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Bicentenary of Ludwig Leichhardt: Contributions to Australia's Natural History in honour of his scientific work exploring Australia

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Kanekonia leichhardti, a new species of velvetfish (Actinopterygii: Scorpaeniformes: Aploactinidae) from the Gulf of Carpentaria, Queensland, Australia

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ABSTRACT

Kanekonia leichhardti, new species, is described from three specimens dredged on soft bottom in the eastern Gulf of Carpentaria, Queensland, Australia. It is distinguished from its three congeners by a combination of mostly smooth skin with minute, sparsely-distributed velvety scales, long snout, narrow head and body, slightly notched predorsal profile, low anal-fin ray and lateral-line tube count, and distinctive configuration of the interorbital ridges (interorbital ridges not prominently sculptured, converging anteriorly to form an inverted Y shape, the symphysis above a vertical from the middle of the eye, and continuing as a single ridge to the base of the first dorsal-fin spine). The species appears to be rare and possibly endemic to the waters of the Gulf of Carpentaria. Wide-ranging surveys conducted with similar gear on the north-west shelf of Western Australia and coastal and inter-reef soft bottom habitats from Torres Strait south throughout the entire length of the Great Barrier Reef have failed to collect any further specimens. ❑ *new species*, Kanekonia, *Aploactinidae*, *velvetfish*, *Gulf of Carpentaria*

The genus *Kanekonia* (Tanaka, 1915) was previously comprised of three species: *Kanekonia florida* Tanaka, 1915 from southern Japan, in the Nagasaki and Kochi Prefectures (Nakabo 2002: 602); *Kanekonia queenslandica* Whitley, 1952, from Australia, between Cockburn Sound, Western Australia and Moreton Island, Queensland, and in Spencer Gulf, South Australia (Hoese *et al.* 2006: 914; this study); and *Kanekonia pelta* Poss, 1982 from Halmahera, Indonesia, known only on the basis of the holotype.

In 1990–91 wide-ranging fisheries surveys of the Gulf of Carpentaria and Arafura Sea were undertaken using the CSIRO research vessel FRV *Southern Surveyor* (Blaber *et al.* 1994; Martin *et al.* 1995). During these surveys a large benthic dredge was deployed to sample soft bottom fish and invertebrate communities from the western Torres Strait, Queensland, throughout the Gulf of Carpentaria westwards to about the Wessel Islands group in the Northern Territory, in depths of 7 to 63 m (Martin *et al.* 1995). From three of 103 sampling stations, three individuals of an unidentified species of *Kanekonia* most closely related to *K. florida* were collected, however it was initially assumed that further material may exist in museum collections, or subsequently be collected when similar gear was utilised in other soft bottom habitats across northern Australia. In 2003–05 the Great Barrier Reef Seabed Biodiversity Project was carried out to sample coastal and inter-reef habitats in Queensland, from Torres Strait, and throughout the Great Barrier Reef to Lady Elliot Island in south-east Queensland (Pitcher *et al.* 2007). Despite almost 2,000 tows of about 200 m in length, with an epibenthic sled of 1.5 m diameter and stretched mesh size of 25 mm, no further specimens of the new *Kanekonia* were collected. Examination of all aploactinid holdings in Australian ichthyological collections also failed to locate any additional material.

Detailed examination of the specimens confirmed the existence of a fourth species with

features consistent with *Kanekonia*, as it was previously defined (D XI–XIII,7–10, A I–II,7–9, P1 13–16, P2 I,2, fin spines not pungent, dorsal fin insertion at or just posterior to rear margin of orbit, gill openings unrestricted, isthmus extension present, skin mostly smooth, with sparse to dense squamation, interorbital ridges weakly to strongly sculptured, vertebrae 25–26) (Tanaka 1918; Poss 1999; Johnson 2004: Table 1). The new species is described and illustrated herein and compared in detail to its congeners. Expansion in the range of some meristic characters for the genus is also recorded.

