IV* field number 71-6-24), although apparently from a different station.

Stevens & Moser (1996: 480, fig. Bregmacerotidae 2) described and illustrated larvae and juveniles of an undescribed species (also referenced by Hare *et al.*, 2006: 583) from the California Current. They were unable to identify these early stages (up to postflexion, 6.2–14.0 mm) by comparison to known valid species in this genus and referred them to *Bregmaceros* sp. It was one of two species of *Bregmaceros* from the California Current for which they reported early stages, the other being *B. bathymaster*. Their specimens do not compare well with those reported for other species and, based on their geographical occurrence, general pigmentation pattern, and meristic values, they are likely to be early stages of the species described here as new, however, we have not examined any material from the California Current. Although the nearest of our records are from further south at 12° 32'N, 118° 54'W (SIO 75-130) or to the west of the CalCOFI (California Cooperative Oceanic Fisheries Investigations) survey area, larvae and later stages are probably transported extensively within the eastern portion of the North Pacific Gyre and the Equatorial Current systems.

No species barcode sequences from verifiable conspecifics are currently available. A population/species-level phylogenetic study (A. Roa-Varón & A.S. Harold, unpubl.) will likely reveal molecular data that will further characterize the new species and contribute to an understanding of its phylogenetic position within the genus.

Comparative material examined

Bregmaceros atlanticus:

ATLANTIC OCEAN. GMBL 6267 (2, 39.8–48.5 mm), 28°59.9'N, 87°30.1'W (Gulf of Mexico), 10.7–1499.7 m, DEEPEND Expedition Cruise DP03, Sta. B175D-056-N0, 0958–1221 h, 13 May 2016. MCZ 32323 (1, 44.1 mm), HOLOTYPE, Caribbean and Straits of Florida, R/V *Blake*, Stations 045, 150, and 262 mixed, 1877, no other data available. MCZ 109991 (2, 31.7–48.5 mm), 11°12'N, 53°49'W (western North Atlantic, Amazonian), 0–140 m, R/V *Oceanus* Cruise 22, Field No. JEC7758, 28 Mar. 1977. USNM 47633 (1, 46.0 mm), PARATYPE, 17°8.4'N, 62°42.0'W (Caribbean Sea, off Nevis, Leeward Islands), 0–651 m, R/V *Blake*, Sta. 151, 15 Jan. 1879. USNM 256739 (3, 48.7–58.7 mm), 31°43.8'N, 63°34.8'W (Bermuda), 1235–1260 m, Ocean Acre Expedition Cruise 82, Sta. 82-43A, 1358–1658 h, 20 Mar. 1973. USNM 325139 (14, 51.4–73.4 mm), 9°0.0'N, 81°22.8'W (Caribbean Sea, off Panama) 0–457 m, R/V *Oregon* Cruise 78, Sta. 3599, 31 May 1962. USNM 325140 (2, 57.6–71.1 mm), 11°46.2'N, 69°15.0'W (Caribbean Sea, off Venezuela), 0–439 m, R/V *Oregon* Cruise 87, Sta. 4417, 4 Oct. 1963.

PACIFIC OCEAN. SIO 55-246 (1, 46.0 mm), 05°06.0'N, 078°09.0'W (eastern Pacific, off Colombia), 0–1436 m, bottom depth 3456–3731 m, EASTROPAC Expedition, near Hydro Sta. ET-H-46, 2050 h, 14 Nov. 1955. SIO 97-98 (4, 28.6–48.7 mm), 24° 00.0'N, 139° 00.0'W (central North Pacific), 0–bottom depth 3800 m, R/V *David Starr Jordan* Cruise 7210-JD, Sta. 24.139, 0040 h, 29 Oct. 1972. SIO 97-101 (2, 41.4–49.6 mm), 27°00.0'N, 135°00.0'W (central North Pacific), 0–443 m, bottom depth 4500 m, R/V *David Starr Jordan* Cruise 7210-JD, Sta. 27-135, 0131 h, 8 Oct. 1972. USNM 285548 (6, 18.2–46.8 mm), 15°5.0'N, 126°1.5'W (central North Pacific), 0–935 m, R/V *Oceanographer*, Hawaii Lab Project 76 Expedition, 20 Feb. 1976.

