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MONOGRAPH

# Review of the genus *Banjos* (Perciformes: Banjosidae) with descriptions of two new species and a new subspecies

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**Abstract** A taxonomic review of the genus *Banjos* (Perciformes: Banjosidae), previously restricted to a single species, *Banjos banjos* (Richardson 1846), recorded from the northwestern Pacific Ocean from the South China Sea north to Japan, as well as Lombok (Indonesia), New Caledonia and Australia, resulted in the recognition of three species, including *B. banjos* (northwestern Pacific Ocean, Indonesia and western Australia), *Banjos aculeatus* sp. nov. (eastern Australia) and *Banjos peregrinus* sp. nov. [northern Australia (Timor Sea)]. Records of *B. banjos* from New Caledonia probably also represent *B. aculeatus*, which is clearly distinct from other congeners in having a relatively long, strongly serrated spine at the posteroventral angle of the preopercle and an entirely dusky membrane on the spinous dorsal fin in juveniles < ca. 70 mm SL, in addition to slightly longer first and second dorsal-fin spines. *Banjos peregrinus* is characterized by a relatively greater head length, orbit diameter, postorbital length and pre-pelvic-fin length, as well as poorly developed serration of the exposed margin of the cleithrum. Within *B. banjos*, a population from the southeastern Indian Ocean, including Indonesia and western Australia, is regarded as a distinct subspecies (*Banjos banjos brevispinis* ssp. nov.), distinguishable from *B. b. banjos* from the northwestern Pacific Ocean by a relatively narrow least interorbital width, and shorter second and eighth dorsal-fin spines. Ontogenetic morphological changes within the genus and the status of the holotype of *Anoplus banjos* Richardson 1846 are discussed in detail.

**Keywords** Banjofish · *Anoplus banjos* · Morphology · Taxonomy · Antitropical distribution

## Introduction

The genus *Banjos* Bleeker 1876 has been regarded as monotypic, represented by *Banjos banjos* (Richardson 1846), recorded from Japan, Taiwan, the South China Sea, Indonesia (Lombok), New Caledonia and Australia. Since the known distribution is essentially north and south of the equatorial region, the species was considered to have an antitropical distribution [equivalent to antiequatorial distribution, as defined by Randall (1982)]. Several hypotheses have been proposed for antitropical distributions of marine taxa (Randall 1998; Burridge 2002), such disjunct distributions having been noted for a variety of marine fishes. However, a number of recent taxonomic revisions have recognized speciation between so-called northern and southern hemisphere populations of several marine fishes, previously considered as having a disjunct, antitropical distribution. For example, *Hapalogenys dampieriensis* Iwatsuki and Russell 2006 (family Hapalogenyidae), known only from northwestern Australia, had been

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previously confused with *Hapalogenys kishinouyei* Smith and Pope 1906, now restricted to the East Asian Shelf (Iwatsuki and Russell 2006). In addition, Australian "members" of *Neosebastes entaxis* (Jordan and Starks 1904) (family Neosebastidae), a species previously recorded from the waters off Japan and Taiwan, were later described by Motomura (2004) as three new species. The present review of *Banjos* on the basis of numerous specimens from its distributional range has resulted in the recognition of three distinct species, including two new species from the Timor Sea and eastern Australia, respectively. Furthermore, although several morphometric differences were recognized between the northern and southern hemisphere populations of *B. banjos*, such were deemed to represent intraspecific geographic variations, the population of *B. banjos* in the southeastern Indian Ocean, including Lombok and Western Australia, being regarded as a distinct new subspecies, the nominotypical subspecies of *B. banjos* being restricted to the northwestern Pacific Ocean. Descriptions of the three new taxa are provided and morphological changes with growth in the genus *Banjos* discussed in detail.

## Materials and methods

Counts and measurements generally follow Hubbs and Lagler (1949), with the following additional characters and modifications: scale rows in longitudinal series—number of scale rows between the scale row just behind the posttemporal bony crest and the scale row on the caudal-fin base; scale rows between the fourth or last dorsal-fin spine base and lateral line include the scale sheath on the dorsal-fin base; number of serrae on the ventral margin of the preopercle were counted from the anteriormost spine to the spine on the posteroventral angle of the preopercle.

Body depth at the pelvic-fin origin—distance between the pelvic-fin spine base and the first dorsal-fin spine base. Body depth at the anal-fin origin—distance between the first anal-fin spine base and the first dorsal-fin soft ray base. Body width—maximum width at the pectoral-fin base. Orbit diameter—maximum horizontal bony diameter. Vertical orbit diameter—maximum vertical bony diameter. Least interorbital width—least bony width, usually taken just behind the preocular. Internasal width—least distance between the inner margins of opposing posterior nostrils. Suborbital depth—shortest distance between the posterior end of the ventral margin of lacrimal and fleshy orbit rim. Caudal-peduncle length—direct distance between the last anal-fin soft ray base and midpoint of caudal-fin base. Upper caudal-peduncle length—direct distance between the last dorsal-fin soft ray base and midpoint of caudal-fin base. Caudal-fin length—horizontal distance between the middle of the caudal-fin base and the posterior tip of the middle ray. Maximum diameter of dorsal fin blotch—measured vertically. Dorsal and anal-fin ray lengths—measured from the base covered by scale sheath. Length of spine at the posteroventral angle of the preopercle—direct distance from the inner angle of the preopercle (posteroventral angle of cheek region) to the distal tip of the spine. Preopercular angle serrae—total number of serrae on spine.

The last two soft rays of the dorsal and anal fins were counted as single rays, each pair being associated with a single pterygiophore. Counts and measurements were made on the left side wherever possible, except for pectoral-fin ray and preopercular angle serrae that were counted on both sides. Gill raker counts include all rudiments. Developed gill rakers included only those of length clearly greater than their base width. Standard length is abbreviated as SL. In the descriptions of new taxa, data for the holotype are given first, followed by other specimen data ranges (if different) in parentheses. In the key to species, species diagnosis, and species comparison section, values in parenthesis for the meristic and morphometric characters indicate modes and means, respectively. The names of the states and territories of Australia are abbreviated as follows: New South Wales (NSW), Northern Territory (NT), Queensland (Qld), and Western Australia (WA). The distribution map was prepared using Quantum GIS 2.2 (Quantum GIS Development Team 2014), with data from ETOPO1 (Amante and Eakins 2009). Institutional codes follow Sabaj (2016), with the following additions: IRDNC, Institut de Récherche pour le Développement, Nouméa; NSMT, National Museum of Nature and Science, Tsukuba; SNFR, Seikai National Fisheries Institute, Nagasaki; USNM, Museum Support Center of the Smithsonian Institution National Museum of Natural History, Suitland. Underwater photographs of *B. banjos* referred to in this study are registered at the Image Database of Fishes in KPM (KPM-NR).

### *Banjos* Bleeker 1876

(Standard Japanese name: Chosen-bakama-zoku)

*Anoplus* Temminck and Schlegel 1843: 17, pl. 8 [type species: *Anoplus banjos* Richardson 1846 subsequently designated by Bleeker (1876) in providing a replacement name; originally not given species name; preoccupied by *Anoplus* Schönherr 1826 (Coleoptera)]

*Banjos* Bleeker 1876: 277 (type species: *A. banjos*; replacement name for *Anoplus*)

**Diagnosis.** Modified from Jordan and Thompson (1912) [see also Shinohara (1966)]. Dorsal-fin rays usually X, 12 (rarely IX, 12, X, 11 or X, 13); membrane of spinous portion strongly incised; anterior spines long, flattened, and

**Table 1** Frequency distribution of selected meristics in *Banjos*

| | Dorsal-fin rays | | | | Anal-fin rays | | | SR in longitudinal series | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | IX, 12 | X, 11 | X, 12 | X, 13 | III, 6 | III, 7 | III, 8 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 |
| *B. aculeatus* | | | 14[H] | | | 14[H] | | | | 1[H] | | 3 | | | 2 | | | 2 | |
| *B. banjos banjos* | 1 | 2 | 152[H] | 1 | 2 | 150[H] | 3 | | 2 | 5 | 7 | 11 | 6 | 15 | 11 | 7 | 6 | 1 | 1 |
| *B. banjos brevispinis* | | | 20[H] | | | 19[H] | | 1 | | 1 | 1 | 1 | 1[H] | 1 | 3 | 3 | | | |
| *B. peregrinus* | | | 1[H] | | | 1[H] | | | | 1[H] | | | | | | | | | |

| | Pectoral-fin ray (one /other side) | | | | | Pored LL scales | | | | | | | SR above LL | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 14/15 | 15/15 | 15/16 | 16/16 | 16/17 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| *B. aculeatus* | | 10 | 2 | 2[H] | | | 2 | | 1 | 2[H] | 1 | | 2 | 1 | 1 | 2[H] | | | | |
| *B. banjos banjos* | 1 | 77[H] | 26 | 21 | 1 | 3 | 6 | 16[H] | 32 | 18 | 12 | 3 | 2 | 14[H] | 30 | 24 | 7 | 2 | | 1 |
| *B. banjos brevispinis* | | 10[H] | 3 | 1 | | | | 1 | 5[H] | 3 | 3 | | | 3[H] | 5 | 4 | 1 | | | |
| *B. peregrinus* | | 1[H] | | | | | 1[H] | | | | | | | | 1[H] | | | | | |

| | SR below LL | | | | | | | | | | SR between 4th DS and LL | | | | | | SR between last DS and LL | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 8 | 9 | 10 | 11 | 12 | 13 | 9 | 10 | 11 | 12 | 13 |
| *B. aculeatus* | | 1 | | 1 | 1[H] | 1 | | 1 | 1 | 1 | 1 | 5[H] | 2 | 1 | | | | 2 | 4 | 2[H] | 1 |
| *B. banjos banjos* | 1 | 2 | 4 | 7 | 15 | 16[H] | 14 | 17 | 6 | 1 | 1 | 7 | 28 | 11 | 12 | 4 | 1 | 14 | 29 | 19 | 3 |
| *B. banjos brevispinis* | | | | 2[H] | | 5 | 1 | 2 | | | | 6[H] | 5 | 1 | | 1 | | 6[H] | 6 | 2 | |
| *B. peregrinus* | | 1[H] | | | | | | | | | | 1[H] | | | | | | | | 1[H] | |

| | Upper gill rakers | | | | | Lower gill rakers | | | | Total gill rakers | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5 | 6 | 7 | 8 | 9 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
| *B. aculeatus* | 3 | 7[H] | 3 | | | 1 | 3[H] | 5 | 4 | | | | 2 | 4[H] | 1 | 5 | 1 | | |
| *B. banjos banjos* | 7 | 51 | 32 | 2 | 1 | 1 | 12 | 47 | 21 | 7 | 3 | 1 | 2 | 12 | 30 | 26 | 12 | 4 | 3 |
| *B. banjos brevispinis* | 2 | 8 | 3[H] | 1 | | | 5[H] | 3 | 4 | 2 | | | 1 | 2 | 4[H] | 5 | 1 | 1 | |
| *B. peregrinus* | | | 1[H] | | | | 1[H] | | | | | | | | 1[H] | | | | |

[H] Includes holotype; *DS*, *LL* and *SR* indicate dorsal-fin base, lateral line and scale rows, respectively

longest spine subequal to head length. Anal-fin rays usually III, 7 (rarely III, 6 or III, 8); spines strong. Small conical teeth on both jaws and vomer; no teeth on palatine. Preopercle, interopercle and subopercle finely serrated; posterior parts of cleithrum, supracleithrum and posttemporal exposed with finely serrated margin. Branchiostegal rays 6. Vertebrae 25.

**Description.** Dorsal-fin rays X, 12 (rarely IX, 12, X, 11 or X, 13); anal-fin rays III, 7 (rarely III, 6 or III, 8); pectoral-fin rays 15 or 16 (rarely 14 or 17); pelvic-fin rays I, 5. Body deep, moderately compressed; caudal peduncle short, shallow; lateral line curved upward above pectoral fin, descending to and more or less straight along caudal peduncle to hypural plate, extending slightly beyond caudal-fin base. Head moderately large, 33–45% of SL; tip of opercle below 2nd or 3rd dorsal-fin spine base. Orbit moderately large, its diameter 33–47% of head length, with broad fleshy rim; anterodorsal margin of orbit continuous with dorsal contour of head in lateral view. Nasal pores in front of orbit; anterior nostril with low raised rim, possessing small flap posteriorly, its tip extending beyond posterior nasal pore when laid posteriorly; posterior nostril simple rounded pore with low raised rim. Mouth relatively small, posterior margin of maxilla extending beyond vertical through anterior margin of orbit; dorsal portion of maxilla covered by lacrimal when mouth closed; lips fleshy with numerous minute papillae; anterior portion of lower jaw and chin sometimes with minute papillae in large specimens; ventral surface of lower jaw with numerous small pores. Gill rakers relatively short, developed rakers with pointed tip, longest raker slightly shorter than gill filaments; 4th gill slit narrow (partially closed by membrane). Margins of preopercle, interopercle and subopercle strongly serrated; opercle without spines; posterior tip of exposed cleithrum above pectoral-fin base with serrations; posterior portion of exposed supracleithrum with serrations; posterior margin of posttemporal exposed above 1st pored lateral-

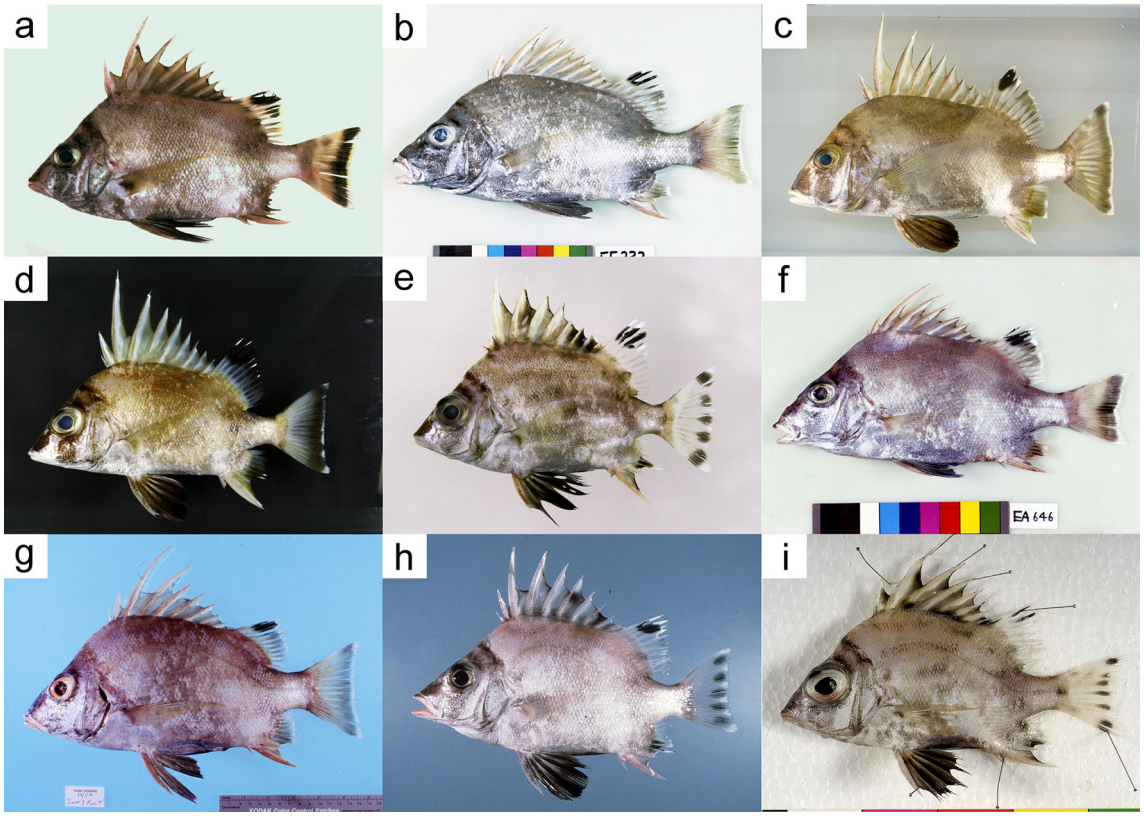



**Fig. 1** Fresh specimens of *Banjos aculeatus* sp. nov. (**a–b**), *B. banjos banjos* (**c–e**), and *B. banjos brevispinis* ssp. nov. (**f–i**). **a** AMS I.23956-004, paratype, 154 mm SL, Ballina, NSW, Australia (photo: K. Graham); **b** NSMT-P 117236, 310 mm SL, Capel Bank, Australia [photo: Far Seas Fisheries Research Laboratory (FSFL)]; **c** KAUM–I. 12836, 286 mm SL, Minami-Kyushu, Kagoshima Prefecture, Japan; **d** KAUM–I. 35676, 209 mm SL, East China Sea; **e** KAUM–I. 29847, 109 mm SL, Tosa Bay, Kochi Prefecture, Japan; **f** NSMT-P 113708, paratype, 249 mm SL, WA, Australia (photo: FSFL); **g** CSIRO H2037-02, paratype, 278 mm SL, Houtman Abrolhos, WA (photo: D. Wright and A. Williams); **h** CSIRO CA994, paratype, 131 mm SL, Bedout Islet, WA (photo: G. Leyland); **i** CSIRO H6422-07, paratype, 80.6 mm SL, Shark Bay, WA (photo: L. Conboy)

line scale with serrations. Both jaws with narrow bands of ca. 5 or 6 rows of small conical teeth in anteriormost portion, those in outermost row generally about twice height of those in inner rows, but not caniniform; vomer with triangular or lunate tooth patch with ca. 2 rows of small conical teeth; teeth absent on palatine; tongue broad with rounded tip, without teeth. Head mostly covered with ctenoid scales, snout (anterior to lacrimal) and maxilla naked; interorbital scales reaching posterior nostrils in large adults, squamation developing with growth; lower jaw partially covered with scales but ventral surface of dentary naked in juveniles (partially scaled in adults). Body entirely covered with ctenoid scales; dorsal and anal fins with high scaly sheath, relatively small ctenoid basal scales extending onto soft-rayed portions; pectoral-fin base with small scales; caudal-fin base with small scales, extending onto fin; pelvic-fin base with longitudinal row of 3–5 axillary scales. Dorsal-fin origin above origin of pectoral-fin base, with single deep notch between spinous and soft-rayed portions; spines robust, extremely long; 1st spine shortest; 3rd spine longest, its length 63–94% of body depth at pelvic-fin origin; membranes between spines deeply incised; all soft rays branched, soft-rayed portion with truncate or rounded margin. Anal-fin origin below 3rd dorsal-fin soft ray base; 1st spine short, subequal to 1st dorsal-fin spine in length; 2nd spine very robust, longest, 1.2–2.1 times 3rd spine in length; all soft rays branched, margin of soft-rayed portion somewhat concave. Pectoral fin long with pointed tip, tip of longest ray reaching vertical through last dorsal-fin spine base. Pelvic-fin rounded, spine robust, flattened, longest ray tip reaching anal-fin origin in small specimens only. Caudal fin truncate, tips of both lobes pointed.