The Aploactinidae (velvetfishes) now contains 49 species belonging to 17 genera (Poss & Eschmeyer 1978; Poss 1999; Johnson 2004; Hoese *et al*. 2006; Eschmeyer 2013). Twenty-two species in 14 genera are now known from Australian waters (Johnson 2004, 2012; Hoese *et al*. 2006; this paper).

MATERIALS AND METHODS

Methods for counts and measurements follow Eschmeyer (1969) and Johnson (2004). The last rays of the dorsal and anal fins appear separate, but are borne on the same pterygiophore as the penultimate, so each pair is counted as one. Numbers of gill rakers and lateral-line tubes were often found to differ between the left and right sides, so counts from both sides of the body were taken for type material. Counts of lateral-line tubes include only those on the body. The one or occasionally two tubes present on the caudal fin are ignored in figures presented in the tables, hence counts for lateral-line tubes quoted from Poss (1982) have been reduced accordingly. Length of the dorsal-fin base is measured to the base of the last ray, not including membrane posterior to that point. Radiographs were used to determine vertebral numbers and to confirm caudal and unpaired fin-ray counts in the type specimens. Computed tomography images at a resolution of 45 microns were captured using a Siemens Inveon PET/CT scanner. Measurements were taken using digital calipers, with the aid of a stereo microscope where necessary. Specimen lengths are standard lengths (SL) in mm. Head length is abbreviated as HL. Where different, values for paratypes follow those of the holotype in parentheses. Meristic and morphometric details for the new taxa are presented in Tables 1–2. Institutional codes follow Fricke & Eschmeyer (2013). Abbreviations: Australian Museum, Sydney (AMS), Kochi University, Department of Biology, Faculty of Science, Kochi, Japan (BSKU), Great Barrier Reef Seabed Biodiversity Project (GBRSBP), Museum Victoria (NMV), Queensland Museum (QM), South Australian Museum (SAM), United States National Museum (USNM).

Kanekonia leichhardti sp. nov.

(Leichhardt's Velvetfish)

(Figs 1A–B, 4A–C, 6A; Tables 1–2)

Material examined. HOLOTYPE: QM-I30099, 35.8 mm, Gulf of Carpentaria, 13º01.3'S, 140º12'E, gritty sandy mud, benthic dredge, 63 m, J. Johnson & S. Cook, *Southern Surveyor* Stn 47, 1.12.1990. PARATYPES: QM-I33325, 25.9 mm, Gulf of Carpentaria, 11º17.9'S, 140º20.5'E, benthic dredge, 58 m, J. Johnson, *Southern Surveyor* Stn 53, 28.11.1991; QM-I30046, 27.0 mm, Gulf of Carpentaria, 15º31.4'S, 139º11.6'E, gritty sandy mud, benthic dredge, 45 m, J. Johnson & S. Cook, *Southern Surveyor* Stn 38, 29.11.1990.

Diagnosis. Species of *Kanekonia* with dorsal-fin rays XII–XIII, 8i; anal-fin rays I, 7i–8i; pectoral-fin rays 15; pelvic-fin rays I, 2; gill rakers 1–2 + 5–7, total 6–8 on first arch; lateral-line tubes 8–9; vertebrae, including urostyle, 25–26; snout long, 2.9–3.1 in HL; head and body narrow, body width 2.0–2.2 in HL; predorsal profile slightly notched; interorbital ridges not prominently sculptured, converging anteriorly to form inverted Y shape, symphysis above vertical from middle of eye, continuing as single ridge to base of first dorsal-fin spine.

Description. Head 2.4 (2.4–2.5) in SL, moderately compressed, with few minute modified scales embedded in papillae sparsely distributed on cheek; scales and papillae absent on remainder of head. Dorsal profile of head slightly notched at anterior margin of eye, ascending gradually to base of dorsal fin, inclined dorsoposteriorly about 40° from horizontal plane. Eye 5.3 (4.2–4.6) in HL, smaller relative to HL in larger specimens. Lacrimal large, moveable; short acute ridge interconnected with main lacrimal ridge below, terminating anteriorly in short blunt spine directed anteroventrally across maxilla at about 45°; shallow pit covered in skin above and below spine, large pore-like opening anteriorly in each pit; main lacrimal ridge

