

***Brotula flaviviridis*, a New Species of *Brotula*
from Fiji (Teleostei: Ophidiidae: Brotulinae)**

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The third known species of *Brotula* from the Indo-Pacific, *B. flaviviridis* sp. nov., is described from Fiji. *Brotula townsendi* is an antiequatorial species, known from the Hawaiian Islands, Johnston Island, and the Marshall Islands in the northern hemisphere, and Chesterfield Islands, New Caledonia, Loyalty Islands, Vanuatu, and Tonga in the southern hemisphere. *Brotula multibarbata* is widespread in the Indo-Pacific. *Brotula flaviviridis* differs from both in coloration, being yellow-green. It is similar to *B. townsendi* in having an eye that is narrower than the fleshy interorbital width, whereas *B. multibarbata* has an eye that is wider. It differs from *B. townsendi* by having a smaller eye and narrower interorbital width.

While conducting a survey of the marine fishes of Fiji, two specimens of a yellow-green brotula were collected using rotenone at the barrier reef on the north side of Kanacea Island in the Northern Lau Group, Fiji. The fresh coloration of these specimens was distinctly different from the other two species in the genus *Brotula* known from the Indo-Pacific.

The new species is placed in the genus *Brotula* because: the anterior nostril is well above the upper lip, near the eye; the supramaxilla is present; the dorsal-fin rays are equal to or longer than opposing anal-fin rays; and six barbels are present on the snout and six on the chin.

Only five species in the genus *Brotula* are currently considered to be valid. *Brotula barbata* (Bloch in Bloch and Schneider, 1801) occurs in the tropical and subtropical Atlantic Ocean. *Brotula clarkae* Hubbs (1944) occurs in the tropical eastern Pacific from the Gulf of California to Peru, and *B. ordwayi* Hildebrand and Barton (1949) occurs at Peru and the Galápagos Islands. In the Indo-Pacific Ocean, *B. townsendi* Fowler (1900) is known from the Hawaiian Islands, Johnston Island, Marshall Islands, Chesterfield Islands, New Caledonia, Loyalty Islands, Vanuatu, and Tonga, and *B. multibarbata* Temminck and Schlegel (1846) is widespread. Hubbs (1944) listed ten other described species as synonyms of *B. multibarbata*, and these were also listed by Nielsen, et al. (1999).

MATERIALS AND METHODS

Information on the holotype is presented first, followed by that of the paratype in parentheses. The paratype died with its mouth open wide, making measurements less accurate than those for the holotype. All measurements are presented as percentage of standard length (SL), and some as percentages of other body parts. Information on *Brotula clarkae* and *B. ordwayi* is from Allen and

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Robertson (1994) and Hubbs (1944). Pectoral-fin ray counts were obtained by slitting the skin on the inside of the right pectoral fin. Other fin-ray counts and vertebral counts were obtained from radiographs. Methods of counting and measuring follow Nielsen et al. (1999), and the format of the description follows Cohen and Nielsen (1982).

SPECIES DESCRIPTION

Brotula flaviviridis Greenfield, sp. nov.

(Figs. 1–3)

MATERIAL EXAMINED.— **HOLOTYPE:** CAS 221531, 125.0 SL, Fiji, Northern Lau Group, north side of Kanacea Island at copra plantation, 17°14.890'S, 179°08.475'W, isolated piece of barrier reef, sand and dead coral, 7–9.5 m, 5 January 2003, field number G03-15, rotenone, collected by D.W. Greenfield, K.R. Longenecker, and R.C. Langston. **PARATYPE:** CAS 221532, 151.0 SL, Fiji, Northern Lau Group, north side of Kanacea Island at copra plantation, 17°14.890'S, 179°08.475'W, overhang on barrier reef with sand at base, 12–14 m, 4 January 2003, field number G03-11, rotenone, collected by D.W. Greenfield, K.R. Longenecker, R.C. Langston, and Bio Koroi

Mataitini. **ADDITIONAL MATERIAL EXAMINED:** *Brotula townsendi*: Hawaiian Islands, Oahu-CAS 221533. Johnston Island-BPBM 33975 (2), BPBM 29609 (1), BPBM 34043 (1). Chesterfield Islands-BPBM 33794 (5). New Caledonia-BPBM 22550 (1). *Brotula multibarbata*: Hawaiian Islands, Oahu-CAS 78987 (5), CAS 78901 (2), CAS 210003 (4). Fiji-CAS 218868 (4), CAS 219394 (5), CAS 219404 (5), CAS 219405 (4).