*Fresh coloration*. Head and body silvery-white to gray, brownish dorsally. Body sometimes with three dark vertical bands (possibly more apparent in preserved material; Fig. 1b); anteriormost band narrow, on thorax below pectoral-fin base; middle band very broad (maximum width subequal to pelvic-fin length) at mid-body; posteriormost band broad, between dorsal- and anal-fin soft-rayed portions. In juveniles < ca. 70 mm SL, body with about 6 or 7 transverse dark bands; black blotch on

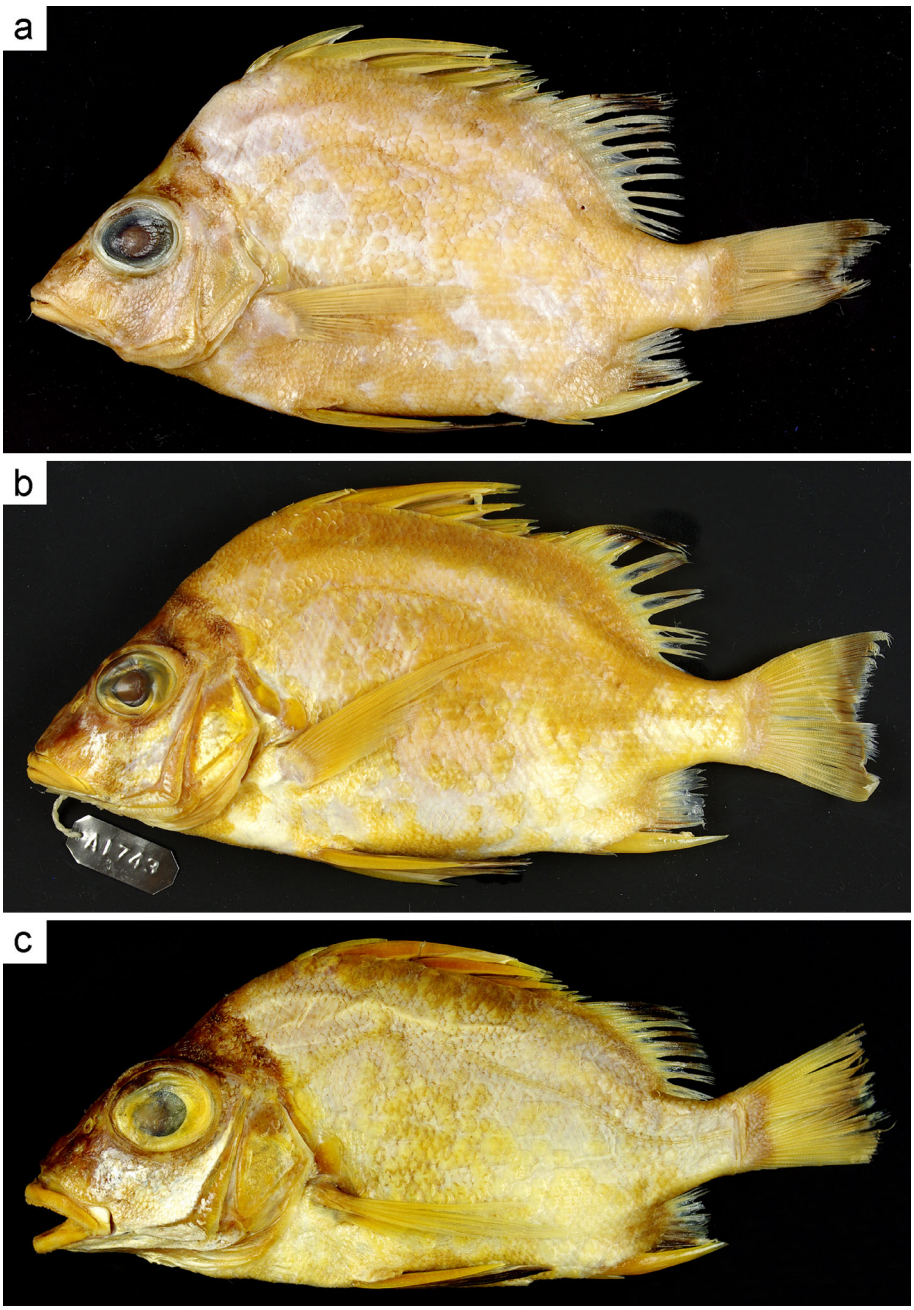



**Fig. 2** Holotypes of *Banjos aculeatus* sp. nov. (**a**), *B. banjos brevispinis* ssp. nov. (**b**) and *B. peregrinus* sp. nov. (**c**). **a** CSIRO H2346-10, 139 mm SL, Townsville Trough, Qld, Australia; **b** NMV A1743, 183 mm SL, North Island, Houtman Abrolhos, WA, Australia; **c** NTM S.13342-004, 177 mm SL, Timor Sea, NT, Australia

middle of caudal-fin base. Upper surface of snout brownish; broad dark band below orbit; two narrow dark bands saddling nape; lips whitish; eye dull yellow. Dorsal-fin spine and membrane of spinous portion pale brown; soft rays with brownish tinge, membrane of soft-rayed portion translucent, with white dorsal margin; large rounded black blotch on anterodorsal portion of soft-rayed portion, subequal to orbit in size. Anal fin membrane translucent, broadly tinged with brown. Pectoral fin tinged with pale brown; lunate or semicircular dark blotch on base. Pelvic fin soft rays and membrane black. Caudal fin semi-translucent, with relatively broad brown to black band posteriorly in adults (5–7 blotches in juveniles < ca. 100 mm SL), posterior margin narrowly tinged with white; rays tinged with pale brown.

*Preserved coloration*. Head and body becoming entirely brown (depending upon period of preservation), darker markings becoming somewhat defuse; white coloration becoming semi-translucent.

**Remarks.** The original description of the perciform genus *Anoplus* by Temminck and Schlegel (1843), on the basis of Japanese specimens, was accompanied by an excellent drawing emphasizing a deep body, steep head profile, and long strong dorsal- and anal-fin spines

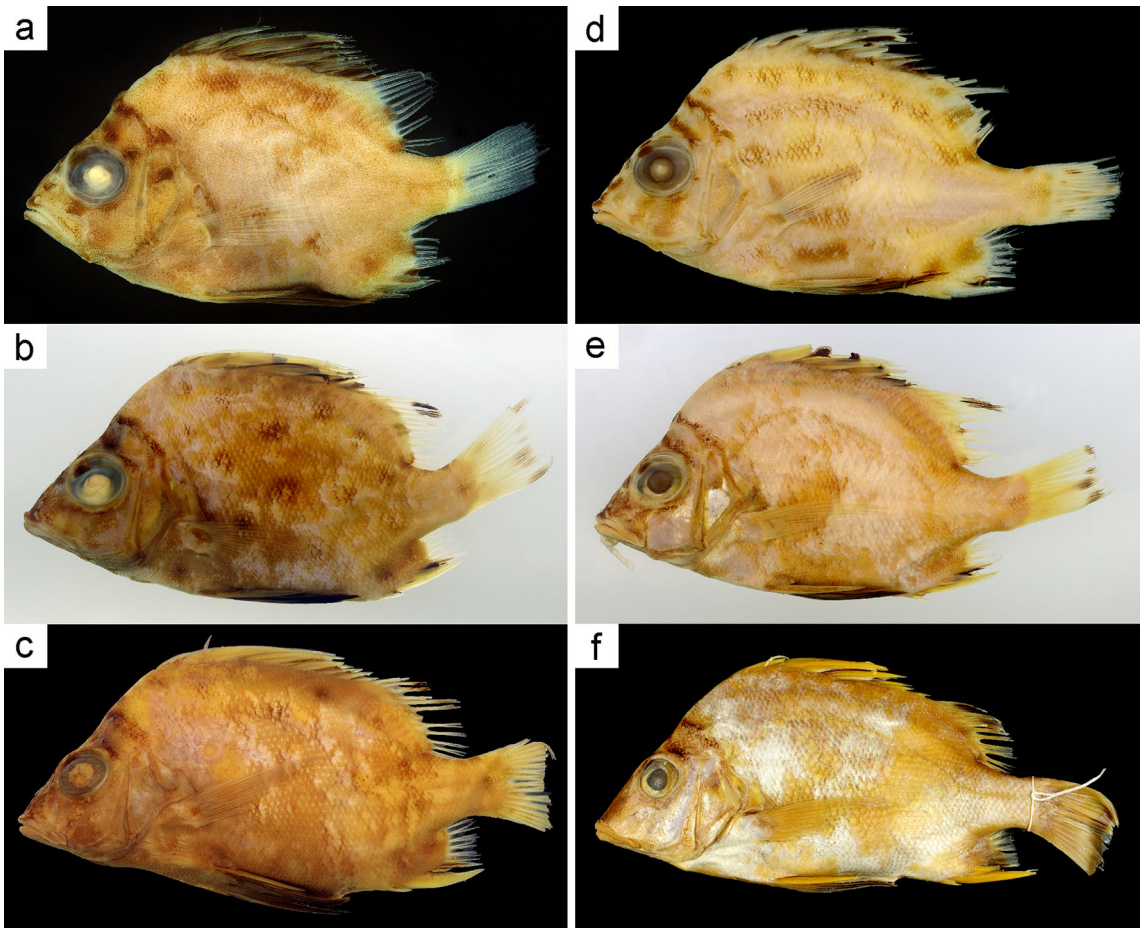



**Fig. 3** Preserved paratype specimens of *Banjos aculeatus* sp. nov. (**a**–**c**) and *B. banjos brevispinis* ssp. nov. (**d**–**f**) at different growth stages. **a** AMS I.37508-002, 36.6 mm SL, off New Castle, NSW, Australia; **b** AMS I.32119-001, 1 of 2 specimens, 98.1 mm SL, Yamba-Iluka, NSW (right side, reversed); **c** AMS I.23956-004, 154 mm SL, Ballina, NSW; **d** WAM P.27219-004, 61.5 mm SL, Houtman Abrolhos, WA, Australia; **e** NMV A1749, 1 of 2 specimens, 91.2 mm SL, Houtman Abrolhos, WA; **f** WAM P.13969.001, 206 mm SL, WA

(Temminck and Schlegel 1843: pl. 8). However, because a specific name was not proposed, "*Anoplus*" must be regarded as an unavailable species name, notwithstanding its acceptability as an available generic name. Subsequently, Richardson (1846) described *Anoplus banjos*, synonymizing "*Banjos*" of Krusenstern (1813, 1814) and "*Anoplus*" of Temminck and Schlegel (1843). Although Tilesius *in* Krusenstern (1813, 1814) provided a drawing of a Japanese fish identifiable as *A. banjos*, his proposed names were written in Russian alphabet and German language and are therefore regarded as unavailable (ICZN 1999: Art. 11.2).

However, Bleeker (1876) later pointed out that the genus *Anoplus* Temminck and Schlegel 1843 was preoccupied by *Anoplus* Schönherr 1826 [order Coleoptera (beetles)] and proposed a replacement name, *Banjos*, for the former. Although Bleeker (1876) also replaced *A. banjos* of Richardson (1846) with *Banjos typus*, such was unnecessary and is regarded as an objective junior synonym of *A. banjos*. Döderlein *in* Steindachner and Döderlein (1883) subsequently included *Anoplus maculatus* in the synonymy of *A. banjos*, listing two juvenile specimens from Japan, but the former is now regarded as an invalid name (ICZN 1999: Art. 11.6).

Although the family Banjosidae has been widely regarded as a valid family, represented by the single monotypic genus *Banjos* (Jordan and Thompson 1912; Fowler 1933; Greenwood et al. 1966; Johnson 1984; Nelson et al. 2016), its phylogenetic position is undetermined. Shinohara (1966) stated that Banjosidae is closely related to the family Lutjanidae, differing from the latter mainly in several osteological characters (e.g., supraneural bones 2; branchiostegal rays 6; and total vertebrae 25 vs. usually 3, 7 and 24, respectively, in Lutjanidae). Although Nelson et al. (2016) commented on the apparently close relationship between Banjosidae and Haemulidae (or Pomadasyidae), Sanciangco

**Table 2** Morphometrics, expressed as percentages of standard length, of *Banjos aculeatus* sp. nov. and *B. peregrinus* sp. nov.

| | *Banjos aculeatus* | | | *Banjos peregrinus* |
|---|---|---|---|---|
| | Holotype CSIRO H2346-10 | Paratypes $n = 13$ | | Holotype NTM S.13342-004 |
| Standard length (mm) | 139 | 29.5–345 | Mean | 177 |
| Body depth at pelvic-fin origin | 47.9 | 42.3–62.7 | 50.5 | 45.6 |
| Body depth at anal-fin origin | 44.4 | 36.9–53.5 | 45.0 | 37.9 |
| Body width | 17.3 | 14.9–18.7 | 16.7 | 16.8 |
| Head length | 36.7 | 34.3–44.8 | 38.8 | 41.2 |
| Snout length | 13.2 | 11.7–15.1 | 13.4 | 15.5 |
| Orbit diameter | 13.6 | 12.0–19.3 | 15.3 | 16.5 |
| Vertical orbit diameter | 14.1 | 10.6–18.6 | 14.3 | 14.5 |
| Least interorbital width | 7.0 | 6.1–10.6 | 8.1 | 7.0 |
| Interorbital width at mid-orbit | 8.7 | 7.8–14.3 | 10.3 | 8.8 |
| Inter-posterior-nostril distance | 6.7 | 5.9–9.7 | 7.3 | 6.5 |
| Width of interorbital scaled area[a] | 1.4 | 1.4–2.5 | 1.9 | 1.2 |
| Upper-jaw length | 14.5 | 12.7–18.4 | 15.1 | 14.7 |
| Suborbital depth | 8.1 | 3.2–10.3 | 7.0 | 8.4 |
| Postorbital length | 13.8 | 12.8–15.9 | 14.3 | 14.8 |
| Pre-dorsal-fin length | 43.4 | 41.7–53.6 | 46.4 | 47.4 |
| Pre-anal-fin length | 75.6 | 75.3–82.7 | 79.3 | 78.2 |
| Pre-pelvic-fin length | 40.5 | 40.4–48.5 | 44.1 | 45.9 |
| 1st dorsal-fin spine length | 8.1 | 5.8–14.2 | 10.4 | – |
| 2nd dorsal-fin spine length | – | 12.5–28.4 | 22.9 | – |
| 3rd dorsal-fin spine length | 33.6 | 32.8–41.4 | 36.9 | 31.6 |
| 4th dorsal-fin spine length | 28.5 | 27.1–38.4 | 32.3 | 28.5 |
| 5th dorsal-fin spine length | 25.5 | 21.4–33.1 | 27.4 | 22.0 |
| 6th dorsal-fin spine length | 21.4 | 18.0–29.1 | 23.4 | 19.4 |
| 7th dorsal-fin spine length | 19.3 | 14.5–25.3 | 20.4 | 15.7 |
| 8th dorsal-fin spine length | 15.0 | 11.4–21.0 | 16.4 | 12.6 |
| 9th dorsal-fin spine length | 12.8 | 8.4–19.3 | 13.8 | – |
| 10th dorsal-fin spine length | 10.2 | 7.1–15.0 | 11.3 | 9.8 |
| 1st dorsal-fin soft ray length | 23.5 | 18.8–23.5 | 21.5 | 20.9 |
| 2nd dorsal-fin soft ray length | 22.6 | 19.5–25.1 | 23.0 | 21.7 |
| 5th dorsal-fin soft ray length | 18.1 | 15.6–25.3 | 19.5 | 16.3 |
| 1st anal-fin spine length | 7.8 | 6.2–14.9 | 10.1 | 6.8 |
| 2nd anal-fin spine length | 24.1 | 19.4–25.1 | 22.0 | 22.0 |
| 3rd anal-fin spine length | 13.8 | 11.8–17.6 | 14.2 | 11.2 |
| 1st anal-fin soft ray length | 17.0 | 14.4–18.0 | 16.3 | 14.1 |
| 3rd anal-fin soft ray length | 14.5 | 10.3–23.1 | 14.1 | 11.4 |
| Longest pectoral-fin length | 36.0 | 31.6–40.4 | 35.3 | 36.7 |
| Pelvic-fin spine length | 24.4 | 19.4–29.5 | 25.1 | 21.9 |
| Longest pelvic-fin soft ray length | 35.0 | 27.3–46.9 | 38.0 | 30.3 |
| Caudal-fin length | 21.4 | 16.9–30.0 | 21.6 | – |
| Caudal-peduncle length | 17.4 | 13.0–17.8 | 15.3 | 16.2 |
| Upper caudal-peduncle length | 15.9 | 12.9–15.9 | 14.6 | 13.4 |
| Caudal-peduncle depth | 12.4 | 11.0–13.7 | 12.5 | 11.1 |

[a] Small specimens without interorbital scales excluded

et al. (2016) and Liu et al. (2015), both, provided a molecular phylogenetic analysis that clustered Banjosidae with fishes of the family Pentacerotidae.

No information on the larvae morphology of *Banjos* is available (Leis and Carson-Ewart 2004). The smallest examined specimen of *B. aculeatus* (AMS I. 32205-001, 29.5 mm

**Table 3** Morphometrics, expressed as percentages of standard length, of *Banjos banjos banjos* and *B. banjos brevispinis* ssp. nov.

| | *Banjos banjos banjos* | | | | *Banjos banjos brevispinis* | | |
|---|---|---|---|---|---|---|---|
| | Holotype of *Anoplus banjos* BMNH 2004.11.5.11 | Non-type Bürger specimen BMNH 2004.11.5.12 | Non-type specimens $n = 161$ | | Holotype NMV A1743 | Paratypes $n = 19$ | |
| Standard length (mm) | 231 | 257 | 32.6–359 | Mean | 183 | 61.5–282 | Mean |
| Body depth at pelvic-fin origin | – | – | 37.9–55.9 | 47.5 | 46.3 | 40.8–55.1 | 46.3 |
| Body depth at anal-fin origin | – | – | 34.7–50.0 | 43.0 | 42.6 | 37.7–49.0 | 42.0 |
| Body width | 17.1 | 17.0 | 14.6–19.9 | 17.4 | 18.5 | 15.8–18.9 | 17.5 |
| Head length | 35.1 | 34.6 | 33.9–42.7 | 37.0 | 35.6 | 33.2–39.1 | 36.0 |
| Snout length | 14.2 | 12.8 | 11.3–17.0 | 14.3 | 14.5 | 12.6–15.8 | 14.5 |
| Orbit diameter | 13.6 | 11.9 | 11.4–19.9 | 14.5 | 13.7 | 11.7–17.9 | 13.9 |
| Vertical orbit diameter | 12.3 | 10.2 | 9.5–17.6 | 13.0 | 11.2 | 10.6–15.6 | 12.3 |
| Least interorbital width | 8.5 | 7.9 | 6.2–10.3 | 7.5 | 6.8 | 5.8–8.1 | 6.8 |
| Interorbital width at mid-orbit | 8.5 | 8.0 | 7.6–12.8 | 9.3 | 8.5 | 7.1–10.2 | 8.3 |
| Inter-posterior-nostril distance | 6.1 | 5.8 | 5.4–8.4 | 6.7 | 6.0 | 5.4–7.0 | 6.0 |
| Width of interorbital scaled area[a] | – | – | 1.0–6.4 | 3.5 | 4.0 | 1.1–5.1 | 3.4 |
| Upper-jaw length | 12.6 | – | 12.2–17.5 | 14.0 | 13.1 | 12.0–15.3 | 13.7 |
| Suborbital depth | 8.9 | 8.3 | 4.1–11.3 | 8.8 | 9.8 | 6.3–10.5 | 9.6 |
| Postorbital length | 12.1 | 12.0 | 11.5–15.7 | 13.4 | 13.6 | 12.0–14.6 | 13.1 |
| Pre-dorsal-fin length | 43.3 | – | 42.1–50.6 | 45.2 | 45.7 | 42.1–49.0 | 45.3 |
| Pre-anal-fin length | – | – | 73.8–82.6 | 77.6 | 76.5 | 75.2–82.8 | 77.1 |
| Pre-pelvic-fin length | – | 39.6 | 38.6–47.0 | 42.0 | 40.8 | 39.1–48.9 | 43.1 |
| 1st dorsal-fin spine length | 5.1 | 5.4 | 4.8–11.7 | 7.3 | 5.6 | 4.5–8.0 | 5.8 |
| 2nd dorsal-fin spine length | – | 12.4 | 11.2–22.7 | 17.1 | – | 11.2–18.3 | 13.6 |
| 3rd dorsal-fin spine length | – | – | 29.9–40.7 | 35.7 | 32.1 | 30.1–39.4 | 32.7 |
| 4th dorsal-fin spine length | – | 25.4 | 24.5–38.0 | 32.4 | 27.0 | 25.1–35.0 | 27.2 |
| 5th dorsal-fin spine length | – | – | 21.7–31.4 | 26.8 | 23.2 | 16.7–30.9 | 22.2 |
| 6th dorsal-fin spine length | – | 19.0 | 18.7–26.7 | 23.0 | 18.0 | 16.6–26.4 | 19.0 |
| 7th dorsal-fin spine length | 14.8 | 15.9 | 13.4–22.9 | 18.8 | 15.4 | 13.7–22.4 | 15.7 |
| 8th dorsal-fin spine length | – | – | 11.3–19.6 | 14.8 | 10.1 | 9.5–18.7 | 11.7 |
| 9th dorsal-fin spine length | 8.2 | 8.9 | 8.1–15.4 | 11.7 | 8.7 | 8.3–16.3 | 9.7 |
| 10th dorsal-fin spine length | – | – | 7.3–13.7 | 10.1 | 7.4 | 7.1–14.7 | 8.7 |
| 1st dorsal-fin soft ray length | – | – | 18.5–28.9 | 23.8 | 23.3 | 18.7–26.2 | 21.5 |
| 2nd dorsal-fin soft ray length | – | – | 18.3–27.3 | 23.5 | 23.2 | 19.3–26.7 | 20.7 |
| 5th dorsal-fin soft ray length | – | – | 14.2–24.5 | 17.6 | 16.8 | 14.5–19.8 | 15.9 |
| 1st anal-fin spine length | 9.7 | 6.9 | 5.3–11.6 | 7.7 | – | 5.0–11.8 | 6.1 |
| 2nd anal-fin spine length | 24.2 | 21.0 | 19.3–26.6 | 23.0 | 22.1 | 18.3–24.7 | 21.2 |
| 3rd anal-fin spine length | 13.1 | – | 10.8–17.5 | 13.6 | 11.5 | 9.8–18.3 | 11.6 |