FIG. 1. *Kanekonia leichhardti* sp. nov. (preserved). **A**, holotype, QM-I30099, 35.8 mm, Gulf of Carpentaria, Qld; **B**, paratype, QM-I33325, 25.9 mm, Gulf of Carpentaria, Qld. (Photos: G. Thompson).

strong, acute, directed dorsoposteriorly to meet anterior edge of orbital ridge; posterior lacrimal spines broadly connected at base, upper spine with long pointed tip, directed posteroventrally toward about third preopercular spine, lower spine shorter, much broader, directed posteroventrally, parallel with median maxillary ridge. Suborbital ridge convex, with two rugose knob-like spines; anterior spine small, situated below anterior margin of eye, posterior spine about 3 times larger, situated under hind margin of pupil; suborbital ridge bifurcating posteriorly, upper arm directed toward pterotic spine, reaching just beyond posterior margin of eye, lower arm directed to, and reaching base of, upper preopercular spine (Fig. 6A).

Interorbital ridges smooth-edged, acute, moderately prominent, beginning opposite tip of ascending premaxillary process, gradually converging posteriorly to merge over middle of orbit, continuing posteriorly as single ridge, terminating at raised transverse bony ridge adjacent to base of first dorsal-fin spine; interspace between interorbital ridges smoothly concave, thinly covered with skin. Ridges and terminus of ascending premaxillary process smooth, but relatively prominent (Fig. 4A–C). No fleshy cirri on head.

Nasal bones without spines, but with two short low horizontal ridges. Anterior nostril a simple tube, slightly closer to eye than tip of snout. Posterior nostril just anterior to middle of eye, an inconspicuous open slit. Preopercle with four blunt spines, uppermost largest, with acute ridge, directed just above horizontal (more so in paratypes); second to fourth spines more broad and flat, decreasing rapidly in size ventrally, directed posteroventrally; second