Bregmaceros cf. *atlanticus* (Indian Ocean):

INDIAN OCEAN. MCZ 108981 (10, 41.3–55.6 mm), 18°3.5'N, 65°5.5'E (Arabian Sea), 875 mwo, R/V *Anton Bruun* Cruise 6, Sta. 328A, Field No. APB7162, 17 May 1964. MCZ 108982 (10, 42.9–58.6 mm), 17°46.5'N, 65°2.5'E (Arabian Sea), 468 mwo, R/V *Anton Bruun* Cruise 06, Sta. 328B, Field No. APB7141, 18 May 1964. MCZ 109217 (9, 37.9–53.6 mm), 15°48.5'N, 65°0.5'E (Arabian Sea), 564 mwo, R/V *Anton Bruun* Cruise 06, Sta. 329B, Field No. APB7145, 19 May 1964. MCZ 138093 (2, 30.3–36.2 mm), 22°17.9'N, 60°44.2'E (Omani Basin, off Oman, Arabian Sea), 450–500 m, R/V *Malcolm Baldrige* Cruise 9503, Field No. MB9503: 10-34, 2, 23 May 1995. USNM 325147 (2, 61.0–64.4 mm), 25°31.0'S, 33°26.5'E (off Delagoa Bay, Mozambique), 450–455 m, R/V *Anton Bruun* Cruise 8, Sta. 396B, 28 Sep. 1964.

***Bregmaceros japonicus*:**

PACIFIC OCEAN. CAS (SU) 22420 (2, 56.5–66.2 mm), Okinose, Sagami Bay, Japan, collected by Tanaka, no other data available. ZUMT 2016 (2, 52.7–62.9 mm), PARATYPES, Sagami Bay, Japan, no other data available.

***Bregmaceros* sp. 5:**

ATLANTIC OCEAN. GMBL 6266 (1, 63.8 mm), 27°2.7'N, 90°5.1'W (Gulf of Mexico), 202.5–601 m, DEEPEND Expedition Cruise DP04, Sta. SW6N-059-N4, collected by T. T. Sutton, Field No. TS3927, 0213–0255 h, 6 Aug. 2016. MCZ 99312 (6, 32.8–75.0 mm), 20°48.0'N, 95°48.0'W (Gulf of Mexico), 0–100 m, R/V *Chain* Cruise 060, Field No. RHB1294, 17 Jun. 1966. MCZ 108985 (1, 62.4 mm), MCZ 108986 (1, 67.8 mm), MCZ 108987 (1, 66.8 mm), and MCZ 108988 (1, 56.8 mm), 00°1.5'N, 37°40.5'W (Equatorial Atlantic, Amazonian), 0–130 m, R/V *Oceanus* Cruise 22, Field No. JEC7713, 15 Mar. 1977. MCZ 109005 (1, 32.3 mm), 15° 43.5'N, 26°24.0'W (Equatorial, Guinean), 0–145 m, R/V *Atlantis II* Cruise 59, Field No. RHB2078, 25 Nov. 1970. MCZ 109076 (6, 37.3–54.2 mm), 27°1.5'N, 90°0.0'W (Gulf of Mexico), 85–95 m, R/V *Chain* Cruise 60, Field No. RHB1307, 22 Jun. 1966. MCZ 109985 (2, 60.9–61.4 mm), 3°58.5'N, 31°0.0'W (Equatorial Atlantic, Amazonian), 0–190 m, R/V *Oceanus* Cruise 22, Field No. JEC7722, 17 Mar. 1977. USNM 256735 (2, 43.9–68.2 mm), 32°10.8'N, 64°10.2'W (Bermuda), 0–150 m, Ocean Acre Expedition Cruise 12, Sta. 12-55N, 2240–2330 h, 20 Aug. 1971.

INDIAN OCEAN. MCZ 138083 (1, 61.2 mm), 5°35.6'N, 49°21.9'E (Arabian Sea), 1021–1421 m, R/V *Malcolm Baldrige*, Cruise 9503, Field No. MB9503:10-02, 2, 1016–1056 h, 5 May 1995. MCZ 138084 (1, 81.6 mm), 10°2.0'N, 52°3.9'E (Arabian Sea), 1006–1511 m, R/V *Malcolm Baldrige*, Cruise 9503, Field No. MB9503:10-07, 2, 1017–1035 h, 9 May 1995.