DIAGNOSIS.— A species of *Brotula* that is yellow-green in coloration, with an eye that is narrower than the interorbital width, 98–103 dorsal-fin rays, 77–79 anal-fin rays, 24 pectoral-fin rays, 43–44 vertebrae, 2–3 developed gill rakers, a fleshy interorbital width of less than 4.5 percent SL, and an orbit diameter 3.5 percent SL or less.

DESCRIPTION.— Dorsal-fin rays 97 (103). Anal-fin rays 77 (79). Pectoral-fin rays 24 (24). Vertebrae 12+32 = 44 (11+32 = 43). Total developed gill rakers 3 (2 one side, 3 other). Longitudinal scale series about 133. Predorsal length 26.6 (25.8). Preanal length 48.8 (48.3). Preventral length 14.2 (21.0). Body depth at vent 19.2 (21.5). Head length 22.3 (23.5). Eye diameter 3.2 (3.5). Snout length 4.6 (6.0). Fleshy-interorbital width 4.2 (3.8). Upper-jaw length 12.0 (13.8). Greatest maxillary width 9.7 (12.4). Pectoral-fin length 14.2 (13.8). Pectoral-fin peduncle width 6.6 (6.3). Ventral-fin length 20.3 (17.8).

Body deepest just before end of pectoral fin, tapering to tail, which is not greatly attenuate. Body scales relatively large for the genus, about 133 rows along the side of the body. Head covered with scales. Scales on belly forward to ventral fins. Scales present on pectoral-fin base and also out onto the dorsal and anal fins. Head compressed. Snout bluntly rounded, longer than orbit diameter. Upper lip terminal, extending slightly beyond lower jaw. Posterior nostril with raised rim, adjacent to anterior margin of eye. Anterior nostril immediately anterior to posterior nostril, with a raised rim and barbel on posterior margin. Two barbels at front of snout, one on each side of mid-

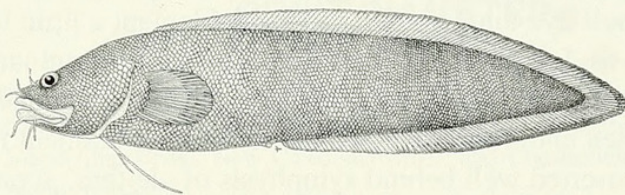


FIGURE 1. Drawing of holotype (CAS 221531) of *Brotula flaviviridis*.



FIGURE 2. Fresh color of holotype (CAS 221531) of *Brotula flaviviridis*. Photo D.W. Greenfield.

dle of snout. Another barbel on each side of snout, about at level of ventral margin of eye, for a total of six barbels on snout. Maxilla notably expanded posteriorly, reaching about one pupil diameter past rear margin of orbit. A sheath of tissue on upper third of maxilla, with a notch at end exposing top end of maxilla. Underside of lower jaw with six barbels, three on each side. Two pores at symphysis and one adjacent to posterior side of anteriormost barbel. Teeth small and granular, some with fine points, on dentary, premaxilla, palatine, and vomer. Vomerine tooth patch rounded anteriorly and V-shaped.

First gill arch with four (five) short, stubby rakers on upper arm, a longer (developed) raker at angle, lower arm with two (one) longer and ten (14) short protuberances. Longest raker about one-half eye diameter. Longest gill filament a little longer. Branchial cavity and palate pale.

Lateral line not obvious. Dorsal fin originating over end of pectoral-fin peduncle, at origin of pectoral-fin rays. Pectoral fin on a short, rounded, fleshy peduncle. Opercle with a strong spine hidden under skin which continues as a prominent flap of skin dorsal to pectoral-fin base. Ventral fins inserted well behind symphysis of cleithra, about under opercular spine. Lining of peritoneal cavity pale, with scattered, small, black spots. Stomach and intestine pale.

Color in alcohol: Background color cream, overlaid with gray-brown pigment on center of scales, leaving the scales outlined. Nape, snout, and front of jaws with greater concentration of gray-brown. Barbels and posterior ends of maxilla and premaxilla white. Ventral surface of head gray. Pectoral fins clear. Pelvic fins white. Bases of dorsal and anal fins gray where scales extend out onto them. Distal margin of anterior two-thirds of dorsal fin clear. Posterior third gray with black margin. Anal fin clear distally on anterior two-thirds of fin, posterior third like posterior part of dorsal fin. Caudal fin edged in black.