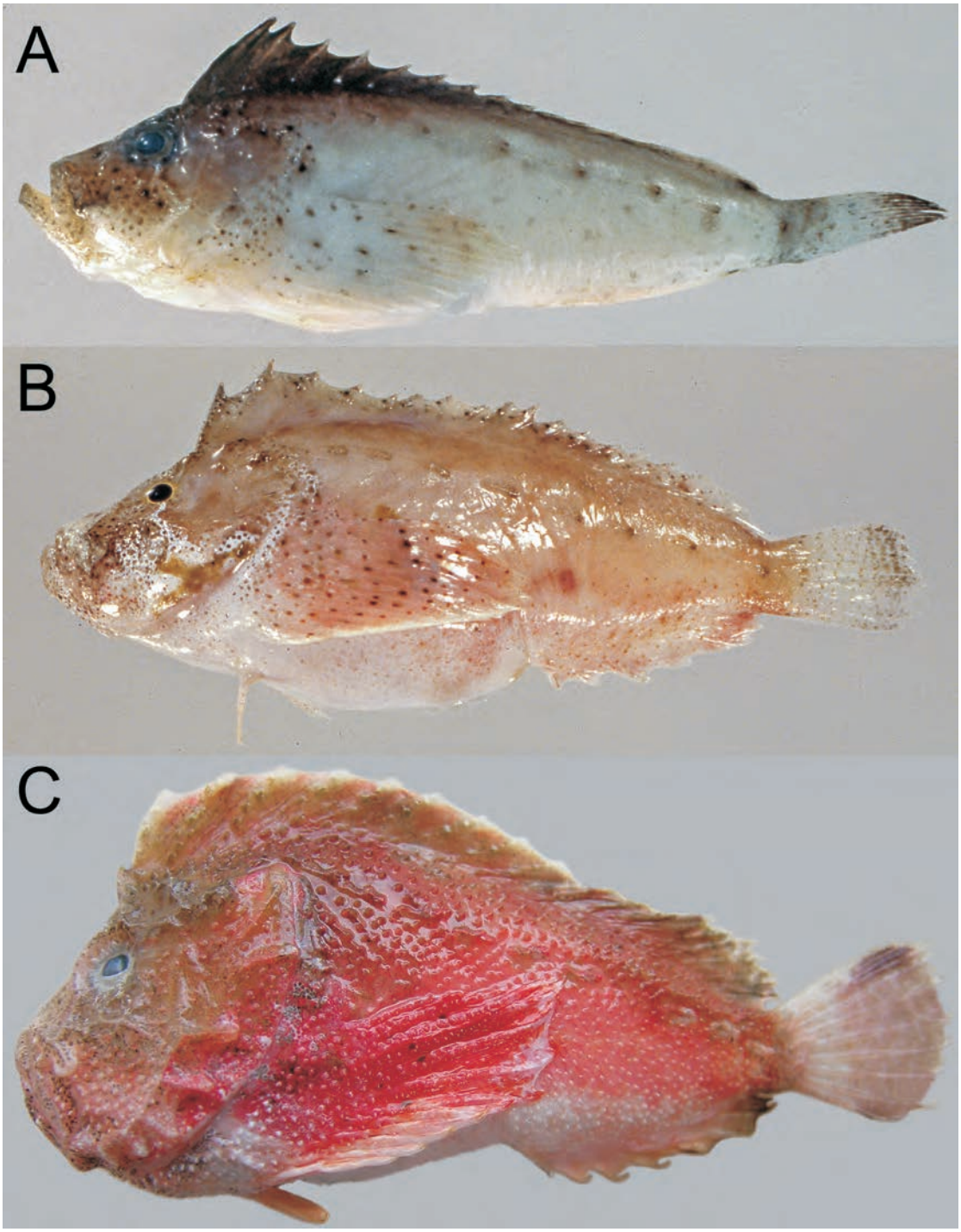

FIG. 2. **A**, *Kanekonia florida*, BSKU-40098, 32.2 mm, Tosa Bay, Japan. (fresh, Photo: H. Endo); **B**, *K. florida*, BSKU-45041 36.5 mm, Tosa Bay, Japan. (fresh, Photo: H. Endo); **C**, *K. queenslandica*, CSIRO-H6796-02, 34.0 mm, NE of Keppel Bay, Qld. (fresh, Photo: D. Gledhill) .