**Table 3** continued

| | *Banjos banjos banjos* | | | *Banjos banjos brevispinis* | |
|---|---|---|---|---|---|
| | Holotype of *Anoplus banjos* BMNH 2004.11.5.11 | Non-type Bürger specimen BMNH 2004.11.5.12 | Non-type specimens $n = 161$ | Holotype NMV A1743 | Paratypes $n = 19$ |
| 1st anal-fin soft ray length | – | – | 13.8–22.2 | 17.5 | 14.7 | 13.0–24.0 | 14.3 |
| 3rd anal-fin soft ray length | – | – | 10.5–20.8 | 14.0 | 11.0 | 10.6–19.4 | 11.3 |
| Longest pectoral-fin length | – | – | 30.1–39.8 | 35.9 | 35.7 | 32.9–39.3 | 36.6 |
| Pelvic-fin spine length | 20.8 | – | 18.1–29.4 | 23.0 | 21.8 | 17.6–29.1 | 21.4 |
| Longest pelvic-fin soft ray length | – | – | 26.6–45.7 | 35.0 | 31.1 | 27.2–43.2 | 31.2 |
| Caudal-fin length | 15.4 | 16.0 | 17.1–27.3 | 21.0 | 19.5 | 17.8–26.8 | 19.3 |
| Caudal-peduncle length | 17.5 | 17.3 | 12.3–17.4 | 15.4 | 16.3 | 14.1–17.6 | 15.7 |
| Upper caudal-peduncle length | – | – | 12.5–16.7 | 15.2 | 16.2 | 14.2–16.9 | 15.6 |
| Caudal-peduncle depth | – | – | 9.7–13.3 | 11.6 | 11.5 | 11.2–12.7 | 11.8 |

[a] Small specimens without interorbital scales excluded

SL; Fig. 3a) possesses a slightly expanded supraoccipital cleft and a strongly serrated, elongate spine at the posteroventral angle of the preopercle, a common feature in perciform larvae.

## Key to species and subspecies of the genus *Banjos*

1a. Head length 41.2% of SL; orbit diameter 16.5% of SL; vertical orbit diameter 14.5% of SL; pre-pelvic-fin length 45.9% of SL; 9 serrae on exposed margin of the cleithrum ·····*B. peregrinus* sp. nov. (Timor Sea)

1b. Head length 32.9–39.6% of SL; orbit diameter 11.2–16.2% of SL; vertical orbit diameter 9.5–15.5% of SL; pre-pelvic-fin length 38.0–44.7% of SL in specimens > 100 mm SL; 14–36 serrae on exposed margin of the cleithrum in specimens 150–200 mm SL·····2

2a. First dorsal-fin spine length 5.8–13.0% of SL; second dorsal-fin spine length 12.5–27.5% of SL; in juveniles <70 mm SL, a relatively long spine at the preopercle angle with well-developed serrations, its tip extending beyond the posterior margin of the interopercle in specimens <46.0 mm SL, length of spine 6.2–8.5% of SL (in specimens of 29.5–46.0 mm SL); spinous dorsal fin membrane entirely dusky, without translucent area in adults and juveniles <70 mm SL·····*B. aculeatus* sp. nov. (eastern Australia and Capel Bank, Coral Sea)

2b. First dorsal-fin spine length 4.5–11.7% of SL; second dorsal-fin spine length 11.2–22.7% of SL; in juveniles <70 mm SL, a short, weakly serrated spine at the preopercle angle, its tip extending beyond the posterior margin of the interopercle in specimens <41.2 mm SL, length of spine 3.5–6.5% of SL (in specimens of 32.6–69.5 mm SL); spinous dorsal fin membrane dusky, with a broad translucent area centrally in juveniles <70 mm SL·····*B. banjos* 3

3a. Least interorbital width 5.8–8.1 (mean 6.8) % of SL; first dorsal-fin spine length 4.5–8.0 (6.1) % of SL; second dorsal-fin spine length 11.2–18.3 (14.0) % of SL; eighth dorsal-fin spine length 9.5–18.7 (12.5) % of SL·····*B. banjos banjos* (northwestern Pacific Ocean from South China Sea to Japan)

3b. Least interorbital width 6.2–10.3 (mean 7.5) % of SL; first dorsal-fin spine length 4.8–11.7 (7.4) % of SL; second dorsal-fin spine length 11.2–22.7 (17.2) % of SL; eighth dorsal-fin spine length 11.3–19.6 (14.8) % of SL·····*B. banjos brevispinis* ssp. nov. [southeastern Indian Ocean, including Lombok (Indonesia) and WA]

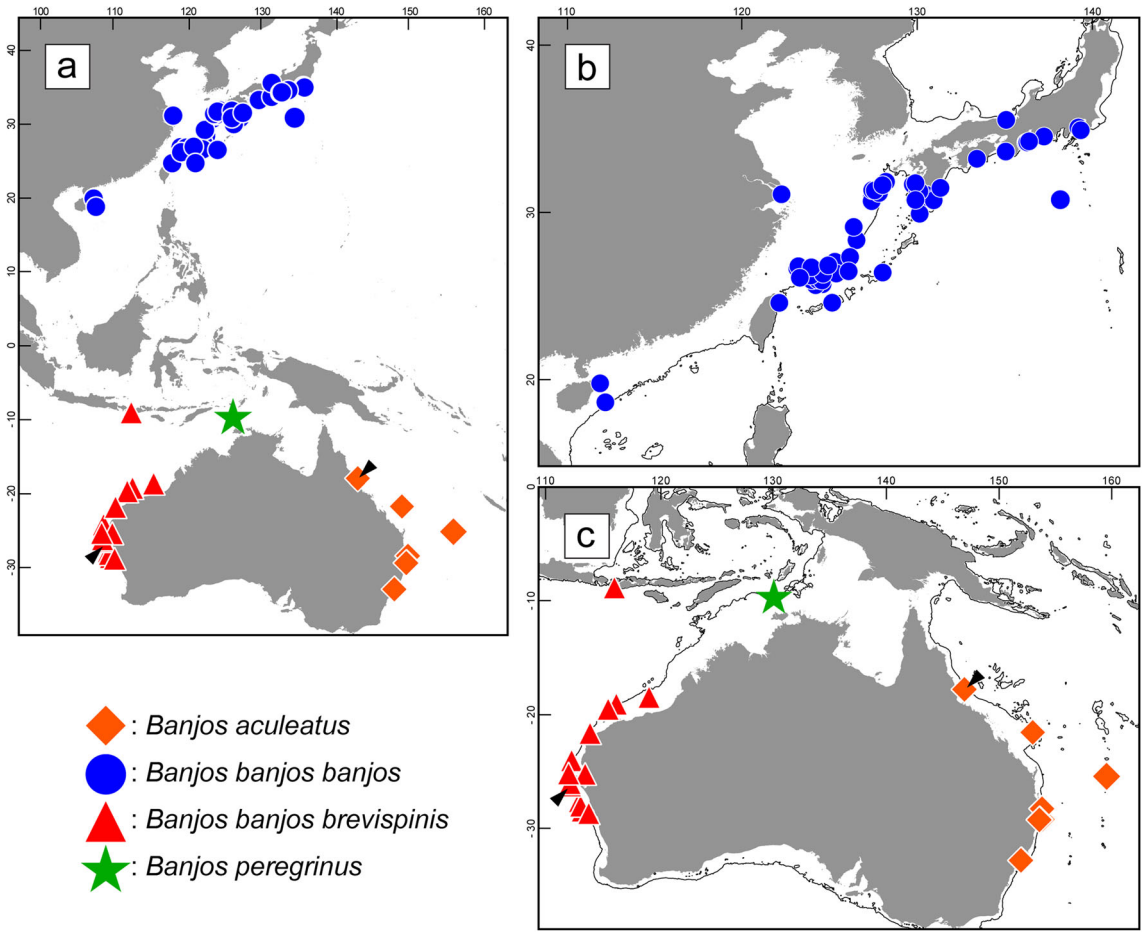



**Fig. 4** Distributional maps of *Banjos aculeatus* sp. nov. (*yellow diamonds*), *B. banjos banjos* (*blue circles*), *B. banjos brevispinis* ssp. nov. (*red triangles*) and *B. peregrinus* sp. nov. (*green star*) (all based on examined specimens). **a** Eastern Indian and western Pacific oceans; **b** Northern Hemisphere; **c** Southern Hemisphere. *Arrowheads* indicate type localities of *B. aculeatus* and *B. b. brevispinis*

***Banjos aculeatus* sp. nov.**
(New English name: Eastern Australian Banjofish) (Figs 1a–b, 2a, 3a–c, 4, 9–10, 11a–c, 12a–d, 13–15; Tables 1–2)

*Banjos banjos* (not of Richardson): Rivaton et al. 1990: 27 (New Caledonia; listed); Kulbicki et al. 1994: 20 (New Caledonia; listed); Allen and Cross 2006: 1078 (in part; NSW, Qld, and WA, Australia); Fricke and Kulbicki 2006: 329 (New Caledonia; listed); Fricke et al. 2011: 389 (New Caledonia; listed)

**Holotype.** CSIRO H2346-10, 139 mm SL, Townsville Trough, northeast of Townsville, Qld, Australia, 18°00.7′S, 147°01.4′E–17°57.4′S, 146°58.3′E, 208–212 m, FRV *Soela*, lobster trawl, 29 Nov. 1985.

**Paratypes.** Thirteen specimens, 29.5–345 mm SL: **AUSTRALIA: Qld—**AMS I.38099-009, 126 mm SL, east of Swains Reef, 21°43.23′S, 152°57.06′E–21°52.85′S, 153°00.17′E, 179 m, J. Lowry and K. Dempsey on FV *Seader Bay*, 10–11 Sept. 1995. **NSW**—AMS I.23956-004, 154 mm SL, off Clarence River, Ballina, 29°02′S, 153°48′E, 135–137 m, K. Graham on FRV *Kapala*, 1 Nov. 1978; AMS I.32119-001, 2 specimens, 95.7–98.1 mm SL, Yamba-Iluka, 28°24′S, 153°46′E–29°21′S, 153°47′, 153–175 m, FRV *Kapala*, prawn trawl, 22 May 1991; AMS I.32195-001, 2 specimens, 37.7–46.0 mm SL, off Iluka, 29°20′S, 153°34′E–29°21′S, 153°34′E, 60–68 m, FRV *Kapala*, prawn trawl, 23 Nov. 1990; AMS I.32205-001, 29.5 mm SL, off Yamba, 29°23′S, 153°32′E–29°30′S, 153°35′E, 66–73 m, FRV *Kapala*, 7 Nov. 1990; AMS I.37508-002, 36.6 mm SL, off Newcastle, 32°55′S, 151°57′E–32°55′S, 151°56′E, 65–72 m, FRV *Kapala*, 2 Nov. 1995; AMS I.37679-002, 35.6 mm SL, off Newcastle, 32°56′S, 151°55′E–32°57′S, 151°56′E, 65–72 m, FRV *Kapala*, 19 Oct. 1995; KAUM–I. 87585 (formerly one of three specimens in AMS I.32195-001), 39.4 mm SL, collected with AMS I.32195-001. **Capel Bank (Coral Sea):** NSMT-P 117236, 310 mm SL, 25°28′18″S,

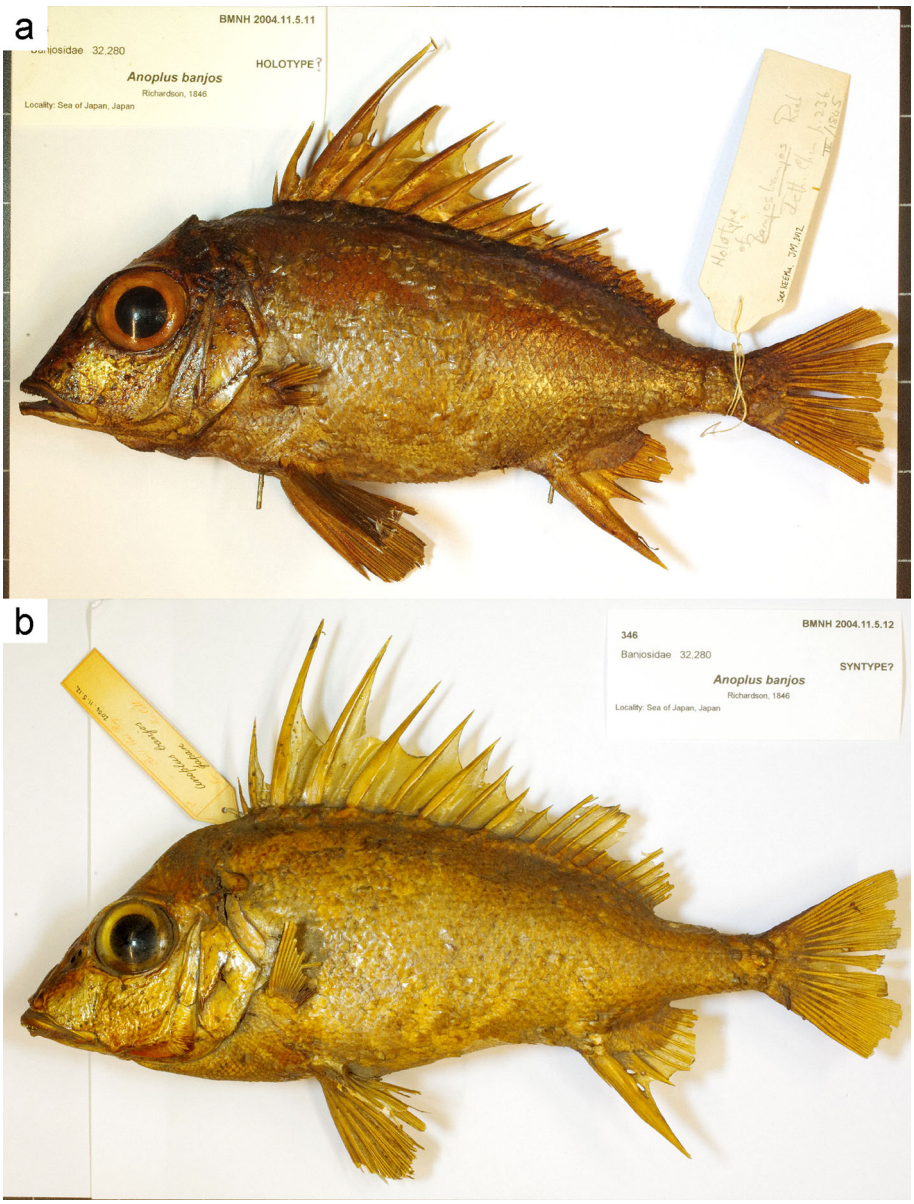



**Fig. 5** Bürger specimens of *Banjos banjos banjos*. **a** BMNH 2004.11.5.11, holotype of *Anoplus banjos*, 231 mm SL, Sea of Japan (probably Nagasaki Prefecture, Japan); **b** BMNH 2004.11.5.12, non-type, 257 mm SL, Sea of Japan (probably Nagasaki Prefecture, Japan)

159°41′12″E, 289–294 m, RV *Kaiyo-maru*, 16 Dec. 1976; NSMT-P 117237, 345 mm SL, NSMT-P 117238, 301 mm SL, 25°21′12″S, 159°46′36″E, 248–265 m, RV *Kaiyo-maru*, 16 Dec. 1976.

**Diagnosis.** A species of *Banjos* distinguished from other members of the genus by the following combination of characters: serrae on ventral margin of lacrimal 0–16; head length 34.3–38.2 (mean 35.7) % of SL in specimens >100 mm SL; orbit diameter 12.0–14.4 (12.8) % of SL in specimens >100 mm SL; vertical orbit diameter 10.6–14.1 (12.2) % of SL in specimens >100 mm SL; postorbital length 12.8–14.5 (13.7) % of SL in specimens >100 mm SL; pre-pelvic-fin length 40.4–42.1 (41.0) % of SL in specimens >100 mm SL; first dorsal-fin spine length 5.8–14.2 (10.4) % of SL; second dorsal-fin spine length 12.5–28.4 (22.9) % of SL; spine at angle of preopercle relatively long, strongly serrated in juveniles <70 mm SL; membrane of dorsal-fin spinous portion uniformly dusky in adults and juveniles <70 mm SL.