Color of fresh specimen: Background color yellow with a greenish tinge. Head yellow-green. Pupil of eye black, surrounded by yellow iris. Barbels on snout orange, barbels under chin white. Snout and tip of upper and lower jaws dusky. Anterior two-thirds of body primarily yellow-green, posterior third more dusky green. Belly yellow-white. Pectoral fin yellow. Anterior half of dorsal fin yellow with orange margin. Posterior half of dorsal fin reddish grading into black posteriorly as it merges with black caudal fin. Anal fin similar to posterior half of dorsal fin. Pelvic fins white.

ETYMOLOGY.—The specific epithet is a compound adjective, combining the Latin *flavus*, meaning golden-yellow, plus *viridis*, meaning green, alluding to the yellow-green color of the species.

COMPARISONS.—*Brotula flaviviridis* differs from all known valid Pacific Ocean species by its yellow-green coloration. It differs from the two eastern Pacific species, *B. clarkae* and *B. ordwayi*, by having fewer dorsal-fin rays, 97–103 versus 108–112 (*B. clarkae*) and 118–125 (*B. ordwayi*), and fewer anal-fin rays, 77–79 versus 78–89 (*B. clarkae*) and 86–94 (*B. ordwayi*). It also differs from *B. clarkae* in having 24 pectoral-fin rays versus 27–28. As pointed out by Hubbs (1944), “the distinction between the relatively large scales of the Indo-Pacific species and the small scales of the American ones, particularly of *B. clarkae*, was obvious at sight.” *Brotula flaviviridis* differs from the Indo-Pacific species *B. multibarbata* by having an eye that is narrower than the interorbital width, versus one that is wider. It differs from the other Indo-Pacific species, *B. townsendi*, by having a smaller eye (3.5 % S.L. or less) and narrower interorbital width (3.8% S.L. or less) (Fig. 3).

DISCUSSION.—Because one of the eleven species listed by Hubbs (1944) as a synonym of *B. multibarbata*, *B. townsendi*, is valid, it was necessary to investigate the status of the other ten species because in many cases he worked only from the literature. Patrice Pruvost (MNHN) provided me with a photograph of the dried holotype (A.8468) of *Brotula burbonensis* Kaup (1858). It has a large eye that is typical of *B. multibarbata*, not the smaller eye of *B. flaviviridis*. The types

of three species of Hubbs' synonyms are at the British Museum of Natural History: *B. ensiformis* Günther (1862) (stuffed syntypes) from Vanuatu, *B. jayakari* Günther (1909) (BMNH 1888.12.29.193) from Oman, and three syntypes of *B. mülleri* (corrected to *B. muelleri*) Günther (1909) (BMNH 1881.10.28.8 from Ponape, 1868.8.1.7 from Tahiti, and 1876.5.19.45 from Tahiti). In his description of *B. ensiformis*, Günther (1862) states "The width of the interorbital space is less than the horizontal diameter of the orbit," which clearly places it in *B. multibarbata*. Oliver Crimmen (BMNH) has kindly examined the types of these three species for me, and confirmed that

B. ensiformis, and *B. jayakari* have the large eye typical of *B. multibarbata*. *Brotula muelleri* is represented by three syntypes and is a mixed type series, containing both large and small eyed species. In the original description, Günther stated that the width of the interorbital space is much smaller than the diameter of the eyes, which clearly places this species as a synonym of *B. multibarbata* as concluded by Hubbs (1944). To avoid further confusion, I am designating one of the syntypes, BM(NH)1876.5.19.45 from Tahiti, which has the large eye, as the lectotype of *B. muelleri*, and as such, it is a synonym of *B. multibarbata*. The other two syntypes, now paralectotypes of *B. muelleri*, have the small eye, typical of *B. townsendi* and *B. flaviviridis*.

Brotula palmietensis Smith (1935) (RUSI 299) from South Africa was listed as a synonym of *B. multibarbata* by Nielsen and Cohen (1986). *Brotula formosae* Jordan and Evermann (1902) (ZUMT 359) from Taiwan was listed as a synonym of *B. multibarbata* by Chen and Shao (1991). *Brotula japonica* Steindachner and Doderlein (1887) (NMW) from Japan was listed as a synonym of *B. multibarbata* by Lindberg and Krasyukova (1975) and also was not listed as a valid species in Nakabo (2002).