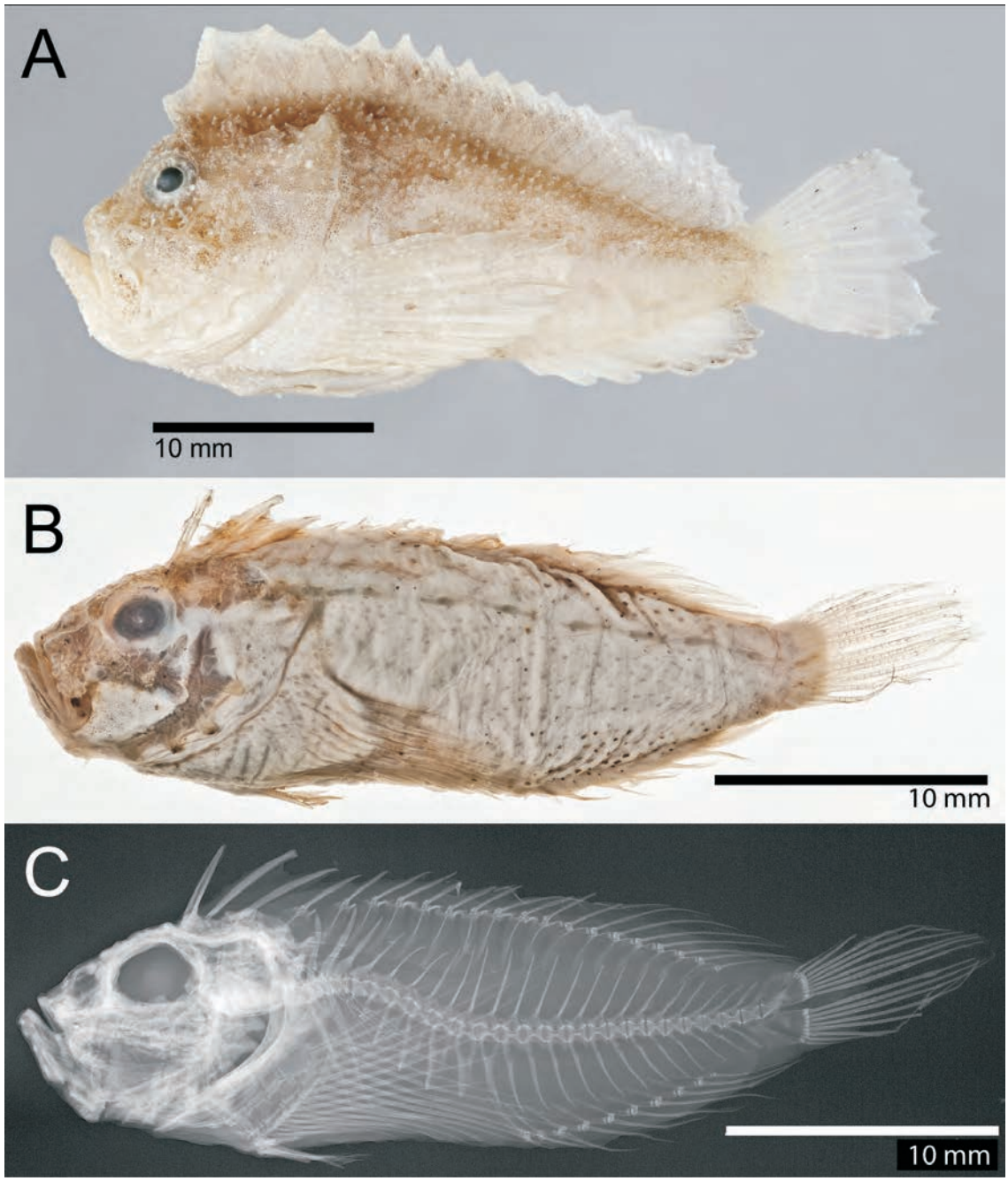

FIG. 3. **A**, *Kanekonia queenslandica*, QM-I40082, 28.4 mm SL, Off Swain Reefs, Qld. (preserved, Photo: G. Thompson); **B**, *K. pelta*, holotype, USNM-227361, 28.5 mm, Halmahera, Indonesia. (preserved, Photo: S. Raredon); **C**, *K. pelta*, holotype (radiograph, Image: S. Raredon).