**Description.** Selected meristics and morphometrics, expressed as percentages of SL, are shown in Tables 1 and 2. Characters that are the same as in generic description and species diagnosis not repeated here. Dorsal-fin rays X, 12; anal-fin rays III, 7; pectoral-fin rays 16 (15 or 16); pelvic-fin rays I, 5; caudal fin with 4 (3) unbranched unsegmented rays, 3 (4) unbranched segmented rays and 8 branched rays in dorsal series; 3 unbranched unsegmented rays, 3 unbranched segmented rays and 7 branched rays in ventral series. Snout pointed, dorsal profile of snout and nape at angle of ca. 50° to horizontal axis of head and

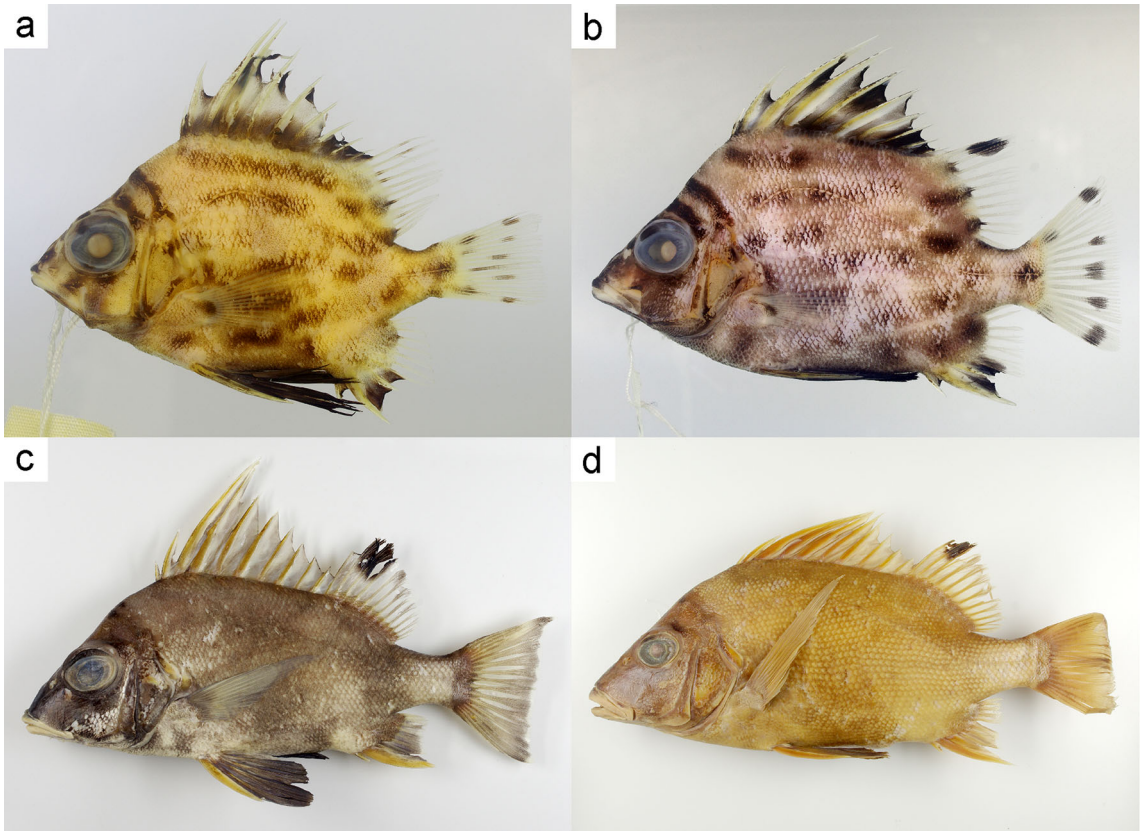



**Fig. 6** Preserved specimens of *Banjos banjos banjos*, showing different growth stages. **a** BSKU 77290, 41.2 mm SL, Tosa Bay, Kochi Prefecture, Japan; **b** KAUM–I. 75271, 84.1 mm, East China Sea; **c** KAUM–I. 74376, 261 mm SL, Sata Point, Kagoshima Prefecture, Japan; **d** MUFS 15903, 359 mm SL, Meitsu, Miyazaki Prefecture, Japan

body. Eye moderately large, orbit diameter 37 (33–44) % of head length. Margins of preopercle, interopercle and subopercle strongly serrated; opercle without spines; posterior tip of exposed cleithrum, located above pectoral-fin base, with serrated margin; posterior portion of exposed supracleithrum, with serrated margin; posterior margin of posttemporal exposed, above 1st pored lateral-line scale, with serrated margin; ventral margin of lacrimal strongly serrated in specimens < ca. 100 mm SL. Upper jaw with band of about 6 (5 or 6) rows (anteriorly) of small conical teeth, teeth on outermost row about twice length of inner teeth, but not caniniform; lower jaw with band of 4 (4 or 5) rows (anteriorly) of small conical teeth, teeth in outer two rows generally about twice length of teeth in inner rows, but not caniniform; vomer with lunate tooth patch with 2 rows of small conical teeth. Head mostly covered with ctenoid scales, snout (anterior to lacrimal) and maxilla naked; interorbital region with isolated band of 4 (3) rows (maximum) of cycloid scales, its anterior margin just behind imaginary line connecting posterior nostrils in dorsal view, posterior margin not continuous with scales on nape (interorbital scales absent in small specimens <100 mm SL but develop with growth); lower jaw partially covered with scales, ventral surface of dentary naked. Body covered with ctenoid scales, those on dorsolateral surface with 39 (26–47) cteni; pelvic-fin base with row of 7 (5–6) axillary scales. Dorsal-fin origin slightly anterior to vertical through origin of pectoral-fin base, with single deep notch between spinous and soft-rayed portions; spines flattened; 1st spine shortest; 3rd spine longest, its length 70 (70–77) % of body depth at pelvic-fin origin, lengths of last 7 spines gradually decreasing posteriorly; membranes between spines deeply incised; all soft rays branched, 1st (1st or 2nd) soft ray longest, soft-rayed portion with slightly rounded margin. Anal-fin origin below 5th dorsal-fin soft ray base; 1st spine short, subequal to 1st dorsal-fin spine in length; 2nd spine robust, longest, 1.8 (1.3–2.1) times 3rd spine in length; all soft rays branched, 1st ray longest, its length 73 (72–82) % of 1st dorsal-fin soft ray length; margin of soft-rayed portion truncated. Pectoral fin long, pointed, its origin below 3rd dorsal-fin spine base; 4th ray longest, fin tip extending slightly beyond vertical through last dorsal-fin spine base; all rays branched except uppermost 2 and lowermost 2 (1 or 3). Pelvic-fin origin

**Fig. 7** Preserved specimen of *Banjos banjos banjos*, ZMB 12061, 125 mm SL, Yedo (Tokyo), Japan

below lower end of pectoral-fin base, with rounded margin; spine long, flattened; all soft rays branched, 2nd soft ray longest, fin tip extending beyond anus, but not reaching anal-fin origin when depressed in large specimens, including holotype (specimens <100 mm SL possessing relatively long pelvic-fin rays, fin tip extending well beyond anal-fin origin). Caudal fin truncate, slightly concave, tips of both lobes pointed.

*Fresh coloration*. Based on photographs of AMS I.23956-004 (154 mm SL) and NSMT-P 117236 (310 mm SL) (Fig. 1a–b). Body pale gray, darker dorsally; head dark gray; eye dull yellow. Membrane of spinous dorsal fin pale brown, soft-rayed portion whitish; two large black rounded blotches anterodorsally on soft dorsal-fin membrane, anterior blotch subequal to orbit in size. Anal fin membrane apparently pale brown but mostly damaged. Pectoral fin tinged with pale brown; dark semicircular blotch on base. Pelvic fin black. Caudal-fin pale brown, with broad black band posteriorly and narrow white margin.

*Preserved coloration*. See Figs 2a, 3a–c. Head and body entirely creamy-white; 2 dark bands saddling anterior half of interorbital region, posterior band across orbit; 2 dark bands saddling nape; no other distinct markings on head and body. Spinous dorsal-fin membrane pale brown; black blotch anterodorsally on soft dorsal-fin membrane between 1st and 3rd rays. Spinous anal-fin pale brown; anterior of soft anal-fin blackish. Pectoral fin semi-translucent. Pelvic-fin membrane and soft rays dark brown. Caudal fin cream white with relatively broad dark brown band submarginally, its width about one-third of orbit diameter. In specimens < ca. 100 mm SL, body with 2 small dark blotches below base of soft dorsal-fin; small dark blotch on posterior potion of anal-fin base; about 13 small (subequal to pupil) dark blotches scattered on body sides.

**Etymology.** The specific name, *aculeatus*, derived from Latin meaning spiny, alludes to the possession of a strongly serrated spine at the angle of the preopercle in this species.

**Distribution.** This species is distributed in the Coral Sea, off eastern Australia, ranging from Townsville, Qld (17°S) to Newcastle, NSW (32°S) (based on examined specimens) and the Capel Bank (Fig. 4). Sampling data for seven specimen lots indicated capture by benthic trawl in 60–294 m depths.

**Remarks.** Records of *B. banjos* from New Caledonia (see synonymy) are most likely to have been of *B. aculeatus*, judging from perceived distributional ranges of the species of *Banjos*. Fricke et al. (2011) stated that the New Caledonian record was based on IRDNC material. Although two specimens of *Banjos* collected from New Caledonian waters between 1987 and 1988 were sent to MNHN (Paris) (G. Mou-Tham, personal communication), they could not be located [Z. Gabsi, personal communication (June 2016)].

## *Banjos banjos* (Richardson 1846)

**Diagnosis.** A species of *Banjos* distinguished from other members of the genus by the following combination of characters: serrae on ventral margin of lacrimal 0–22; serrae on cleithrum 14–36 in specimens 150–200 mm SL; head length 33.2–39.6 (mean 36.5) % of SL in specimens >100 mm SL; orbit diameter 11.2–16.6 (14.1) % of SL in specimens >100 mm SL; vertical orbit diameter 9.5–14.9 (13.5) % of SL in specimens >100 mm SL; least interorbital width 5.8–10.3 (7.3) % of SL; postorbital length 11.5–15.7 (13.3) % of SL; pre-pelvic-fin length 38.0–44.7 (41.5) % of SL in specimens >100 mm SL; first dorsal-fin spine length 4.5–11.7 (6.7) % of SL; second dorsal-fin spine length 11.2–22.7 (16.1) % of SL; spine at angle of preopercle relatively short, moderately serrated in juveniles <70 mm SL; membrane of spinous dorsal-fin with broad central translucent area in juveniles <70 mm SL.

**Remarks.** This species is distributed in the northwestern Pacific, ranging from the South China Sea north to Japan, and the southeastern Indian Ocean, including the west coast of Australia and Indonesia. Detailed distributional ranges of the two subspecies are given below.

### Subspecies of *Banjos banjos*

#### *Banjos banjos banjos* (Richardson 1846)

(English name: Banjofish; Standard Japanese name: Chosen-bakama) (Figs 1c–e, 4–10, 11d–f, 12e–g, 13–15; Tables 1, 3, 4)

*Anoplus banjos* Richardson 1846: 236 [type locality: Sea of Japan (probably Nagasaki)]; Günther 1859: 264 (catalog of fish specimens at BMNH); Steindachner and Döderlein 1883: 7, pl. 4, fig. 1 (Tokyo, Japan); Nyström 1887: 9 (Nagasaki, Japan; listed); Jordan and Snyder 1900: 357 (Tokyo, Japan; listed); Jordan and Snyder 1901: 82 (Yokohama and Nagasaki, Japan; listed); Jordan and Evermann 1902: 351 (Taiwan; listed); Jordan and

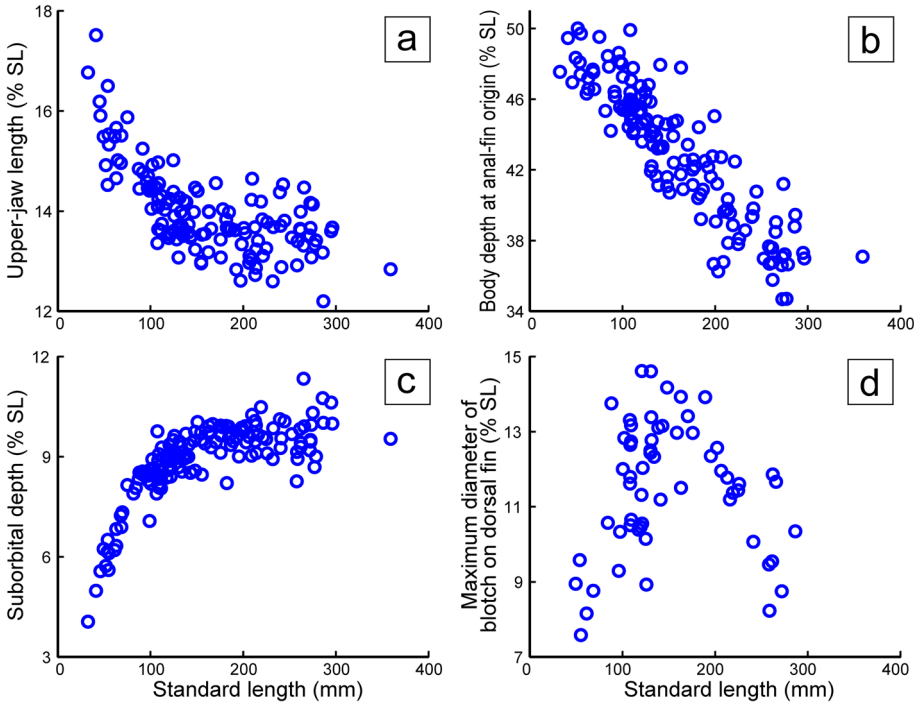



**Fig. 8** Ontogenetic changes apparent in relationships as percentages of standard length of **a** upper-jaw length; **b** body depth at anal-fin origin; **c** suborbital depth; **d** maximum diameter of blotch on dorsal fin to standard length (mm) in *Banjos banjos banjos*

Richardson 1909: 188 (Taiwan; listed); Franz 1910: 45, pl. 5, fig. 27 (Japan)

*Banjos typus* Bleeker 1876: 277 (based on *Anoplus banjos* Richardson 1846; unnecessary replacement name for *A. banjos*)

*Anoplus maculatus* Döderlein *in* Steindachner and Döderlein 1883:7, pl. 4, fig. 1 (unavailable name; name included in synonymy of *Anoplus banjos* Richardson 1846)

*Banjos banjos*: Jordan and Thompson 1912: 540, fig. 2 (Japan and Korea); Mori 1928: 6 (Korea; listed); Fowler 1933: 2 (Taiwan and Japan); Okada and Matsubara 1938: 222 (Japan; listed); Uchida and Yabe 1939: 9 (Jeju Island, Korea; listed); Kamohara 1950: 135, fig. 117 (Kochi and Wakayama prefectures, Japan); Kamohara 1952: 44, fig. 39 (Kochi Prefecture, Japan); Matsubara 1955: 665 (Japan and Taiwan; listed); Abe 1963: 129, unnumbered fig. (Japan, Taiwan, and China); Kamohara 1964: 47 (Kochi Prefecture, Japan; listed); Fourmanoir and Nhu-Nhung 1965: 42 (Nha Trang Bay, Vietnam; listed); Gamo and Kato 1973: 78 (Manazuru, Sagami Bay, Kanagawa Prefecture, Japan; listed); Orsi 1974 (Vietnam; listed); Dotsu and Tomiyama 1976: 21 (Nagasaki Prefecture, Japan; listed); Akazaki 1984: 169, pl. 163-H (Japan); Shen 1984: 46, pl. 46, fig. 300-1 (Taiwan); Machida 1985: 477, unnumbered fig. (Okinawa Trough, East China Sea); Yamada 1991: 22, fig. 4-3 (Misaki, Kanagawa Prefecture, Japan); Senou 1992: 1, unnumbered fig. (Izu, Shizuoka Prefecture, Japan); Lee 1993: 305, pl. 79-4 (Taiwan); Masuda and Kobayashi 1994: 128, unnumbered figs. (Japan); Akazaki 1997: 285, unnumbered fig. (Japan); Honma et al. 1997: 92, fig. 4 (Niigata Prefecture, Japan); Shinohara and Matsuura 1997: 303 (Suruga Bay, Japan; listed); Randall and Lim 2000: 612 (South China Sea; listed); Shinohara et al. 2001: 323 (Tosa Bay; listed); Chen 2003: 80, unnumbered fig. (Taiwan); Ide et al. 2003: 25 (Susaki, Tosa Bay, Kochi Prefecture, Japan; listed); Nakajima 2003: 97 (off Kami-shima island, Mie Prefecture, Japan); Yamaguchi and Machida 2003: 169 pl. 48, figs 186–187 (report of fish specimens collected by von Siebold and Bürger); Kim et al. 2005: 288, unnumbered fig. (Korea); Matsumoto 2005: 82 (Uyagawa, Shimane Prefecture, Japan; listed); Shinohara et al. 2005: 432 (off Ryukyu Islands, Japan; listed); Senou et al. 2006: 449 (Sagami Sea, Japan; listed); Yamada et al. 2007: 587, pl. 28-6 (East China and Yellow seas); Shao et al. 2008: 246 (southern Taiwan; listed); The Kagoshima City Aquarium 2008: 90, unnumbered fig. (Kagoshima Prefecture, Kyushu, Japan); Kim et al. 2009: 19 (Jeju Island, Korea; listed); Takagi et al. 2010: 190, unnumbered fig. (Ainan, Ehime Prefecture, Japan; listed); Kawano et al. 2011: 82 (Japan Sea; listed); Shen and Wu 2011: 394, unnumbered fig. (Taiwan); Miura 2012: 31, unnumbered fig. (Okinawa-jima Island, Okinawa Prefecture, Japan); Hatooka 2013: 819, unnumbered fig. (Japan); Sun and Chen 2013: 598 (South China Sea); Yabe 2013: 113, unnumbered fig. (Jeju Island, Korea); Kuriiwa et al. 2014: 1491 (Zunan Islands, Japan; listed); Shinohara et al. 2014: 260 (Japan Sea; listed); Ikeda and Nakabo 2015: 128, pl. 127-4 (Wakayama

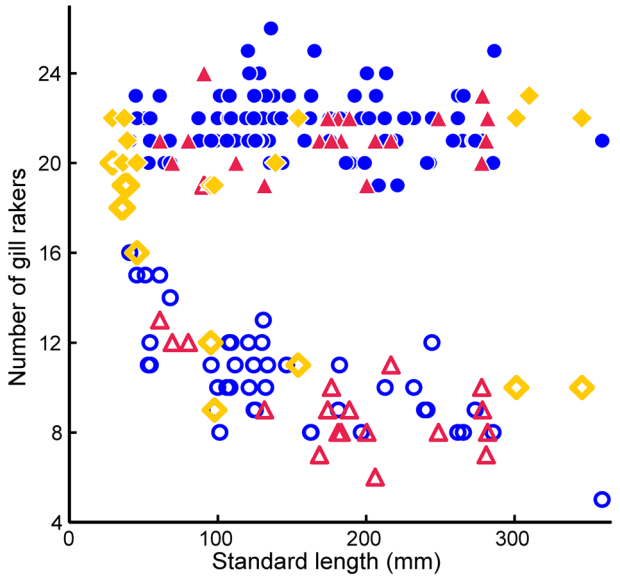



**Fig. 9** Relationships of number of total gill rakers and standard length (mm) in *Banjos aculeatus* sp. nov. (*yellow diamonds*), *B. banjos banjos* (*blue circles*) and *B. banjos brevispinis* ssp. nov. (*red triangles*). Solid symbols indicate number of gill rakers, including rudiments; open symbols indicate number of developed gill rakers only

Prefecture, Japan); Takeuchi et al. 2015: 8 (Tsushima Island, Nagasaki Prefecture, Japan; listed)