Two of the species were described from the Hawaiian Islands, *B. marginalis* Jenkins (1901) and *B. multicirrata* Vaillant and Sauvage (1875). Hubbs (1944) examined the type of *B. marginalis* at the USNM (49694) and found it to be *B. multibarbata* with a damaged tail. Both Fowler (1900) and Hubbs (1944) considered *B. multicirrata* to be a synonym of *B. multibarbata*. It was described as having eight rather than six barbels on the snout. Many individuals of *B. multibarbata* have been collected at the Hawaiian Islands and none have had eight barbels. Hubbs (1944) speculated that the nasal flap had been counted as a barbel. Considering that only two species of *Brotula* are known from the well-collected Hawaiian Islands, and that *B. townsendi* is relatively rare, treating *B. multicirrata* as a synonym of *B. multibarbata* is justified.

Finally, *B. ferruginosus* (Tickell in Day, 1888) is not available (Eschmeyer 1998).

Brotula flaviviridis appears to be most similar to *B. townsendi*, which was previously known only from the Hawaiian Islands and Johnston Island but now is known to be antiequatorial. Randall (in press) lists its distribution as "Known from the Hawaiian Islands, Johnston Island, Marshall Islands, Tonga, Loyalty Islands, and Vanuatu." It is also known from the Chesterfield Islands and New Caledonia (this paper). *Brotula flaviviridis* shares the relatively small eyes with *B. townsendi*, and has similar counts. *Brotula townsendi* is an orange brown with a yellowish pectoral fin in fresh coloration. Two lots at the Bishop Museum from the South Pacific were identified as *B. townsendi*: BPBM 22550 from New Caledonia and BPBM 33794 from Chesterfield Islands in the

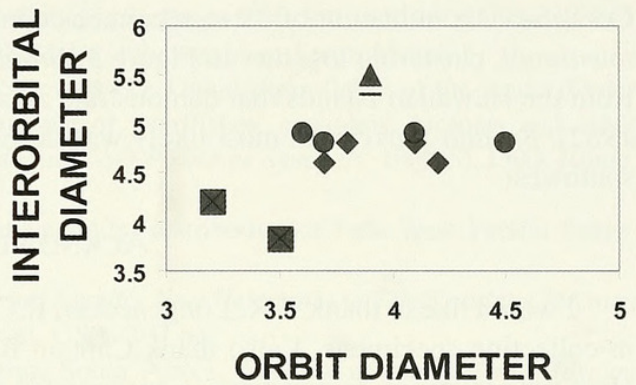


FIGURE 3. Interorbital diameter versus orbit diameter, both as percentage SL for *Brotula flaviviridis* (squares), and *B. townsendi* from Hawaiian Islands (triangle), Johnston Island (diamonds), New Caledonia (line), and Chesterfield Islands (circles).

Coral Sea. Examination of these specimens confirmed that they appear to be conspecific with *B. townsendi*, clustering together in Figure 3. *Brotula townsendi* thus joins a number of other species from the Hawaiian Islands that demonstrate an antitropical or antiequatorial distribution (Randall, 1982). *Brotula flaviviridis* most likely was derived from these populations of *B. townsendi* to the southwest.

ACKNOWLEDGMENTS

I would like to thank K.R. Longenecker, R.C. Langston, and Bio Koroi Mataitini for assistance in collecting specimens. I also thank Captain B. Vasconcellos and the crew of the *Moku Moku Hine* for assistance in our work. I am grateful to J. Seeto, G.R. South, R.R. Thaman, and R.W. Tuxton of the University of the South Pacific, Fiji for facilitating our collections in Fiji. I also thank the Fijian Government and local village chiefs for permission to collect fishes. I thank Susan Monden for drawing the figure. Patrice Pruvost (MNHN) kindly photographed the holotype of *B. burbonensis* for me. Special thanks goes to Oliver Crimmen (BMNH) who examined the types of three species for me. W.N. Eschmeyer provided valuable guidance in nomenclatural matters. I also thank the staff at CAS for lending material and providing assistance: D. Catania, W.N. Eschmeyer, J. Fong, M. Hoang, and T. Iwamoto. This research was supported by National Science Foundation grants INT97-29666 and DEB0-1027545, and Sea Grant Project R/FM-6PD.