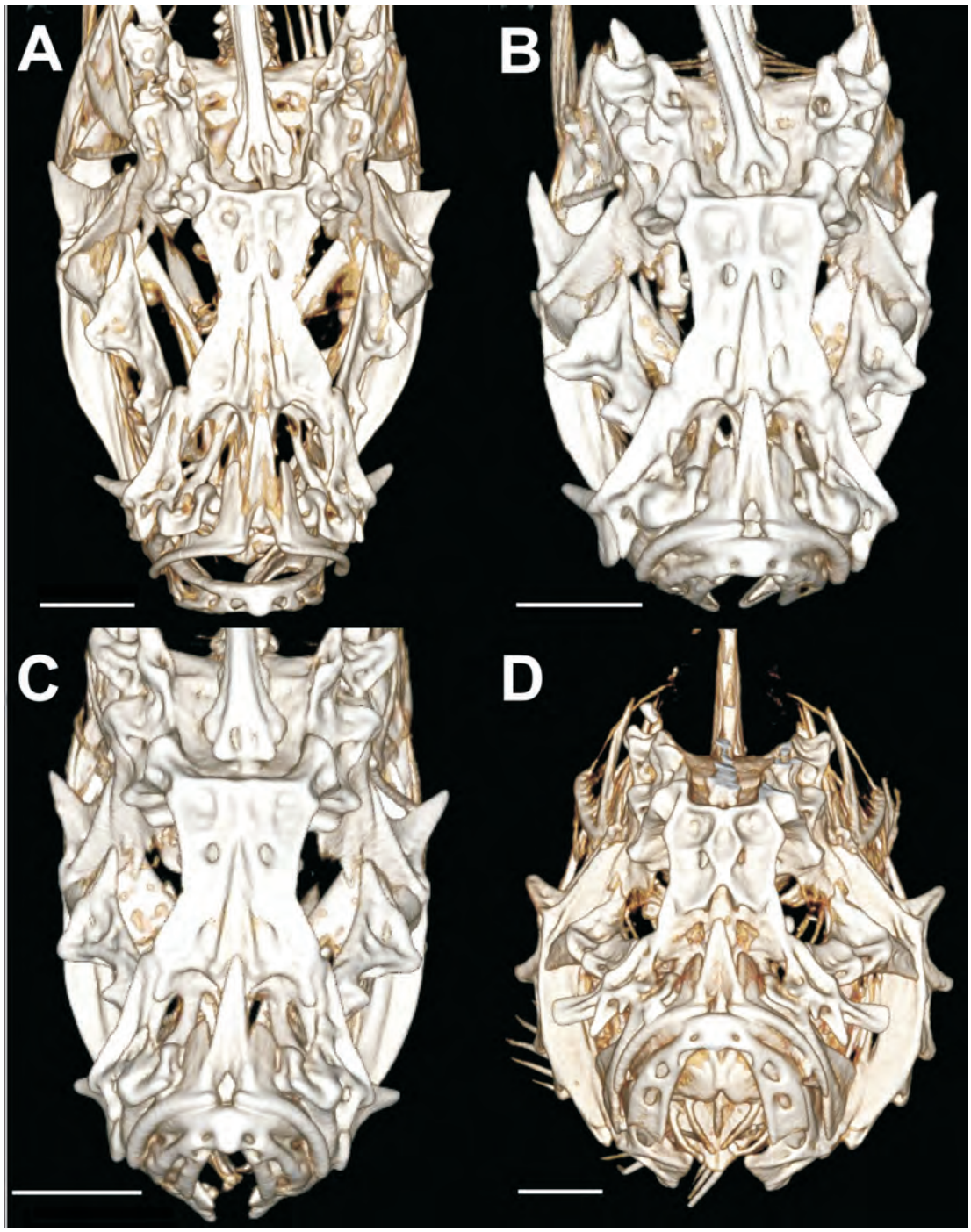

FIG. 4. Computed tomography frontal view of forehead in *Kanekonia* species, showing structure of interorbital ridges. **A**, *K. leichhardti* sp. nov., holotype, QM-I 30099, 35.8 mm; **B**, *K. leichhardti*, paratype, QM-I33325, 25.9 mm; **C**, *K. leichhardti*, paratype, QM-I30046, 27.0 mm; **D**, *K. queenslandica*, QM-I40082, 28.4 mm SL, Off Swain Reefs, Qld. Scale bar = 2.0 mm. (Images: K. Mardon, CAI, University of Qld).