PACIFIC OCEAN. MCZ 97626 (1, 23.3 mm), 07°24.5'S, 150°49.5'E (Solomon Sea), 2384 mwo, bottom depth 1190 m, R/V *Lady Basten*, Field No. GRH1003, 15 May 1981. MCZ 97630 (1, 31.0 mm), 06°12.5'S, 152°11.5'E (Solomon Sea), 2388 mwo, bottom depth 1190 m, R/V *Lady Basten*, Field No. GRH1010, 19 May 1981. MCZ 97637 (1, 41.7 mm), 17°46.5'S, 148°58.5'E (Coral Sea), 0–600 m, R/V *Lady Basten*, Field No. GRH1024, 21 Jun. 1981. SIO 75-381 (8, 38.2–55.7 mm), 20°0.0'N 145°0.0'W (central North Pacific), 1000 mwo, bottom depth 4800 m, R/V *David Starr Jordan* Cruise 7205-JD, Sta. 20.145, 0533 h, 23 May 1972. SIO 92-57 (1, 52.3 mm), 06°06.0'N, 104°29.0'W (eastern North Pacific), EASTROPAC Expedition Cruise 30, Sta. ETP 30.183, 2350 h, 14 Jul. 1967. SIO 96-42 (1, 41.9 mm), 15°17.0'S, 112°00.0'W (eastern South Pacific), R/V *Thomas Washington*, EASTROPAC Expedition Cruise 75, Sta. ETP 75.133, 0018 h, 8 Mar. 1968. SIO 97-204 (11, 29.6–48.0 mm), 20°0.0'N, 129°0.0'W (central North Pacific), 1000 mwo, bottom depth 4800 m, R/V *David Starr Jordan* Cruise 7205-JD, Sta. 20.129, 2103 h, 27 May 1972. USNM 285537 (9, 43.6–63.3 mm), 12°10'N, 153°12'W (central North Pacific), 0–270 m, R/V *Wecoma*, Norpax-79 Expedition, Sta. 79-8-5N, 0409–0604 h, 28 Aug. 1979. USNM 00285585 (5, 40.1–57.2 mm), 01°07'S 158°00'W (Equatorial central Pacific), 0–270 m, R/V *Gyre*, Norpax-79 Expedition, Sta. 79-5-10, 19 May 1979. USNM 309306 (2, 44.7–73.5 mm), 21°30'N, 158°30'W (central North Pacific, off Oahu, Hawaiian Islands), 800–900 m, R/V *El Pescadero* Cruise II, Hawaii Lab Project Expedition, Sta. 70-12-31, 1220–1620 h, 16 Dec. 1970. USNM 325142 (2, 41.6–52.2 mm), 21°25.0'N, 158°25.0'W (central North Pacific, off Oahu, Hawaiian Islands), 950–1000 m, R/V *Townsend Cromwell*, Sta. 70-12-30, 0735-1207 h, 16 Dec. 1970.