LITERATURE CITED

- ALLEN, G.R. AND D.R. ROBERTSON. 1994. *Fishes of the tropical Eastern Pacific*. University of Hawaii Press, Honolulu, Hawaii, USA. 332 pp.
- BLOCH, M.E., AND J.G. SCHNEIDER. 1801. *Systema ichthyologiae iconibus ex illustratum*. Sanderiano Commisum, Berlin, Germany. 584 pp.
- CHEN, L.J., AND K.T. SHAO. 1991. Fishes of the families Ophidiidae and Bythitidae from Taiwan. *Bulletin of the Institute of Zoology, Academia Sinica (Taipei)* 30(1):9–18.
- COHEN, D.M., AND J.G. NIELSEN. 1982. *Spottobrotula amaculata*, a new ophidiid fish from the Philippines. *Copeia* 1982(3):479–500.
- ESCHMEYER, W.N., ed. 1998. *Catalog of Fishes*. Vol. I. California Academy of Sciences, San Francisco, California, USA. 958 pp.
- FOWLER, H.W. 1900. Contributions to the ichthyology of the tropical Pacific. *Proceedings of the Academy of Natural Sciences of Philadelphia* (1900):493–528.
- GÜNTHER, A. 1862. *Catalogue of the fishes in the British Museum*, 4. The Trustees of the British Museum, London, England, UK. 534 pp.
- GÜNTHER, A. 1909. Andrew Garrett's Fische der Südsee *Journal des Museum Godeffroy* 6:261–388.
- HILDEBRAND, S.F., AND O. BARTON. 1949. A collection of fishes from Talara, Peru. *Smithsonian Miscellaneous Collections* 111(10):1–36.
- HUBBS, C.L. 1944. Species of the circumtropical fish genus *Brotula*. *Copeia* 1944(3):162–178.
- JENKINS, O.P. 1901. Descriptions of fifteen new species of fishes from the Hawaiian Islands. *Bulletin of the United States Fish Commission* 19(1899):387–404.
- Jordan, D.S., and B.W. Evermann. 1902. Notes on a collection of fishes from the island of Formosa. *Proceedings of the United States National Museum* 25:315–368.
- KAUP, J.J. 1858. Übersicht der familie Gadidae. *Archiv für Naturgeschichte* 24:85–93.
- LINDBERG, G.U., AND Z.J. KRASYUKOVA. 1975. *Fishes of the Sea of Japan and adjacent territories of the Okhotsk and Yellow Sea*. Part 4. Teleostomi. XXIX. Perciformes. 2. Blennioidei. 13. Gobioidae (CXLV. Fam. Anarhichthididae — CLXXV. Family Periophthalmidae). Akademiya Nauk, SSSR. 463 pp.
- NAKABO, T.(ed.). 2002. *Fishes of Japan with Pictorial Keys to the Species*, English edition. Vol. 1. Tokai University Press, Tokyo, Japan. 866 pp.

NIELSEN, J.G., AND D.M. COHEN. 1986. Family No. 96: Ophidiidae. Pages 344–350 in M.M. Smith and P.C. Heemstra, eds., *Smith's Sea Fishes*. Macmillan South Africa, Johannesburg, South Africa.

NIELSEN, J.G., D.M. COHEN, D.F. MARKLE, AND C.R. ROBINS. 1999. Ophidiiform fishes of the world (Order Ophidiiformes). An annotated and illustrated catalogue of pearlfishes, cusk-eels, brotulas and other ophidiiform fishes known to date. *FAO species catalogue. FAO Fisheries Synopsis*. 18(125). FAO, Rome, Italy. 178 pp.

RANDALL, J.E. 1982. Examples of antitropical and antiequatorial distribution of Indo-West Pacific fishes. *Pacific Science* 35(3):197–209.

RANDALL, J.E. (In Press.) *Reef and shore fishes of the south Pacific: New Caledonia to Tahiti and the Pitcairn Islands*. University of Hawaii Press, Honolulu, Hawaii, USA. 707 pp.

SMITH, J.L.B. 1935. New and little known fishes from South Africa. *Records of the Albany Museum* 4:169–235.

STEINDACHNER, F., AND L. DODERLEIN. 1887. Beitrage zur Kenntniss der Fische Japan's (IV). *Denkschriften der Kaiserlichen Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Klasse* 53: 257–296.

TEMMINCK, C.J., AND H. SCHLEGEL. 1846. Pisces. Pages 173–269 in P. F. von Siebold, ed., *Fauna Japonica*, parts 10–14. Nagasaki, Japan. 324 pp.

TICKELL, S.R. 1888. in F. DAY. 1888. *Fishes of India*. Supplement. London, England, UK. pp. 779–816.

VAILLANT, L., AND H.E. SAUVAGE. 1875. Note sur quelques espèces nouvelles de poissons des Iles Sandwich. *Revue et Magasin de Zoologie Pure et Appliquée* 38 (sèr. 3, vol 3):278–287.



2005. "Brotula flaviviridis, a new species of Brotula from Fiji (Teleostei: Ophidiidae: Brotulinae)." *Proceedings of the California Academy of Sciences, 4th series* 56, 80–85.

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