**Holotype.** BMNH 2004.11.5.11, 231 mm SL, Sea of Japan (probably Nagasaki Prefecture, Japan).

**Other specimens examined.** 163 specimens, 32.6–359 mm SL: **JAPAN: Chiba Prefecture:** FAKU 86731, 176 mm SL, Susaki, Tateyama Bay, T. Watanabe, 15 July 2003; NSMT-P 32759, 154 mm SL, Banda, Tateyama Bay, Chiba Prefecture, K. Utsugi, set net, 29 May 1990. **Tokyo**: NSMT-P 64811, 328 mm SL, 120 mile south-southwest of Hachijo-jima Island, 30°52′30″N, 138°43′36″E, FV *Taiyo-maru*, 9 or 10 Sept. 2002; USNM 38817, 106 mm SL, Tokyo Market; ZMB 12061, 125 mm SL, Yedo (Tokyo). **Kanagawa Prefecture:** CAS SU23412, 163 mm SL, Misaki, K. Aoki; FAKU 28247, 107 mm SL; KPM-NI 1036, 175 mm SL, 2 Nov. 1969. **Aichi Prefecture:** FAKU 97732, 135 mm SL, Enshu-nada Sea, Y. Kai, 14 Mar. 2010. **Mie Prefecture:** KAUM–I. 2955, 189 mm SL, Houzaura, 100–120 m, S. Konishi, gill net, 12 or 13 Mar. 2007; KAUM–I. 3124, 221 mm SL, Nieura, 60–80 m, FV *Fukuyoshi-maru*, gill net, 21 or 22 Apr. 2007; KAUM–I. 4351, 197 mm SL, Asoura, 45 m, FV *Koyo-maru*, set net, 9 May 2007; KAUM–I. 5973, 199 mm SL, Gokasyo, 120 m, FV *Seiho-maru*, long-line, 30 Apr. 2007; MTUF-P 21152, 130 mm SL, Kumano-nada Sea, 2 Mar. 1936. **Wakayama Prefecture:** FAKU 95502, 208 mm SL, Tanabe, 3 May 1950. **Kochi Prefecture (Tosa Bay):** BSKU 9224, 64.6 mm SL; BSKU 9225, 61.3 mm SL, 28 Apr. 1949; BSKU 9226, 143 mm SL, 2 Jan. 1950; BSKU 9979, 242 mm SL, 6 Jan. 1961; BSKU 11484, 125 mm SL, 22 Oct. 1965; BSKU 37099, 220 mm SL, 20 Apr. 1982; BSKU 52607, 111 mm SL, 28 Nov. 2000; BSKU 54086, 61.3 mm SL, 11 June 1999; BSKU 57795, 134 mm SL, 23 Nov. 2001; BSKU 59679, 109 mm SL, 11 Sept. 2002; BSKU 65197, 49.4 mm SL, 16 Apr. 2003; BSKU 67387, 97.0 mm SL, 4 July 2002; BSKU 68132, 101 mm SL, 33°17′02″N, 133°35′24″E–33°10′29″N, 133°35′13″E, 124–125 m, RV *Kotaka-maru*, 3 Dec. 1997; BSKU 71724, 46.0 mm SL, 27 Feb. 2004; BSKU 73632, 63.0 mm SL, 5 Apr. 2002; BSKU 74710, 162 mm SL, 7 June 2004; BSKU 74894, 45.1 mm SL, 25 Feb. 2004; BSKU 77290, 41.2 mm SL, 23 Feb. 2006; BSKU 79537, 32.6 mm SL, 31 Mar. 1999; BSKU 79988, 115 mm SL, 8 Nov. 1989; BSKU 80636, 128 mm SL, BSKU 80637, 117 mm SL, 16 Oct. 1992; BSKU 80638, 120 mm SL, BSKU 80639, 88.0 mm SL, 17 Oct. 1992; BSKU 92950, 206 mm SL, 14 Oct. 2007; BSKU 94612, 132 mm SL, 22 Apr. 2008; BSKU 109631, 101 mm SL, 11 Dec. 2012; FAKU 21804, 68.0 mm SL, 10–20 Apr. 1954; KAUM–I. 9870, 118 mm SL, KAUM–I. 9871, 138 mm SL, 100–200 m, KAUM Fish Team, bottom trawl, 9 Mar. 2008; KAUM–I. 21183, 134 mm SL, KAUM–I. 21185, 130 mm SL, 100–200 m, N. Nakayama, bottom trawl, 6 Mar. 2008; KAUM–I. 21184, 108 mm SL, 100–200 m, N. Nakayama, bottom trawl, 7 Mar. 2008; KAUM–I. 21186, 108 mm SL, 100–200 m, N. Nakayama, bottom trawl, 18 Apr. 2008; KAUM–I. 29844, 202 mm SL, 100–200 m, N. Nakayama, bottom trawl, 23 Oct. 2009; KAUM–I. 29845, 131 mm SL, KAUM–I. 29846, 108 mm SL, KAUM–I. 29847, 109 mm SL, KAUM–I. 29848, 54.8 mm SL, KAUM–I. 29849, 53.8 mm SL, 100–200 m, N. Nakayama, bottom trawl, 19 Mar. 2010. **Miyazaki Prefecture (off Meitsu):** MUFS 12085, 277 mm SL, 24 Apr. 1996; MUFS 12786, 271 mm SL, 27 Dec. 1996; MUFS 13006, 126 mm SL, MUFS 20824, 112 mm SL; MUFS 13045, 225 mm SL, 27 May 1997; MUFS 13913, 258 mm SL, 1 Sept. 1997; MUFS 13952, 95.9 mm SL, MUFS 13953, 118 mm SL,11 Sept. 1997; MUFS 14018, 215 mm SL, 12 Sept. 1997; MUFS 14657, 141 mm SL, 5 Jan. 1998; MUFS 14787, 272 mm SL, MUFS 14788, 213 mm SL, 7 Feb. 1998; MUFS 15903, 359 mm SL, 6 July 1998. **Kagoshima Prefecture:** KAUM–I. 8757, 252 mm SL, Shimokoshiki-jima Island, Koshiki-jima Islands, 31°45′34″N, 129°46′41″E, 36 m, G. Ogihara, set net, 19 Mar. 2008; KAUM–I. 12836, 286 mm SL, Ishigaki, Minami-kyushu, 31°10′17″N, 130°25′57″E, 150 m, G. Ogihara, set net, 16 Dec. 2008; KAUM–I. 25238, 240 mm SL, KAUM–I. 25239, 219 mm SL, Nagasaki-bana, Ibusuki, 31°08′N, 130°35′E, 130–135 m, long-line, 22 Dec. 2009; KAUM–I. 33965, 213 mm SL, west of Okiakime-jima Island, Minami-satsuma, 31°21′N, 130°10′E, 27 m, M. Itou, set net, 16 May 2010; KAUM–I. 48633, 258 mm SL, about 20 km southeast of Sata Point, 30°52′N, 130°48′E,

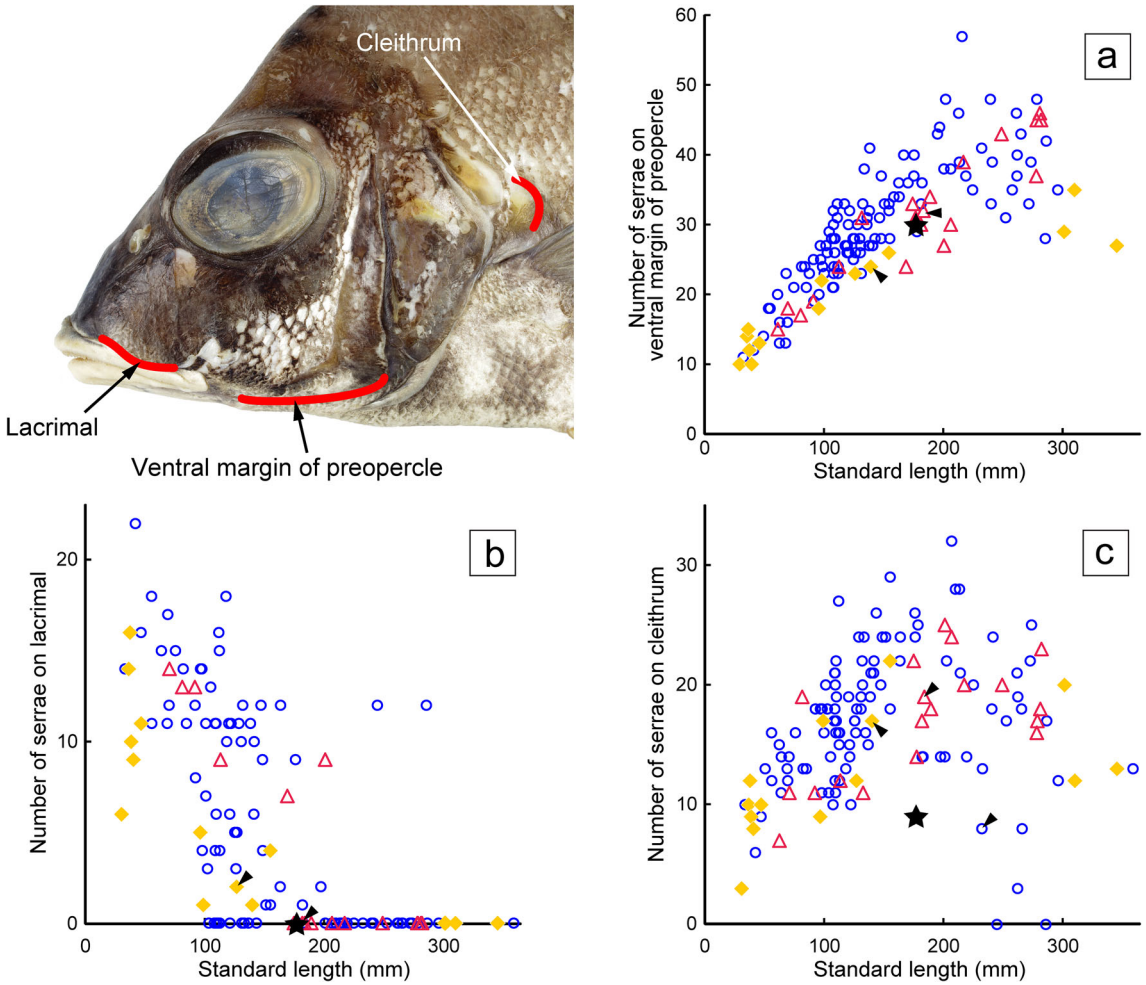



**Fig. 10** Relationships of numbers of **a** serrae on ventral margin of preopercle, **b** serrae on lacrimal and **c** serrae on cleithrum in *Banjos aculeatus* sp. nov. (*yellow diamonds*), *B. banjos banjos* (*blue circles*), *B. banjos brevispinis* ssp. nov. (*red triangles*) and *B. peregrinus* sp. nov. (*black star*). *Arrowheads* indicate holotypes

M. Takayama, hand line, 30 June 2012; KAUM–I. 63215, 261 mm SL, Kunigami, Tanega-shima Island, 30°49′N, 131°01′E, 110 m, M. Takayama, hand line, 1 Sept. 2014; KAUM–I. 72541, 224 mm SL, KAUM–I. 72542, 232 mm SL, west of Okiakime-jima Island, Minami-satsuma, 31°21′N, 130°10′E, 40 m, Y. Ushijima, set net, 16 May 2015; KAUM–I. 74376, 261 mm SL, southeast of Sata Point, 30°50′N, 130°45′E, M. Takayama, long-line, 22 June 2015; KAUM–I. 77359, 265 mm SL, north of Kuchino-shima Island, Tokara Islands, 30°01′N, 130°11″E, H. Hata, hand line, 3 Aug. 2015; KAUM–I. 78133, 206 mm SL, east of Sato, Kamikoshiki-shima Island, Koshiki Islands, 31°50′N, 129°56′E, H. Imamura, line fishing, 12 Aug. 2015; KAUM–I. 78582, 296 mm SL, north of Mage-jima Island, Osumi Islands, 30°50′N, 129°56′E, FV *Dai-san-hoyo-maru*, long-line, 1 Oct. 2015. **Kyoto Prefecture:** FAKU 102697, 87.4 mm SL, Maizuru, 18 Oct. 1959; FAKU 25731, 108 mm SL, Maizuru, 29 Sept. 1955. **Nagasaki Prefecture:** BMNH 2004.11.5.12, 257 mm SL, Sea of Japan (probably Nagasaki Prefecture). **Okinawa Prefecture:** URM-P 1351, 278 mm SL, Okinawa-jima Island, hand line, 28 June 1969; URM-P 6132, 273 mm SL, Miyako Islands, 18 Dec. 1982; URM-P 8245, 285 mm SL, Okinawa-jima Island, 13 Sept. 1983; URM-P 35577, 244 mm SL, Okinawa-jima Island, 7 May 1996. **Ryukyu Islands:** KAUM–I. 2533, 262 mm SL, southern Ryukyu Islands between Amami and Yaeyama islands, Y. Sakurai, hand line, 26 Jan. 2007; KAUM–I. 2534, 265 mm SL, southern Ryukyu Islands between Amami and Yaeyama islands, Y. Sakurai, hand line, 7 Feb. 2007; KAUM–I. 4756, 241 mm SL, southern Ryukyu Islands between Amami and Yaeyama islands, Y. Sakurai, 9 June 2007; KAUM–I. 8980, 239 mm SL, southern Ryukyu Islands between Amami and Yaeyama islands, Y. Sakurai, 18 Mar. 2008. **No further data:** FAKU 71445, 275 mm SL, FAKU 75941, 295 mm SL, FAKU 78376, 214 mm SL, FAKU 78377, 184 mm SL, FAKU 78401, 209 mm SL; **EAST CHINA SEA:** BSKU 32452, 162 mm SL, BSKU 32453,

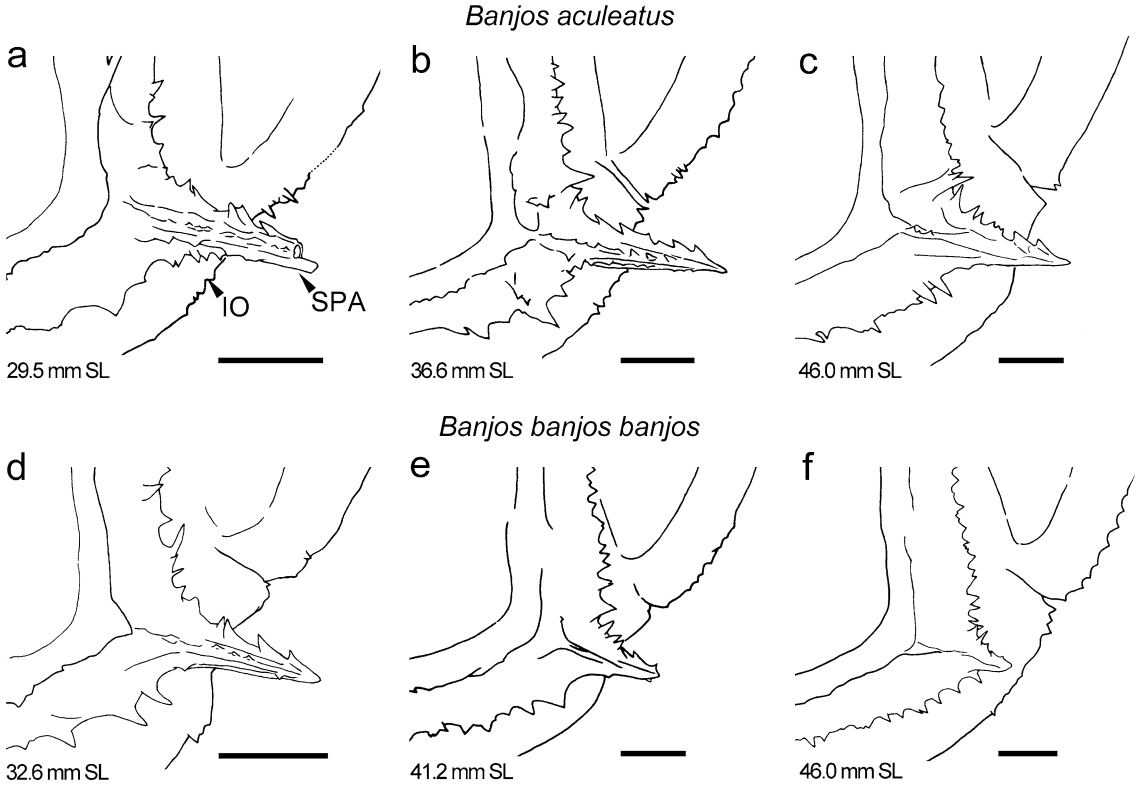
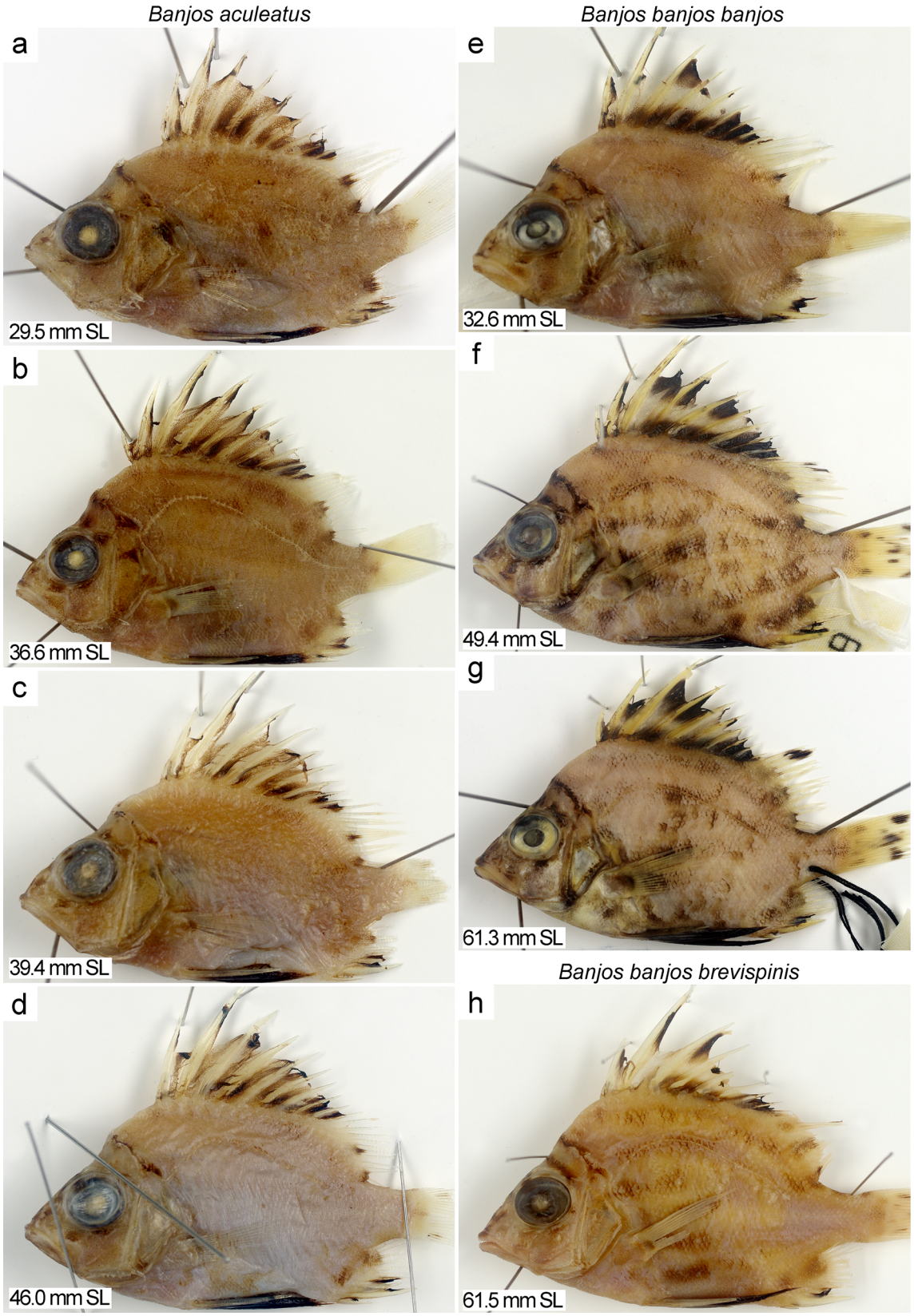



**Fig. 11** Illustrations of spine at preopercle angle (*SPA*) in *Banjos aculeatus* sp. nov. (**a**–**c**) and *B. banjos banjos* (**d**–**f**), showing different growth stages in juvenile specimens < 70 mm SL. Note differences in spine length and serration between the two species. **a** AMS I.32205-001, 29.5 mm SL, Yamba, NSW, Australia (tip of spine slightly broken); **b** AMS I.37508-002, 36.6 mm SL, New Castle, NSW; **c** AMS I.32195-001, 1 of 2 specimens, 46.0 mm SL, Iluka, NSW; **d** BSKU 79537, 32.6 mm SL, Tosa Bay, Kochi Prefecture, Japan; **e** BSKU 77290, 41.2 mm SL, Tosa Bay, Kochi Prefecture, Japan (right side, reversed); **f** BSKU 71724, 46.0 mm SL, Tosa Bay, Kochi Prefecture, Japan (right side, reversed). *IO* indicates the margin of the interopercle