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References

- Belyanina, T.N. (1974) Materials on development, taxonomy, and distribution of the fishes of the family Bregmacerotidae. *Trudy Instituta Okeanologii*, 96, 143–188. [translated from Russian for the Smithsonian Institution by Saad Publications, Karachi, Pakistan, 1987].
- D'Ancona, U. & Cavinato, G. (1965) The fishes of the family Bregmacerotidae. *Dana Report*, 64, 1–91.
- Fricke, R., Eschmeyer, W.N. & Van der Laan, R. (Eds.) (2022) Eschmeyer's Catalog of Fishes: Genera, Species, References. Available from: <http://researcharchive.calacademy.org/research/ichthyology/catalog/fishcatmain.asp> (accessed 19 July 2022)
- Goode, G.B. & Bean, T.H. (1886) Report on the results of dredging by the United States Coast Survey Steamer "Blake." XXVIII. Description of thirteen species and two genera of fishes from the "Blake" collection. *Bulletin of the Museum of Comparative Zoology, Harvard College*, 12 (5), 153–170.
- Hare, J.A., Marancik, K.E. & Greene, M.D. (2006) Bregmacerotidae: codlets, unicorn cods. In: Richards, W.J. (Ed.), *Early Stages of Atlantic Fishes. An Identification Guide for the Western Central North Atlantic*. CRC Press, Boca Raton, Florida, pp. 583–594.
- Harold, A.S., & Golani, D. (2016) Occurrence of the Smallscale Codlet, *Bregmaceros nectabanus* in the Mediterranean Sea, previously misidentified as *B. atlanticus* in this region. *Marine Biodiversity Records*, 9 (71), 1–7.
<https://doi.org/10.1186/s41200-016-0071-0>
- Ho, H.-C., Endo, H. & Chu, T.-W. (2020a) A new species of the codlet genus *Bregmaceros* from the western Pacific Ocean (Gadiformes: Bregmacerotidae). *Zootaxa*, 4786 (4), 565–573.
<https://doi.org/10.11646/zootaxa.4786.4.8>
- Ho, H.-C., Endo, H., Lee, C.-L. & Chu, T.-W. (2020b) *Bregmaceros anchovia* sp. nov., a new codlet species from the western Pacific Ocean (Gadiformes: Bregmacerotidae). *Zootaxa*, 4801 (3), 559–569.
<https://doi.org/10.11646/zootaxa.4801.3.8>
- Houde, E.D. (1984) Bregmacerotidae: development and relationships. In: Moser, H.G., Richards, W.J., Cohen, D.M., Fahay, M.P., Kendall Jr., A.W. & Richardson, S.L. (Eds.), *Ontogeny and Systematics of Fishes. American Society of Ichthyologists and Herpetologists Special Publication No. 1*. American Society of Ichthyologists and Herpetologists, Lawrence, Kansas, pp. 300–308.
- Howes, G.J. (1991) Anatomy, phylogeny and taxonomy of the gadoid fish genus *Macruronus* Günther, 1873, with a revised hypothesis of gadoid phylogeny. *Bulletin of the British Museum of Natural History, Zoology*, 51 (1), 77–110.
- Hubbs, C.L. & Lagler, K.F. (1958) *Fishes of the Great Lakes Region*. Cranbrook Institute of Science, Bloomfield Hills, Michigan, 213 pp.
- Jordan, D.S. & Bollman, C.H. (1890) No. IV.—Descriptions of new species of fishes collected at the Galapagos Islands and along the coast of the United States of Colombia, 1887–'88. In: Scientific results of explorations by the U. S. Fish Commission steamer Albatross. *Proceedings of the United States National Museum*, 12 (770), 149–183.
<https://doi.org/10.5479/si.00963801.12-770.149>
- Markle, D.F. (1989) Aspects of character homology and phylogeny of the Gadiformes. In: Cohen, D.M. (Ed.), *Papers on the Systematics of Gadiform Fishes. Science Series No. 32*. Natural History Museum of Los Angeles County, Los Angeles, California, pp. 59–88.
- Masuda, S. & Ozawa, T. (1979) Reexamination of the holotypes of *Bregmaceros japonicus* Tanaka and *B. nectabanus* Whitley. *Japanese Journal of Ichthyology*, 25 (4), 266–268.
<https://doi.org/10.11369/jji1950.25.266>
- Masuda, S., Ozawa, T. & Tabeta, O. (1986) *Bregmaceros neonectabanus*, a new species of the family Bregmacerotidae, Gadiformes. *Japanese Journal of Ichthyology*, 32 (4), 392–399.
<https://doi.org/10.11369/jji1950.32.392>
- Milliken, D.M. & Houde, E.D. (1984) A new species of Bregmacerotidae (Pisces), *Bregmaceros cantori*, from the western Atlantic Ocean. *Bulletin of Marine Science*, 35 (1), 11–19.
- Munro, I.S.R. (1950) Revision of *Bregmaceros* with descriptions of larval stages from Australasia. *Proceedings of the Royal Society of Queensland*, 61 (5), 37–53.
<https://doi.org/10.5962/p.245086>
- Nakabo, T. (2002) 130. Bregmacerotidae, codlets. In: Nakabo, T. (Ed.), *Fishes of Japan with Pictorial Keys to the Species, English Edition. Vol. 1*. Tokai University Press, Tokai, pp. 415–416.
- Nichols, J.T. (1952) A new fish of the genus *Bregmaceros* from the Straits of Florida. *American Museum Novitates*, 1556, 1–3.
- Potthoff, T. (1984) Clearing and staining techniques. In: Moser, H.G., Richards, W.J., Cohen, D.M., Fahay, M.P., Kendall Jr., A.W. & Richardson, S.L. (Eds.), *Ontogeny and Systematics of Fishes. American Society of Ichthyologists and Herpetologists Special Publication No. 1*. American Society of Ichthyologists and Herpetologists, Lawrence, Kansas, pp. 35–37.
- Roa-Varón, A., Dikow, R.B., Carnevale, G., Tornabene, L., Baldwin, C.C., Li, C. & Hilton, E.J. (2021) Confronting sources of systematic error to resolve historically contentious relationships: A case study using gadiform fishes (Teleostei, Paracanthopterygii, Gadiformes). *Systematic Biology*, 70 (4), 739–755.
<https://doi.org/10.1093/sysbio/syaa095>
- Sabaj, M.H. (2020) Codes for natural history collections in ichthyology and herpetology. *Copeia*, 108 (3), 593–669.