146 mm SL, Okinawa Trough, 25°50.0′N, 124°25.0′E, 350–400 m, 14 Sept. 1979; BSKU 32556, 190 mm SL, Okinawa Trough, 25°46.5′N, 124°00.3′E, 175–180 m, 16 Sept. 1979; FAKU 77165, 198 mm SL, 122 m, 11 Oct. 1998; FAKU 79346, 53.6 mm SL, 20 Jan. 1991; KAUM–I. 7198, 158 mm SL, 30°56′48″N, 127°20′40″E–31°01′48″N, 127°21′14″E, 121 m, bottom trawl, 8 Nov. 2007; KAUM–I. 32479, 212 mm SL, KAUM–I. 32480, 165 mm SL, KAUM–I. 32481, 200 mm SL, 26°04′19″N, 123°46′49″E, bottom trawl, 23 May 2010; KAUM–I. 32482, 75.0 mm SL, 26°46′42″N, 122°55′12″E, 123 m, bottom trawl, 21 May 2010; KAUM–I. 32483, 55.0 mm SL, 28°27′30″N, 126°26′40″E, 126 m, bottom trawl, 2 June 2010; KAUM–I. 32484, 68.5 mm SL, 27°10′29″N, 125°09′35″E, 114 m, bottom trawl, 19 May 2010; KAUM–I. 32485, 175 mm SL, 26°04′18″N, 123°46′50″E, 133 m, bottom trawl, 23 May 2010; KAUM–I. 32486, 178 mm SL, KAUM–I. 32487, 186 mm SL, 31°55′00″N, 128°11′26″E, 150 m, bottom trawl, 19 June 2010; KAUM–I. 32488, 181 mm SL, KAUM–I. 32489, 184 mm SL, 26°06′11″N, 124°07′20″E, 157 m, bottom trawl, 23 May 2010; KAUM–I. 34124, 192 mm SL, 30°46′22″N, 127°20′29″E–30°56′54″N, 127°24′17″E, 150 m, bottom trawl, 5–11 Nov. 2010; KAUM–I. 35676, 209 mm SL, 26°03′N, 124°23′E, 210 m, 21 Nov. 2010; KAUM–I. 35677, 91.3 mm SL, KAUM–I. 35678, 100 mm SL, 27°27′N, 126°03′E, 136 m, 5 Dec. 2010; KAUM–I. 35813, 103 mm SL, 26°33′N, 124°26′E, 108 m, 22 Nov. 2010; KAUM–I. 35814, 112 mm SL, 27°23′N, 125°24′E, 116 m, 25 Nov. 2010; KAUM–I. 35815, 108 mm SL, KAUM–I. 35816, 111 mm SL, 31°25′N, 127°22′E, 134 m, 28 Nov. 2010; KAUM–I. 40456, 272 mm SL, 31°16′N, 130°04′E, 70 m, 2 Aug. 2011; KAUM–I. 40457, 111 mm SL, KAUM–I. 40458, 148 mm SL, KAUM–I. 40459, 143 mm SL, 26°28′N, 125°14′E, 169 m, 23 May 2011; KAUM–I. 58642, 108 mm SL, 29°14′N, 126°16′E, 102 m, 6 Dec. 2013; KAUM–I. 70260, 143 mm SL, 31°15′N, 127°46′E, 138–140 m, 8 Oct. 2014; KAUM–I. 70280, 109 mm SL, 26°21′N, 123°43′E, 142–152 m, 21 Nov. 2014; KAUM–I. 70287, 109 mm SL, 26°27′N, 124°27′E, 147–157 m, 22 Nov. 2014; KAUM–I. 75227, 155 mm SL, KAUM–I. 75228, 69.5 mm SL, 31°24′N, 127°31′E, 127–128 m, 17 June 2015; KAUM–I. 75271, 84.1 mm SL, 26°54′N, 122°59″E, 119–120 m, 15 May 2015; KAUM–I. 75956, 195 mm SL, 31°43′N,


Banjos aculeatus
a
29.5 mm SL
b
36.6 mm SL
c
39.4 mm SL
d
46.0 mm SL
Banjos banjos banjos
e
32.6 mm SL
f
49.4 mm SL
g
61.3 mm SL
Banjos banjos brevispinis
h
61.5 mm SL

◀**Fig. 12** Preserved specimens of *Banjos aculeatus* sp. nov. (**a**–**d**), *B. banjos banjos* (**e**–**g**), and *B. banjos brevispinis* ssp. nov. (**h**) showing different growth stages in juvenile specimens < 70 mm SL. Note differences in coloration of spinous dorsal-fin membrane between *B. aculeatus* and *B. banjos* ssp. **a** AMS I.32205-001, 29.5 mm SL, Yamba, NSW, Australia; **b** AMS I.37508-002, 36.6 mm SL, New Castle, NSW; **c** AMS I.32195-001, 1 of 2 specimens, 39.4 mm SL, Iluka, NSW; **d** AMS I. 32195-001, 1 of 2 specimens, 46.0 mm SL, Iluka, NSW; **e** BSKU 79537, 32.6 mm SL, Tosa Bay, Kochi Prefecture, Japan; **f** BSKU 65197, 49.4 mm SL, Tosa Bay, Kochi Prefecture, Japan; **g** BSKU 54086, 61.3 mm SL, Tosa Bay, Kochi Prefecture, Japan; **h** WAM P.27219-004, 61.5 mm SL, Houtman Abrolhos, WA, Australia

127°59′E, 146–152 m, 24 Sept. 2015; KAUM–I. 81024, 91.7 mm SL, 31°23′N, 127°44′E, 133–137 m, 23 Sept. 2015; KAUM–I. 81321, 85.4 mm SL, 31°44′N, 127°45′E, 142 m, 13 Dec. 2015; KAUM–I. 81683, 104 mm SL, 26°27′N, 124°27′E, 147–157 m, 22 Nov. 2014; KAUM–I. 86584, 167 mm SL, KAUM–I. 86586, 170 mm SL, 26°36′N, 125°58′E, 126–127 m, 26 May 2015; SNFR 12254, 140 mm SL, RV *Kumamoto-maru*, bottom trawl, 8 June 2008; SNFR 12383, 150 mm SL, 26°05′N, 123°45′E–26°04′N, 123°46′E, 135–136 m, RV *Kumamoto-maru*, bottom trawl, 24 May 2008; SNFR 13248, 203 mm SL, 26°13′N, 123°04′E–26°11′N, 123°05′E, 122 m, RV *Kaiho-maru*, 29 Jan. 1997; SNFR 14075, 81.5 mm SL, 26°57′N, 124°45′E–26°55′N, 124°45′E, 109–117 m, RV *Kumamoto-maru*, bottom trawl, 30 May 2008; URM-P 25710, 63.0 mm SL, RV*Nagasaki-maru*, bottom trawl, 15 Apr. 1991; URM-P 35681, 97.4 mm SL, RV *Nagasaki-maru*, bottom trawl, 12 Nov. 1994. **CHINA:** CAS 30646, 2 specimens, 99.0–100 mm SL, off Taya Islands, east of Hainan Island, Guangdong, 19°38′N, 111°30′E, ca. 91 m depth, R. Bolin on MV *Alister Hardy*, 21 July 1958; MTUF-P 21144, 119 mm SL, "China Sea"; SFU 3876, 121 mm SL, SFU 3877, 124 mm SL, Shanghai; USNM 335537, 121 mm SL, east of Hainan Island, 18°49′N, 111°31′E–18°53′30″N, 111°31′E, 157–165 m, W. Chan on RV *Cape St. Mary*, 5 Dec. 1963. **TAIWAN:** ASIZP 59349, 2 specimens, 137–154 mm SL, Dashi, Yilan, P.-L. Lin, 11 Apr. 1990; KAUM–I. 39291, 131 mm SL, KAUM–I. 39292, 148 mm SL, KAUM–I. 39293, 120 mm SL, KAUM–I. 39294, 136 mm SL, KAUM–I. 39295, 130 mm SL, KAUM–I. 39296, 124 mm SL, KAUM–I. 39297, 136 mm SL, KAUM–I. 39298, 138 mm SL, Dashi, Yilan, bottom trawl. **SOUTH CHINA SEA:** MTUF-P 21160, 182 mm SL, South China Sea, 145 m, 26 Nov. 1934.

**Diagnosis.** A subspecies of *B. banjos* distinguished from other subspecies by the following combination of characters: least interorbital width 6.2–10.3 (7.5) % of SL; first dorsal-fin spine length 4.8–11.7 (7.4) % of SL; second dorsal-fin spine length 11.2–22.7 (17.2) % of SL; eighth dorsal-fin spine length 11.3–19.6 (14.8) % of SL.

**Distribution.** *Banjos b. banjos* is distributed in the northwestern Pacific from the South China Sea north to Japan. A distributional map of the subspecies based on examined specimens is shown in Fig. 4. The subspecies has also been recorded (as *Banjos banjos*) from Korea and Vietnam (Fourmanoir and Nhu-Nhung 1965; Kim et al. 2005). In Japanese waters, the subspecies has been recorded from the Zunan Islands (between Izu and Ogasawara islands); Kanagawa, Shizuoka, Wakayama, Kochi, Ehime and Kagoshima prefectures on the Pacific or East China Sea coasts; Niigata, Shimane and Nagasaki prefectures on the Japan Sea or East China Sea coasts; and Okinawa Prefecture (southern Ryukyu Islands) (see Synonym list).

Sampling data for 45 lots of examined specimens indicate capture by benthic trawl, line fishing and set net, at depths of 27–400 m. The deepest record (350–400 m) is for BSKU 32556 from the Okinawa Trough, East China Sea. However, the subspecies has been most often collected from the continental shelf and slope at depths of 100–200 m. Underwater photographs of juveniles have been taken from the Sagami Sea and Suruga Bay, central Pacific coast of Honshu, Japan, in relatively shallow water (20–26 m depth) (KPM-NR 9927, 21651, 63088 and 93627). Senou (1992) and Masuda and Kobayashi (1994) reported an underwater photograph of a ca. 7 cm TL juvenile from Izu, Shizuoka Prefecture, central Pacific coast of Japan, taken at 33 m depth. Uryu (2003) also provided underwater photographs of juveniles from Izu, stating that juveniles could be (rarely) found on sandy bottoms at depths of 20–40 m. Kamohara (1952) reported 5–8 cm TL juveniles in tide pools from February to April in Kochi Prefecture, Japan. Apparently, *B. b. banjos* inhabits shallow waters during early life stages, later shifting to deep water habitats.

**Holotype of *A. banjos*.** Richardson (1846) originally described *Anoplus banjos*, referring to "*Anoplus*" of Temminck and Schlegel (1843) and "*Banjos*" of Krusenstern (1813, 1814). Krusenstern (1813) and a subsequent German–Russian edition (Krusenstern 1814) provided an illustration of a fish (pl. 54, fig. 1) collected from Nagasaki, Japan, which was drawn by W. G. von Tilesius, a German natural scientist and artist. That illustration is clearly identifiable as *B. b. banjos* described herein. Although Tilesius *in* Krusenstern (1813, 1814) provided a name (a combination of two words meaning "Japanese Bigeye") for the fish, it was spelt in the Russian alphabet and is therefore unavailable according to ICZN (1999: Art. 11.2). A similar situation for platycephalid fishes in Tilesius *in* Krusenstern (1813) [author as Tilesius] was discussed in detail by Imamura and Yoshino (2009). Moreover, although Tilesius *in* Krusenstern (1814) also noted his drawing as "Der Banjos", it was written in German

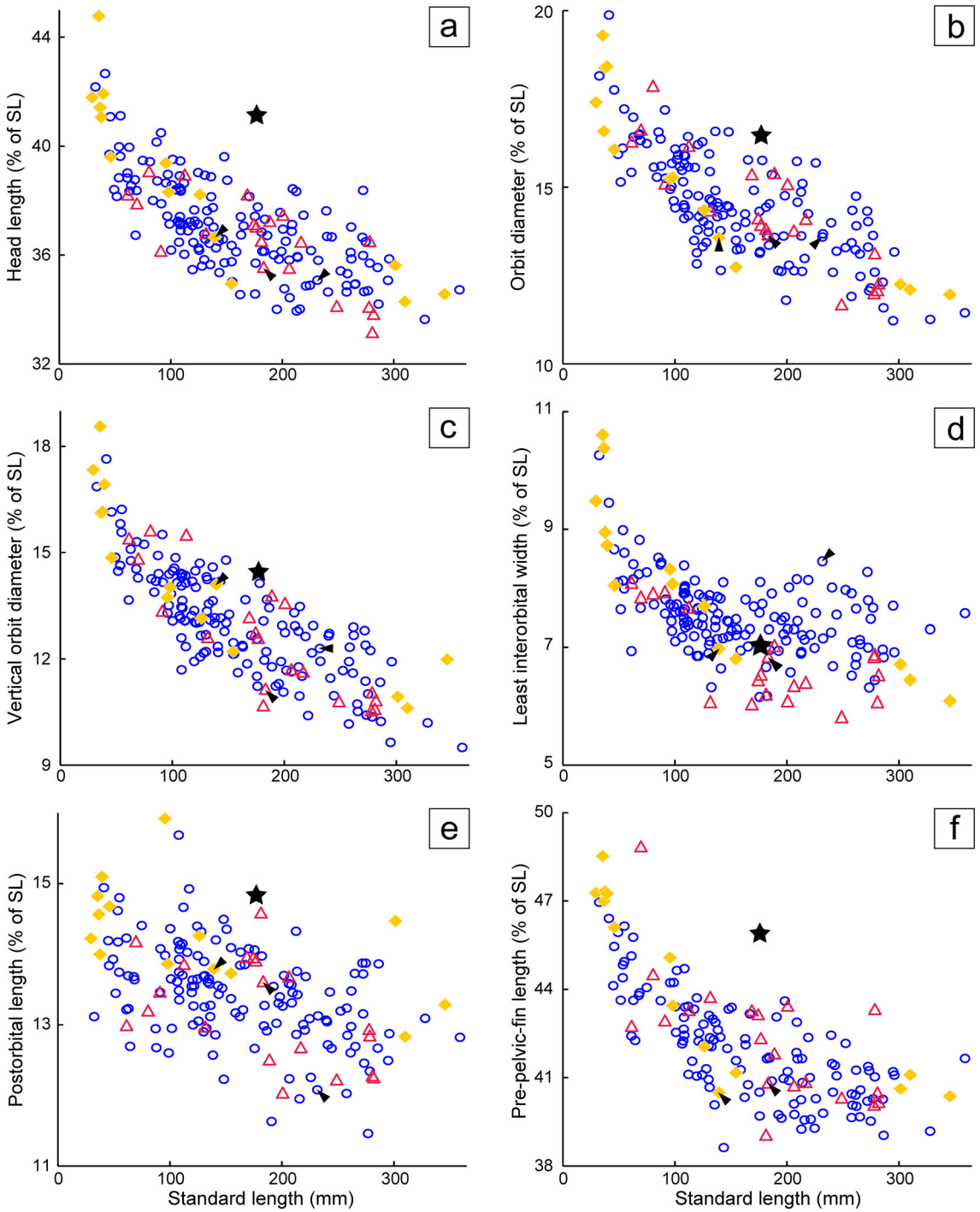



**Fig. 13** Relationships of **a** head length; **b** orbit diameter; **c** vertical orbit diameter; **d** least interorbital width; **e** postorbital length; **f** pre-pelvic-fin length (all percentages of standard length) to standard length (mm) in *Banjos aculeatus* sp. nov. (*yellow diamonds*), *B. banjos banjos* (*blue circles*), *B. banjos brevispinis* ssp. nov. (*red triangles*) and *B. peregrinus* sp. nov. (*black star*). *Arrowheads* indicate holotypes

without a formal Latin name and should therefore also be treated as unavailable.

Temminck and Schlegel's (1843) original description of "L'ANOPLE. (Anoplus.)" from Japan included an excellent drawing (pl. 8) of a specimen, which can be identified as *B. b. banjos*. Although a specific name was not proposed for "*Anoplus*", the latter is acceptable as a valid genus name. Although Temminck and Schlegel (1843) did not mention the whereabouts of "*Anoplus*" specimens, their description of an ontogenetic change in preopercular

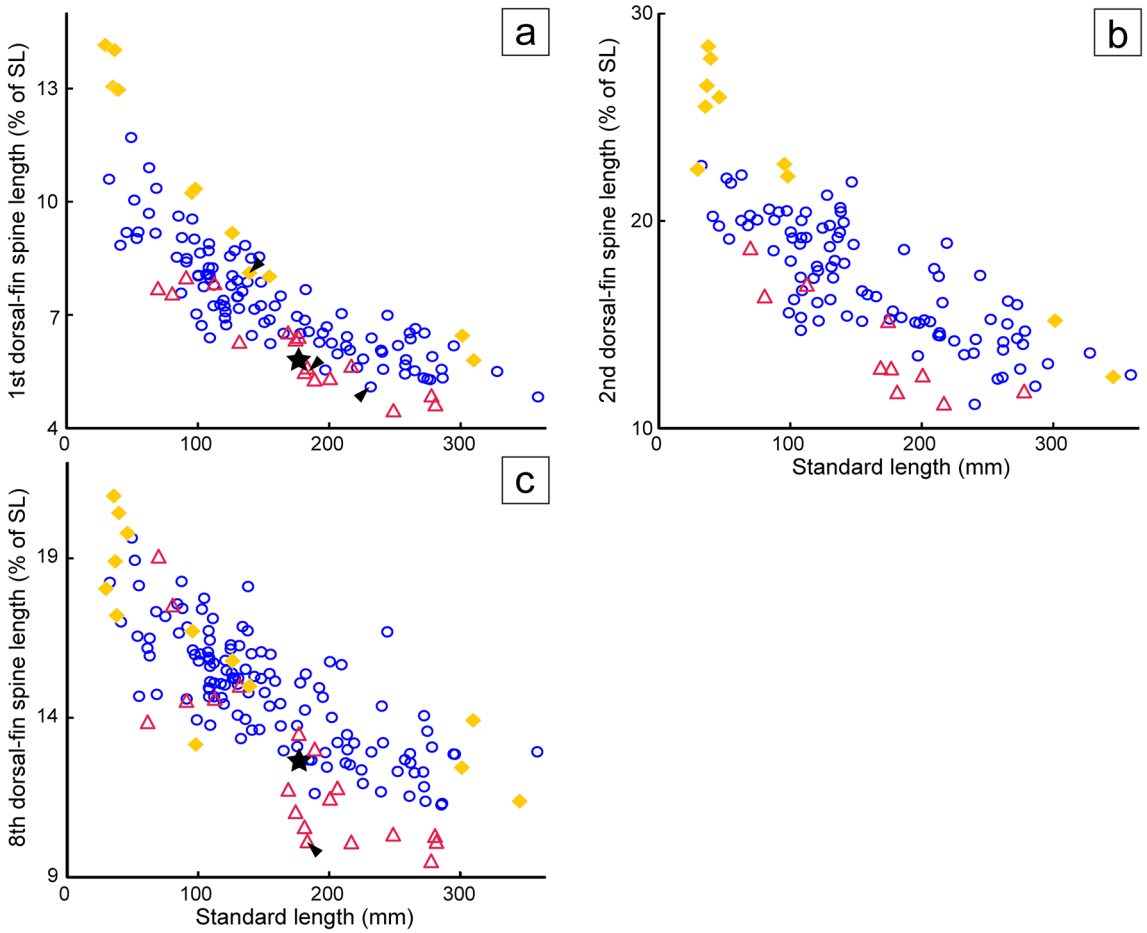
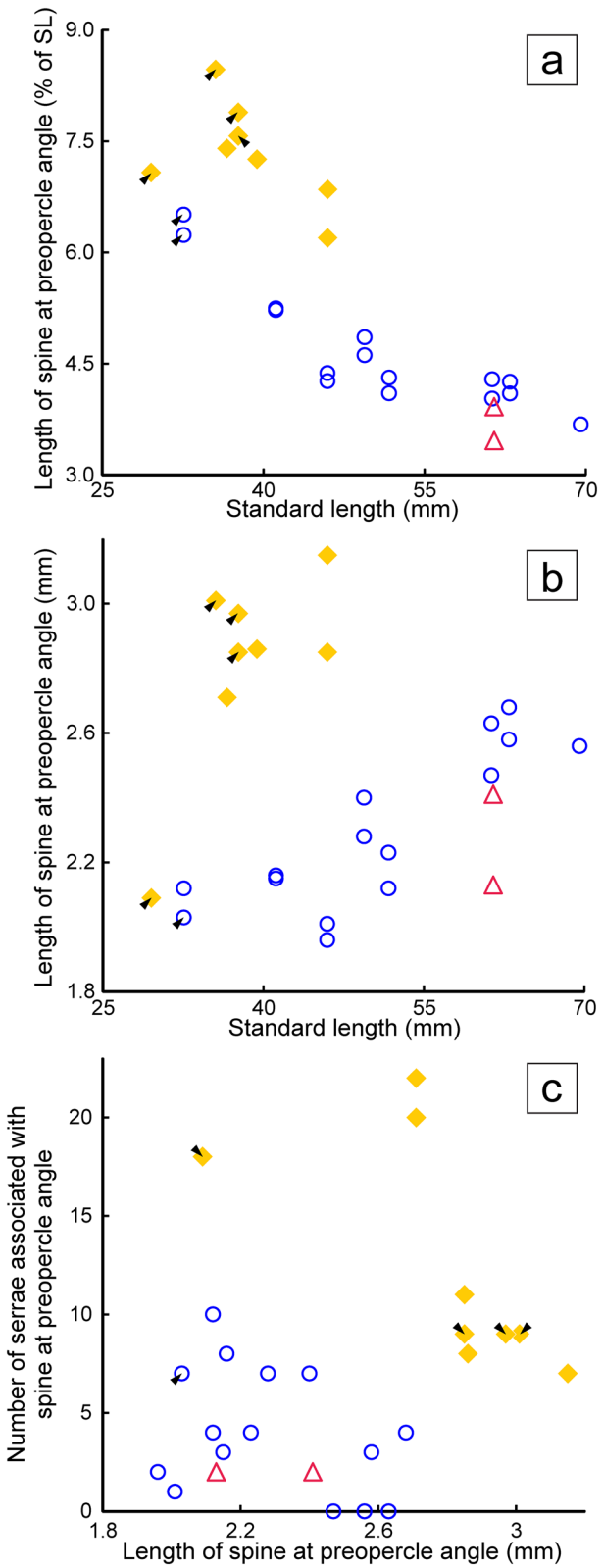



**Fig. 14** Relationships of **a** 1st dorsal-fin spine length; **b** 2nd dorsal-fin spine length; **c** 8th dorsal-fin spine length (all percentages of standard length) to standard length (mm) in *Banjos aculeatus* sp. nov. (*yellow diamonds*), *B. banjos banjos* (*blue circles*), *B. banjos brevispinis* ssp. nov. (*red triangles*) and *B. peregrinus* sp. nov. (*black star*). *Arrowheads* indicate holotypes

serrations in "*Anoplus*" clearly indicated that their description was based on a number of differing size specimens. Subsequently, Boeseman (1947), who reviewed the Japanese fish collections made by Bürger and von Siebold, stated that four stuffed and one alcoholic specimen (6–30.5 cm SL) of "*Anoplus*" existed in Bürger's and von Siebold's collections, respectively. The five specimens are still held at Naturalis, Leiden (RMNH), being catalogued as RMNH D 66–69 (four Bürger specimens) and RMNH 192 (one Siebold specimen) (Boeseman 1947; Yamaguchi and Machida 2003; Y. Takigawa personal communication). Another specimen, donated from Leiden, is at the Museum of Natural History of the Humboldt University of Berlin (ZMB) (registered as ZMB 457) (Paepke 2001; Yamaguchi and Machida 2003). Two other Bürger specimens from Leiden are held at the British Museum (BMNH), London. Their type status is discussed below.

In his description of *A. banjos*, Richardson (1846) did not clearly identify the basis for that description. However, his statement "*Rad*. D. 10 / 12; A 3 / 7; C 17 4/3; V. 1/5. (Bürger's Spec.)" clearly suggests that he examined a specimen (s) collected by Bürger. In a similar case, his description of *Crenidens leoninus* (Kyphosidae) [*in* Richardson (1846: 242)] stated "(Reeves's fig.)", indicating that the description was based solely on Reeves' fish drawing (Yagishita and Nakabo 2000). Richardson (1846) also stated "A Japanese species of *Anoplus* collected by Bürger exists in the British Museum", which is unequivocal. Moreover, the numbers of dorsal (D), anal (A), caudal (C) and pelvic (V) fin rays of *A. banjos* described by Richardson (1846) differ from those reported by Temminck and Schlegel' (1843) for "*Anoplus*" viz., "D. 10 + 13; A. 3 + 8; V. 3 + 5; P. [pectoral-fin rays] 15; C. 18". Such disagreements support the likelihood that Richardson's (1846) description was based solely on his examined specimen, despite Jordan and Thompson's (1912) statement that Richardson's (1846) description of *A. banjos* was based on that of Temminck and Schlegel (1843). We conclude therefore, that a single Japanese specimen




◀**Fig. 15** Relationships of **a** length of spine at preopercle angle (SPA) (% of SL) to standard length (mm); **b** length of SPA (mm) to standard length (mm); **c** number of serrae associated with SPA to length of SPA (mm) in *Banjos aculeatus* sp. nov. (*yellow diamonds*), *B. banjos banjos* (*blue circles*) and *B. banjos brevispinis* ssp. nov. (*red triangles*). *Arrowheads* indicate specimens with damaged SPA

collected by Bürger, which formed the basis for Richardson's (1846) description, should be regarded as the holotype of *A. banjos*.

Richardson (1846) did not include a catalog number for the holotype of *A. banjos*. Although the publication indicated a single specimen of *A. banjos* at BMNH, Günther (1859) later reported that two Bürger specimens (originating from Leiden) were held at BMNH. In contrast, Boeseman (1947) and Yamaguchi and Machida (2003) referred to only a single Bürger specimen at BMNH. However, two stuffed specimens, clearly identifiable as *B. b. banjos*, presently exist at BMNH (Fig. 5), both with evidence of having been on mounts at some time. One of these specimens (Fig. 5a) is presently accompanied by a handwritten label (stating that it is the holotype of *A. banjos*), written by A. Wheeler, Head of the Fish Section of BMNH in the 1980s (J. Maclaine personal communication). The specimen, kept in the type specimen store room at BMNH, had been registered as BMNH 2004.11.5.11, due to the apparent absence of an original catalog number (J. Maclaine personal communication). Although this information was not included in the print edition of the Catalog of Fishes (Eschmeyer 1998), it has been updated in the current online version (Eschmeyer et al. 2016). The second specimen (Fig. 5b), subsequently discovered in the non-type collection, also lacked an original catalog number, being registered as BMNH 2004.11.5.12. These two specimens are regarded as the two Bürger specimens originally reported by Günther (1859), with no other specimens of *Banjos* being held at BMNH.

Notwithstanding the above, an early BMNH ledger lists two specimens of *Anoplus* [BMNH 1844.2.21.34 (registered as "*Anoplus* sp.") and BMNH 1846.2.16.95 ("*Anoplus tetraodon*")]. According to the ledger, both were collected from Japan and purchased from the Leiden Museum via G. A. Frank, a natural historian and book dealer in Amsterdam (Grouw and Steinheimer 2008). These catalog numbers are regarded as the original catalog numbers of the two extant BMNH Bürger specimens. However, there is now no indication to which specimen each catalog number referred to as the original catalog numbers and mounting boards no longer exist. Furthermore, any correspondence which may shed light on the applicability of the catalog numbers to a particular specimen is unknown.

BMNH 2004.11.5.11, having been held in the BMNH type specimen store room, is regarded here as the holotype of *A. banjos*, with the second Bürger specimen, BMNH

2004.11.5.12, having no type status. This decision has been made arbitrarily, since there is no way of determining the original status of each specimen.

**Remarks.** Morphometrics and meristics are given in Tables 1, 3. Photographs of fresh and preserved specimens are shown in Fig. 1c–e and Fig. 6, respectively. A precise locality for the holotype of *A. banjos* is unknown, although Richardson (1846) stated that *A. banjos* is distributed in the "Sea of Japan". The holotype was collected by Bürger (Richardson 1846). Since Bürger's collection of fish specimens was restricted to the Nagasaki Prefecture, northwestern Kyushu, during his stay at Japan (Boeseman 1947; Yamaguchi and Machida 2003), the type locality of *A. banjos* is most likely Nagasaki Prefecture, on the southwestern entrance to the Japan Sea (also referred to as the "Sea of Japan").

As mentioned above, *B. typus* Bleeker 1876, originally based on Richardson's (1846) *A. banjos*, was an unnecessary replacement name and is regarded as an objective synonym of the latter. In a later description of *A. banjos*, Steindachner and Döderlein (1883) included a manuscript name, *Anoplus maculatus*, for two juvenile specimens from Japan, subsequently recognized as juveniles of *A. banjos* by Franz (1910). However, *A. maculatus* is unavailable (Eschmeyer 1998; Eschmeyer et al. 2016; ICZN 1999: Art. 11.6), although a single specimen (ZMB 12061, 125 mm SL; Fig. 7) labeled "type of *Anoplus maculatus*" is still held in the Zoologisches Museum, Berlin. It is clearly identifiable as *B. b. banjos*.

### *Banjos banjos brevispinis* ssp. nov.

(New English name: Western Australian Banjofish) (Figs 1f–i, 2b, 3d–f, 4, 9–10, 12h, 13–15; Tables 1, 3)

*Banjos banjos* (not of Richardson): Gloerfelt-Tarp and Kailola 1984: 141, unnumbered fig. (Timor Sea); Sainsbury et al. 1985: 142, unnumbered fig. (northwestern Australia); Allen and Swainston 1988: 82, unnumbered fig. (northwestern Australia); Williams et al. 1996: 152 (WA, Australia; listed); Hutchins 2001: 31 (WA, Australia; listed); Allen and Cross 2006: 1078 (in part; NSW, Qld, and WA, Australia)

**Holotype.** NMV A1743, 183 mm SL, northwest of North Island, Houtman Abrolhos, WA, Australia, 27°56′S, 113°14′E–27°48′S, 113°14′E, 190–210 m, M. Gomon et al. on RV *Hai Kung*, otter trawl, 1 Mar. 1981.

**Paratypes.** 19 specimens, 61.5–282 mm SL: **INDONESIA:** NMNZ 15089, 71.3 mm SL, south of Lombok, Indonesia, 9°01′S, 116°18′E, 150 m, T. Gloerfelt-Tarp, July 1981. **AUSTRALIA (WA):** CSIRO CA994, 131 mm SL, northeast of Bedout Islet, 18°37′S, 119°20′E–18°38′S, 119°19′E, 122–125 m, FRV *Soela*, 6 June 1980; CSIRO CA4214, 168 mm SL, north of Dampier Archipelago, 19°13.0′S, 116°28.2′E–19°13.2′S, 116°26.8′E, 192–194 m, FRV *Soela*, Frank and Bryce demersal trawl, 11 Aug. 1983; CSIRO H2037-02, 278 mm SL, west of Houtman Abrolhos, 28°34.6′S, 113°29.4′E, 216 m, RV *South Passage*, trawl, 29 Jan. 1989; CSIRO H6422-07, 80.6 mm SL, CSIRO H6422-08, 176 mm SL, CSIRO H6422-09, 217 mm SL, northwest of Shark Bay, 24°09.95′S, 112°33.17′E–24°15.78′S, 112°29.47′E, 234–240 m, RV *Congasa*, demersal trawl, 26 Apr. 2006; NMV A1749, 2 specimens, 91.2–181 mm SL, northwest of North Island, Houtman Abrolhos, 27°45′S, 113°14′E–27°43′S, 113°13′E, 180 m, M. Gomon et al. on RV *Hai Kung*, otter trawl, 1 Mar. 1981; NMV A1750, 174 mm SL, southwest of Shark Bay, 25°28′S, 112°27′E–25°19′S, 112°17′E, 131–139 m, M. Gomon et al. on RV *Hai Kung*, otter trawl, 4 Mar. 1981; KAUM–I. 89443 (formerly NSMT-P 114011), 282 mm SL, NSMT-P 113708, 249 mm SL, NSMT-P 113709, 281 mm SL, 26°22.7′S, 112°26.9′E, 288 m, RV *Kaiyo-maru*, 9 Nov. 1975; NSMT-P 114010, 278 mm SL, 28°09.2′S, 113°19.5′E, 177 m, RV *Kaiyo-maru*, 11 Nov. 1975; WAM P.13969.001, 206 mm SL, 25°21′S, 113°44′E, W. Poole et al., trawl, Aug. 1965; WAM P.23899.001, 187 mm SL, 21°47′S, 114°10′E, 137.2 m, R. Row, trawl, Aug. 1973; WAM P.25927.004, 200 mm SL, 19°40′S, 115°45′E, 128 m, R. Walker, trawl, 25 Aug. 1977; WAM P.27219.004, 61.5 mm SL, Hummock Island, Houtman Abrolhos, 28°48′S, 114°03′E, D. Heald, trawl, 22 November 1980; WAM P.27236-001, 114 mm SL, 26°10′S, 112°25′E, M. Walker on RV *Taiyo-maru*, trawl, 9 August 1979.

**Diagnosis.** A subspecies of *B. banjos* distinguished from other subspecies by the following combination of characters: least interorbital width 5.8–8.1 (mean 6.8) % of SL; first dorsal-fin spine length 4.5–8.0 (6.1) % of SL; second dorsal-fin spine length 11.2–18.3 (14.0) % of SL; eighth dorsal-fin spine length 9.5–18.7 (12.5) % of SL.

**Description.** Selected meristics and morphometrics, expressed as percentages of SL, are shown in Tables 1, 3. Characters same as in generic description, species and subspecies diagnosis are not repeated here. Pelvic-fin rays I, 5; caudal fin with 4 (3 or 4) unbranched unsegmented rays, 3 (3 or 4) unbranched segmented rays and 8 branched rays in dorsal series; 3 unbranched unsegmented rays, 2 unbranched segmented rays and 7 branched rays in ventral series. Snout pointed, dorsal profile of snout and nape ca. 50° (40–50°) and ca. 50° (50–60°), respectively, to horizontal axis of head and body. Eye moderately large, orbit diameter 38 (34–42) % of head length. Margins of preopercle, interopercle and subopercle well serrated; opercle

without spine; posterior tip of exposed cleithrum, located above pectoral-fin base, with serrated margin; posterior portion of exposed supracleithrum, with serrated margin; posterior margin of posttemporal exposed, above 1st pored lateral-line scale, with serrated margin; ventral margin of lacrimal serrated in small specimens <113 mm SL. Upper jaw with band of about 6 (5 or 6) rows of small conical teeth anteriorly, teeth on outermost row about twice length of inner teeth, but not caniniform; lower jaw with band of about 5 rows of small conical teeth anteriorly, teeth on outer two rows generally about twice length of teeth on inner rows, but not caniniform; vomer with lunate tooth patch with 3 (1–3) rows of small conical teeth. Head covered with ctenoid scales but snout (anterior to lacrimal) and maxilla naked; interorbital region with isolated band of 7 (6–11) rows of cycloid scales, its anterior margin reaching imaginary line connecting posterior nostrils in dorsal view, posterior margin scale band connected with scaled area on nape (interorbital scales absent in specimens <113 mm SL; interorbital squamation developing with growth); lower jaw partially covered with ctenoid scales, scaled area extending onto ventral surface of dentary in large specimens, including holotype. Body covered with ctenoid scales, scale on dorsolateral body with 47 (18–48) cteni; dorsal and anal fins with high scaly sheath, relatively small ctenoid basal scales extending onto soft-rayed portions of dorsal and anal fins; pectoral-fin base with small scales (based solely on paratypes); caudal-fin base with small weakly developed ctenoid scales, extending onto fin; pelvic-fin base with row of 4 (5–7) ctenoid axillary scales. Dorsal-fin origin slightly anterior to vertical through origin of pectoral-fin base, with single deep notch between spinous and soft-rayed portions; spines flattened; 1st spine shortest; 3rd spine longest, its length 69 (63–75) % of body depth at pelvic-fin origin, lengths of 3rd to last spines gradually decreasing posteriorly; membranes between spines deeply incised; all soft rays branched, 2nd (1st or 2nd) soft ray longest, soft-rayed portion of fin with truncated margin. Anal-fin origin below 5th dorsal-fin soft ray base; 1st spine short, subequal to 1st dorsal-fin spine in length; 2nd spine robust, longest, 1.9 (1.4–2.1) times 3rd spine length; all soft rays branched, 1st ray longest, its length 63 (61–78) % of 1st dorsal-fin soft ray length; soft-rayed portion of fin with truncated margin. Pectoral fin origin below 3rd dorsal-fin spine base, long, pointed; 4th ray longest, fin tip extending slightly beyond vertical through last dorsal-fin spine base; all rays branched, except for uppermost 2 and lowermost 2 (1 or 2) unbranched rays. Pelvic-fin origin below lower end of pectoral-fin base, with rounded margin; spine long, flattened; all soft rays branched, 2nd soft ray longest, fin tip reaching anus, but not reaching anal-fin origin when depressed in large specimens, including holotype (specimens <91 mm SL possessing relatively long pelvic-fin rays, the fin tip extending beyond anal-fin origin). Caudal fin truncate, slightly convex, tips of both lobes pointed.

*Fresh coloration*. Based on photographs of CSIRO CA994 (131 mm SL), CSIRO H2037-02 (278 mm SL), CSIRO H6422-07 (80.6 mm SL), CSIRO H6422-08 (176 mm SL) and NSMT-P 113708 (249 mm SL) (see Fig. 1f–i). Head and body silvery white to gray, darker dorsally; small specimen with several indistinct dark stripes on side of body and small black blotch on caudal-fin base (Fig. 1i); frontal portion of head blackish; lips whitish; eye dull yellow. Dorsal-fin spines and associated membrane pale brown (membrane with broad central translucent area in small specimens); soft dorsal-fin rays with brownish tinge, associated membrane translucent with a white dorsal margin and large black rounded blotch anterodorsally, subequal to orbit in size. Anal fin membrane translucent, anterior portion brown, with narrow white distal margin. Pectoral fin tinged with pale brown; lunate or semicircle dark blotch on base. Pelvic-fin soft rays and membrane black. Caudal fin semi-translucent with broad brown to black band posteriorly in large specimens (5 dark blotches in small specimens), with narrow white distal margin.

*Preserved coloration*. See Figs 2b, 3d–f. Head and body entirely creamy-white; 2 indistinct dark bands saddling anterior half of interorbital region, posterior band across orbit; 2 dark bands saddling nape; no other distinct markings on head or body. Spinous dorsal-fin membrane pale brown; black blotch anterodorsally on soft-rayed portion between 1st and 4th rays. Spinous anal-fin membrane pale brown; anterior portion of soft-rayed portion brownish. Pectoral fin semi-translucent. Pelvic-fin membrane and soft rays brown to black. Caudal fin semi-translucent, white with relatively broad dark band submarginally, its width about one-third of orbit diameter. In a juvenile [61.5 mm SL (WAM P.27219-004; Fig. 3d)], body with about 6 indistinct pale brown transverse bands; membrane of spinous dorsal-fin pale brown with broad central translucent area; 3 pale brown blotches on base of dorsal-fin soft rays; two pale brown blotches on anal-fin base; 10 or more small dark blotches or short lines on caudal fin.