<https://doi.org/10.1643/ASIHCODONS2020>

- Sabaj, M.H. (2022) *Codes for natural history collections in ichthyology and herpetology (online supplement). Version 9.0. 14 February 2022*. American Society of Ichthyologists and Herpetologists, Washington, D.C. Available from: <https://asih.org> (accessed 19 July 2022)
- Saksena, V.P. & Richards, W.J. (1986) A new species of gadiform fish, *Bregmaceros houdei*, from the western north Atlantic. *Bulletin of Marine Science*, 38 (2), 285–292.
- Shen, S.-C. (1960) *Bregmaceros lanceolatus* and *Bregmaceros pescadorus*, two new species of dwarf fishes from southern Taiwan and Pescadore Islands. *Quarterly Journal of the Taiwan Museum*, 13 (1), 67–74.
- Stevens, E.G. & Moser, H.G. (1996) Bregmacerotidae: Codlets. In: Moser, H.G. (Ed.), *California Cooperative Oceanic Fisheries Investigations, Atlas No. 33. The Early Stages of Fishes in the California Current Region*. National Marine Fisheries Service, La Jolla, California, pp. 477–481.
- Świdnicki, J. (1991) New data on the osteology of some species of *Bregmaceros* (Teleostei, Gadiformes). *Journal of Morphology*, 208 (2), 129–160.
<https://doi.org/10.1002/jmor.1052080202>
- Tanaka, S. (1908) Descriptions of eight new species of fishes from Japan. *Annotationes Zoologicae Japonenses*, 7 (1), 27–47.
- Taylor, W.R. & Van Dyke, G.C. (1985) Revised procedures for staining and clearing small fishes and other vertebrates for bone and cartilage study. *Cybium*, 9 (2), 107–119.
- Thompson, W. (1840) On a new genus of fishes from India. *Magazine of Natural History, New Series*, 4, 184–187.
- Torii, A., Harold, A.S. & Ozawa, T. (2003c) Redescription of type specimens of three *Bregmaceros* species (Gadiformes: Bregmacerotidae): *B. bathymaster*, *B. rarisquamosus*, and *B. cayorum*. *Memoirs of the Faculty of Fisheries, Kagoshima University*, 52, 23–32.
- Torii, A., Harold, A.S., Ozawa, T. & Iwatsuki, Y. (2003a) Redescription of *Bregmaceros mcllellandi* Thompson, 1840 (Gadiformes: Bregmacerotidae). *Ichthyological Research*, 50 (2), 129–139.
<https://doi.org/10.1007/s10228-002-0148-0>
- Torii, A., Javonillo, R. & Ozawa, T. (2004) Reexamination of *Bregmaceros lanceolatus* Shen, 1960 with description of a new species *Bregmaceros pseudolanceolatus* (Gadiformes: Bregmacerotidae). *Ichthyological Research*, 51 (2), 106–112.
<https://doi.org/10.1007/s10228-003-0202-6>
- Torii, A., Ozawa, T. & Harold, A.S. (2003b) Morphological characters of *Bregmaceros japonicus* Tanaka, 1908 (Gadiformes: Bregmacerotidae). *Memoirs of the Faculty of Fisheries, Kagoshima University*, 52, 43–50.
- Whitley, G.P. (1941) Ichthyological notes and illustrations. *Australian Zoologist*, 10 (1), 1–50.