**Etymology.** The subspecific name, *brevispinis*, derived from Latin meaning short-spine, alludes to the subspecies possessing relatively short dorsal-fin spines, compared with *B. b. banjos*.

**Distribution.** The subspecies has currently been recorded from the southeastern Indian Ocean, including Lombok, Indonesia and WA, between 9°S and 28°S (Fig. 4). Sampling data for 16 lots of specimens recorded their collection by benthic trawl at depths of 122–288 m.

**Remarks.** Specimens reported as *B. banjos* and figured by Gloerfelt-Tarp and Kailola (1984) (NMNZ 15089, 71.3 mm SL) and Sainsbury et al. (1985) (CSIRO CA994, 131 mm SL) were examined in this study and identified as this subspecies.

***Banjos peregrinus* sp. nov.**

(New English name: Timor Sea Banjofish) (Figs 2c, 4, 10, 13–14; Tables 1–2)

*Banjos banjos* (not of Richardson): Ramm 1997: 15 (Timor and Arafura seas, between longitudes 127–137°E, NT, Australia; listed); Larson et al. 2013: 244 (NT, Australia; listed)

**Holotype.** NTM S.13342-004, 177 mm SL, Timor Sea, NT, Australia, 10°01′01″S, 130°07′59″E, 172 m, NT Fisheries, bottom trawl, shot 121, 16 Nov. 1990.

**Diagnosis.** A species of *Banjos* distinguished from other members of the genus by the following combination of characters: serrae on cleithrum 9; head length 41.2% of SL; orbit diameter 16.5% of SL; vertical orbit diameter 14.5% of SL; postorbital length 14.8% of SL; pre-pelvic-fin length 45.9% of SL.

**Description.** Selected meristics and morphometrics, expressed as percentages of SL, are shown in Tables 1–2. Characters same as in generic description and species diagnosis are not repeated here. Pelvic-fin rays I, 5; caudal fin with 3 unbranched unsegmented rays, 2 unbranched segmented rays and 8 branched rays in dorsal series; 3 unbranched unsegmented rays, 2 unbranched segmented rays and 7 branched rays in ventral series. Snout pointed, dorsal profile of snout and nape ca. 50° and ca. 30°, respectively, to horizontal axis of head and body. Eye moderately large, orbit diameter 40% of head length, with broad fleshy rim; anterodorsal margin of orbit continuous with dorsal contour of head in lateral view. Ventral margin of lacrimal smooth without serrations. Upper jaw with band of about 5 rows of small conical teeth anteriorly, teeth in outermost row about three times length of inner teeth, but not caniniform; lower jaw with band of about 4 rows of small conical teeth anteriorly, teeth in outermost row generally about twice length of teeth on inner rows, but not caniniform; vomer with triangular tooth patch of 1–3 rows of small conical teeth. Head covered with ctenoid scales but snout (anterior to lacrimal) and maxilla naked; interorbital region with isolated band of about 4 rows (maximum) of weakly developed ctenoid scales between interorbital ridges, anterior margin of scale band reaching imaginary line connecting posterior nostrils in dorsal view, posterior margin of scale band not connected with scaled area on nape; ventral surface of angular partially covered with ctenoid scales. Body covered with ctenoid scales, those on dorsolateral surface with 34 cteni; dorsal and anal fins with very scaly sheath, relatively small, elongate ctenoid basal scales extending onto soft-rayed portions of dorsal and anal fins; pectoral-fin base with scales (based on scale pockets); caudal-fin base with small, elongate weakly developed ctenoid scales, extending onto fin; pelvic-fin base with row of 5 ctenoid axillary scales. Dorsal-fin origin slightly anterior to a vertical through origin of pectoral-fin base, with single deep notch between spinous and soft-rayed portions; spines flattened; 1st spine shortest; 3rd spine longest, its length 69% of body depth at pelvic-fin origin, lengths of 3rd to last spines gradually decreasing posteriorly; membranes between spines deeply incised; all soft rays branched, 2nd soft ray longest, soft-rayed portion with slightly rounded margin. Anal-fin origin below 2nd dorsal-fin soft ray base; 1st spine short, subequal to 1st dorsal-fin spine length; 2nd spine robust, longest, twice 3rd spine in length; all soft rays branched, 1st ray longest, its length 67% of 1st dorsal-fin soft ray length; soft-rayed portion of fin with truncated margin, slightly convex. Pectoral fin long, pointed, its origin below 3rd dorsal-fin spine base; 4th ray longest, fin tip extending slightly beyond vertical through last dorsal-fin spine base; all rays branched except for uppermost 2 and lowermost 1 unbranched rays. Pelvic-fin origin below lower end of pectoral-fin base, with rounded margin; spine long, flattened; soft rays all branched, 2nd soft ray longest, fin tip reaching anus, but not reaching anal-fin origin when depressed. Caudal fin damaged.

*Preserved coloration*. Photograph of holotype shown in Fig. 2c. Head and body entirely creamy-white but most body scales missing; dorsal and anterior portions of head dark brown; 2 dark bands saddling nape; no other distinct markings on head and body. Spinous dorsal-fin membrane pale brown; a large black blotch, subequal to pupil, anterodorsally on soft-rayed portion between 1st and 4th rays. Spinous anal-fin membrane pale brown; anterior portion of soft-rayed portion brownish. Pectoral fin semi-translucent. Pelvic-fin membrane and soft rays dark brown. Caudal fin semi-translucent with broad brown band submarginally, its width about one-third orbit diameter. Fresh coloration unknown.

**Etymology.** The specific name, *peregrinus*, derived from Latin meaning strange, alludes to the unusual overall appearance of the species, particularly the large head and orbit, compared with congeners.

**Distribution.** *Banjos peregrinus* is currently known only from the type locality, the Timor Sea, off northern Australia at a depth of 172 m.

**Remarks.** The holotype of *B. peregrinus* is the same specimen reported by Ramm (1997) (as *B. banjos)* from the Timor and Arafura seas, although Larson et al. (2013) subsequently believed it to have been lost.

## Discussion

**Morphological changes with growth in *Banjos*.** An assessment of morphological changes with growth within each species, where possible, was helpful in determining

the extent of intraspecific variations compared with interspecific differences.

Analysis of 42 measurements taken on 163 specimens of *B. b. banjos* showed that several morphological proportions (expressed as percentages of SL) changed significantly with growth (Table 4). The relative length of the following characters to SL clearly decreased with growth: body depth at pelvic- and anal-fin origins, head length, orbit diameter, horizontal orbit diameter, least interorbital width, interorbital width at mid-orbit, inter-posterior-nostril distance, upper-jaw length, dorsal-fin spine and soft ray (except for third dorsal-fin spine) lengths, anal-fin spine and soft ray (except for second anal-fin spine) lengths, pelvic-fin spine and soft ray lengths, caudal-fin length and caudal-peduncle depth. Among these, the proportions of the least interorbital width, interorbital width at mid-orbit, inter-posterior-nostril distance and upper-jaw length progressively decreased with growth in specimens <ca. 150 mm SL, thereafter remaining unchanged or increasing slightly with further growth (Fig. 8a); the other proportions continued to decrease with growth throughout life (Fig. 8b). In contrast, relative snout length and relative suborbital depth both increased with growth in specimens <ca. 150 mm SL, thereafter remaining unchanged (Fig. 8c). Such proportional changes result in large specimens having a relatively shallower body, longer snout, smaller orbit and shorter fins, compared with small specimens (see Fig. 6). Interestingly, the relative maximum diameter of the black blotch on the soft dorsal fin increased with growth in specimens <ca. 150 mm SL, but decreased with further growth (Fig. 8d).

Although the number of gill rakers including rudiments varied considerably in all members of *Banjos* where multiple specimens were available (Table 1), no significant relationship with SL was recognized, with the range in number apparently being simply due to individual variation. However, when considered alone, the number of developed rakers decreased significantly with growth, indicating a change from elongate to reduced and rudimentary (knob-like) (Fig. 9), possibly related to a dietary shift.

Serrations and spination on the head are well developed in juveniles in *Banjos*, with head spination being one of the most striking larval specializations in many fish species (Leis and Carson-Ewart 2004). Although larval specimens of *Banjos* were unavailable for this study, juvenile *Banjos* possess relatively large spinules on the preopercular, interopercular and subopercular margins, compared with large adults. Juvenile *Banjos* are also characterized by a serrated ventral lacrimal margin, with the number of serrae progressively decreasing with growth (serrated lacrimal rare in large adults) (Fig. 10b). Similarly, *B. aculeatus* and *B. b. banjos* juveniles < ca. 40 mm SL possess a relatively long spine with several serrated ridges on the posteroventral angle of the preopercle (Fig. 11), with the spine subsequently becoming shorter with growth. Moreover, the smallest specimen of *Banjos* examined in this study (*B. aculeatus*, AMS I.32205-001, 29.5 mm SL; Fig. 3a) possesses a low elevated supraoccipital cleft, absent in larger specimens.

An ontogenetic change in coloration was also recognized in species of *Banjos*, except for *B. peregrinus*. Juveniles < ca. 100 mm SL possessed 5 or 6 transverse dark bands on the sides of the body, forming several blotches with growth and subsequently disappearing in large specimens (Figs 3, 6). Juveniles also have distinct dark bands on the frontal region of the snout and interorbital region, but become obscured with growth. Moreover, markings on the caudal fin also change with growth, with juveniles <ca. 70 mm SL possessing 3 or 4 dark streaks anteriorly and 6 or 7 dark streaks posteriorly. The anterior streaks become small blotches, thereafter disappearing, and the posterior streaks become rounded blotches; specimens of 90–110 mm SL possessed 5 such blotches. In large specimens >ca. 110 mm SL, the blotches became connected to form a broad submarginal dark band. Furthermore, in *B. b. banjos* and *B. b. brevispinis*, juveniles <ca. 70 mm SL possess a blackish spinous dorsal-fin membrane with a broad central translucent area (Fig. 12), with the membrane being entirely blackish in large specimens. In contrast, no ontogenetic changes were evident in the spinous dorsal-fin coloration of *B. aculeatus*, with the membrane being entirely blackish throughout all stages. Senou (1992), Masuda and Kobayashi (1994) and Uryu (2003) included excellent underwater photographs of juveniles (3–8 cm) of *B. b. banjos*, indicating a yellowish body ground color, compared with the gray body of large adults. Senou (1992) also commented that *B. b. banjos* juveniles share similarities in their characteristic broken line markings on the side of the body in juveniles with *Stereolepis doederleini* Lindberg and Krasyukova 1969 (Polyprionidae).

**Species comparisons.** Because of the ontogenetic changes evident in several morphometric characters, *B. peregrinus* (177 mm SL) was restricted to comparisons with congeners >100 mm SL.

This study resulted in the recognition of three species and two subspecies of *B. banjos* in the genus *Banjos*, having been previously regarded as a monotypic genus. All three species of *Banjos* are very similar to each other in morphology, with *B. aculeatus* being the most distinct with a relatively long first dorsal-fin spine [5.8–14.2 (mean 10.4) % of SL] and second dorsal-fin spine [12.5–28.4 (22.9) % of SL], compared with *B. b. banjos* [4.8–11.7 (7.3) and 11.2–22.7 (17.1), respectively] and *B. b. brevipectoralis* [4.5–8.0 (6.1) and 11.2–18.7 (14.0), respectively] (Fig. 14a–b).

**Table 4** Relationships between morphometric measurements, expressed as percentages of SL, and standard length (mm) in *Banjos banjos banjos* on the basis of 163 specimens of 32.6–359 mm SL

| | Pearson's correlation coefficient |
|---|---|
| Body depth at pelvic-fin origin | -0.918 |
| Body depth at anal-fin origin | -0.894 |
| Body width | -0.021 |
| Head length | -0.694 |
| Snout length | 0.652 |
| Orbit diameter | -0.721 |
| Vertical orbit diameter | -0.796 |
| Least interorbital width | -0.447 |
| Interorbital width at mid-orbit | -0.672 |
| Inter-posterior-nostril distance | -0.704 |
| Width of interorbital scaled area | 0.506 |
| Upper-jaw length | -0.665 |
| Suborbital depth | 0.719 |
| Postorbital length | -0.470 |
| Pre-dorsal-fin length | -0.652 |
| Pre-anal-fin length | -0.654 |
| Pre-pelvic-fin length | -0.736 |
| 1st dorsal-fin spine length | -0.850 |
| 2nd dorsal-fin spine length | -0.788 |
| 3rd dorsal-fin spine length | -0.282 |
| 4th dorsal-fin spine length | -0.738 |
| 5th dorsal-fin spine length | -0.775 |
| 6th dorsal-fin spine length | -0.816 |
| 7th dorsal-fin spine length | -0.805 |
| 8th dorsal-fin spine length | -0.775 |
| 9th dorsal-fin spine length | -0.803 |
| 10th dorsal-fin spine length | -0.853 |
| 1st dorsal-fin soft ray length | -0.761 |
| 2nd dorsal-fin soft ray length | -0.797 |
| 5th dorsal-fin soft ray length | -0.857 |
| 1st anal-fin spine length | -0.769 |
| 2nd anal-fin spine length | -0.334 |
| 3rd anal-fin spine length | -0.637 |
| 1st anal-fin soft ray length | -0.849 |
| 3rd anal-fin soft ray length | -0.855 |
| Longest pectoral-fin length | 0.455 |
| Pelvic-fin spine length | -0.876 |
| Longest pelvic-fin soft ray length | -0.942 |
| Caudal-fin length | -0.846 |
| Caudal-peduncle length | 0.355 |
| Upper caudal-peduncle length | 0.458 |
| Caudal-peduncle depth | -0.770 |

*p*-value is 0.000 for all characters, except for body width which equals 0.788

*Banjos aculeatus* is also characterized by a relatively long, strongly serrated spine on the posteroventral angle of the preopercle in juveniles less than 70 mm SL (Fig. 15). With well-developed serrated ridges on the ventral, lateral and dorsal surfaces, the spine clearly extends beyond the posterior margin of the interopercle in all of the *B. aculeatus* juveniles examined (29.5–46.0 mm SL) (Fig. 11a–c). In contrast, *B. b. banjos* juveniles possess a relatively short spine at the preopercle angle, with poorly developed serrated ridges on the surface and the tip extending beyond the posterior margin of the interopercle in 32.6 mm SL and 41.2 mm SL specimens, but not reaching the margin in specimens > 46.0 mm SL (Fig. 11d–f). In the single juvenile *B. b. brevispinis* examined (61.5 mm SL), the equivalent spine did not reach the posterior margin of the interopercle. The relative length of the preopercle spine of *B. aculeatus* ranges from 6.2 to 8.5% of SL, whereas 3.7–6.5% of SL in *B. b. banjos* (32.6–69.5 mm SL) and 3.5–3.9% of SL in *B. b. brevispinis* (Fig. 15a). The relationships of preopercular spine length (mm) and total number of serrae on the spine with standard length also indicate consistent differences between *B. aculeatus* and *B. banjos* ssp. (Fig. 15b, c). Moreover, *B. aculeatus* tends to have fewer serrae on the ventral margin of the preopercle and lacrimal, compared with *B. banjos* ssp., although the ranges overlap (Fig. 10).

Juvenile specimens of *B. aculeatus* (29.5–46.0 mm SL) could also be clearly distinguished from *B. banjos* ssp. by the entirely dusky spinous dorsal fin membranes, lacking a translucent area in preserved specimens (Fig. 12a–d), whereas a large central translucent area occurs on the otherwise dusky membranes of *B. b. banjos* (32.6–69.5 mm SL) and *B. b. brevispinis* (single specimen, 61.5 mm SL) (Fig. 12e–h). In life, juvenile *B. b. banjos* possess a pale yellow area (retained as a translucent area in preserved specimens) on membranes of the spinous dorsal fin, as evident on underwater photographs (KPM-NR 9927, 21651, 63088, and 93627; Uryu, 2003).

*Banjos peregrinus* is characterized by a relatively large head and orbit among the members of *Banjos*, differing from congeners (based on specimens >100 mm SL) in relative head length 41.2% of SL [vs. 34.3–38.2 (mean 35.7) % of SL in *B. aculeatus*; 33.9–39.6 (36.6) % of SL in *B. b. banjos*; and 33.2–39.0 (36.2) % of SL in *B. b. brevispinis*]; orbit diameter 16.5% of SL [vs. 12.0–14.4 (12.8); 12.7–14.4 (13.6); and 11.2–16.6 (14.1)]; vertical orbit diameter 14.5% of SL [vs. 10.6–14.1 (12.2); 12.2–14.1 (13.2); and 9.5–14.9 (12.6)]; postorbital length 14.8% of SL [vs. 12.8–14.5 (13.7); 11.5–15.7 (13.4); and 12.0–14.6 (13.1)]; and pre-pelvic-fin length 45.9% of SL [vs.

40.4–42.1 (41.0); 40.5–42.1 (41.2); and 38.0–44.7 (41.4)] (Fig. 13a–c, e–f). *Banjos peregrinus* is further diagnosed by fewer serrae (9) on the exposed margin of the cleithrum, compared with 14–36 and 17–25 in *B. b. banjos* and *B. b. brevispinis*, respectively, in specimens 150–200 mm SL (Fig. 10c).

*Banjos banjos* differs from *B. aculeatus* in having first dorsal-fin spine length 4.5–11.7% of SL (vs. 5.8–13.0% of SL in the latter); second dorsal-fin spine length 11.2–22.7% of SL (vs. 12.5–27.5% of SL); in juveniles <70 mm SL, a short, weakly serrated spine at preopercle angle, its tip extending beyond posterior margin of interopercle in specimens < 41.2 mm SL (vs. a relatively long spine at preopercle angle with well-developed serrations, its tip extending beyond posterior margin of interopercle in specimens < 46.0 mm SL); and spinous dorsal fin membrane dusky, with a broad translucent area centrally in juveniles < 70 mm SL (vs. entirely dusky, without translucent area). Moreover, *B. banjos* can be distinguished from *B. peregrinus* by having head length 33.2–39.6% of SL (vs. 41.2% of SL in *B. peregrinus*); orbit diameter 11.2–16.6% of SL (vs. 16.5% of SL in *B. peregrinus*); vertical orbit diameter 9.5–14.9% of SL (vs. 14.5% of SL in *B. peregrinus*); postorbital length 11.5–15.7% of SL (vs. 14.8% of SL in *B. peregrinus*); pre-pelvic-fin length 38.0–44.7% of SL (vs. 45.9% of SL in *B. peregrinus*); serrae on exposed margin of cleithrum 14–36 (vs. 9 in *B. peregrinus*). The subspecies of *B. banjos* are similar to each other, sharing most body proportions, head serration and coloration. However, *B. b. brevispinis* can be distinguished from *B. b. banjos* by a slightly narrower least interorbital width 5.8–8.1 (mean 6.8) % of SL [vs. 6.2–10.3 (7.5) % of SL in the latter]; and slightly shorter lengths of the first dorsal-fin spine 4.5–8.0 (6.1) % of SL [vs. 4.8–11.7 (7.3) % of SL], second dorsal-fin spine 11.2–18.3 (14.0) % of SL [vs. 11.2–22.7 (17.1) % of SL] and eighth dorsal-fin spine 9.5–18.7 (12.5) % of SL [11.3–19.6 (14.8) % of SL] (Fig. 13d, 14). Further investigations, based on molecular analysis, should reveal the genetic population structure of *B. banjos*. For the present, the morphometric differences and allopatric distribution of known populations is considered sufficient for the recognition of separate subspecies.

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