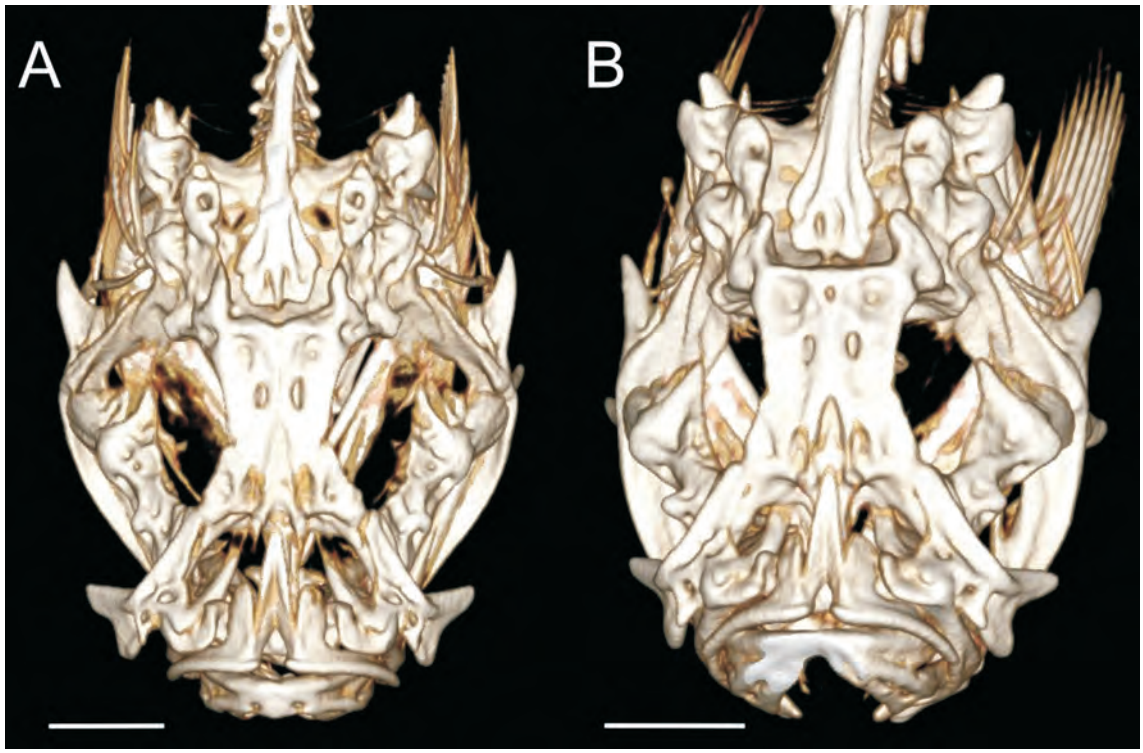

FIG. 5. Computed tomography frontal view of forehead in *Kanekonia florida*, showing structure of interorbital ridges. **A**, UMMZ-192040, 30.1 mm, vicinity of Nagasaki, Japan; **B**, UMMZ-192040, 26.9 mm, vicinity of Nagasaki, Japan. Scale bar = 2.0 mm. (Images: K. Mardon, CAI, University of Qld).

and third spines in holotype with tips slightly hooked upward (Fig. 6A). Pores along preopercular margin, below each preopercular spine. Operculum with two low ridges; lower ridge inclined slightly below horizontal, upper just above horizontal; upper with more developed spinous tip than lower. Dorsal margin of operculum scalloped, steeply inclined dorsoposteriorly; opercular tip narrow, inclined at about 70° toward base of about fifth dorsal-fin spine.

Sphenotic, pterotic and lower posttemporal ridges irregular, rugose and relatively similar in size. Upper posttemporal ridge largest and roughest. Small pore above and below posttemporal ridge, and between sphenotic and posttemporal ridges. Supracleithral spine small, bluntly pointed and relatively smooth. Cleithrum without spine. Ventral surface of lower jaw without cirri. Pair of pores close together just posterior to symphysis; three additional pores each side, evenly spaced ventrally along dentary.

Lips smooth, without cirri. Maxilla broad, smooth, rear margin straight to slightly curved, inclined anteroventrally at about 45°, extending about two-thirds distance between snout tip and anterior margin of eye (just short of eye in smaller paratypes). Both jaws with broad uniform band of minute firm conical teeth. Similar, smaller but well-developed teeth in crescentic band on vomer, band widest medially. No teeth on palatines. Tongue stout and broadly rounded. Gill rakers short knobs, 1 on upper limb, 6 on right side, 7 on left side lower limb, total 7 and 8 (1–2 + 5–6, total 6–7 in paratypes). Spacing of rakers somewhat irregular, particularly in paratypes. No slit behind posterior hemibranch. Branchiostegal membranes not fused to isthmus. Isthmus with fleshy extension anteriorly, slightly expanded, its free tip longer than wide.

Body markedly compressed, depth 3.0 (3.2) in SL, width 5.3 (5.0–5.1) in SL, skin mostly smooth, with minute sparsely-distributed

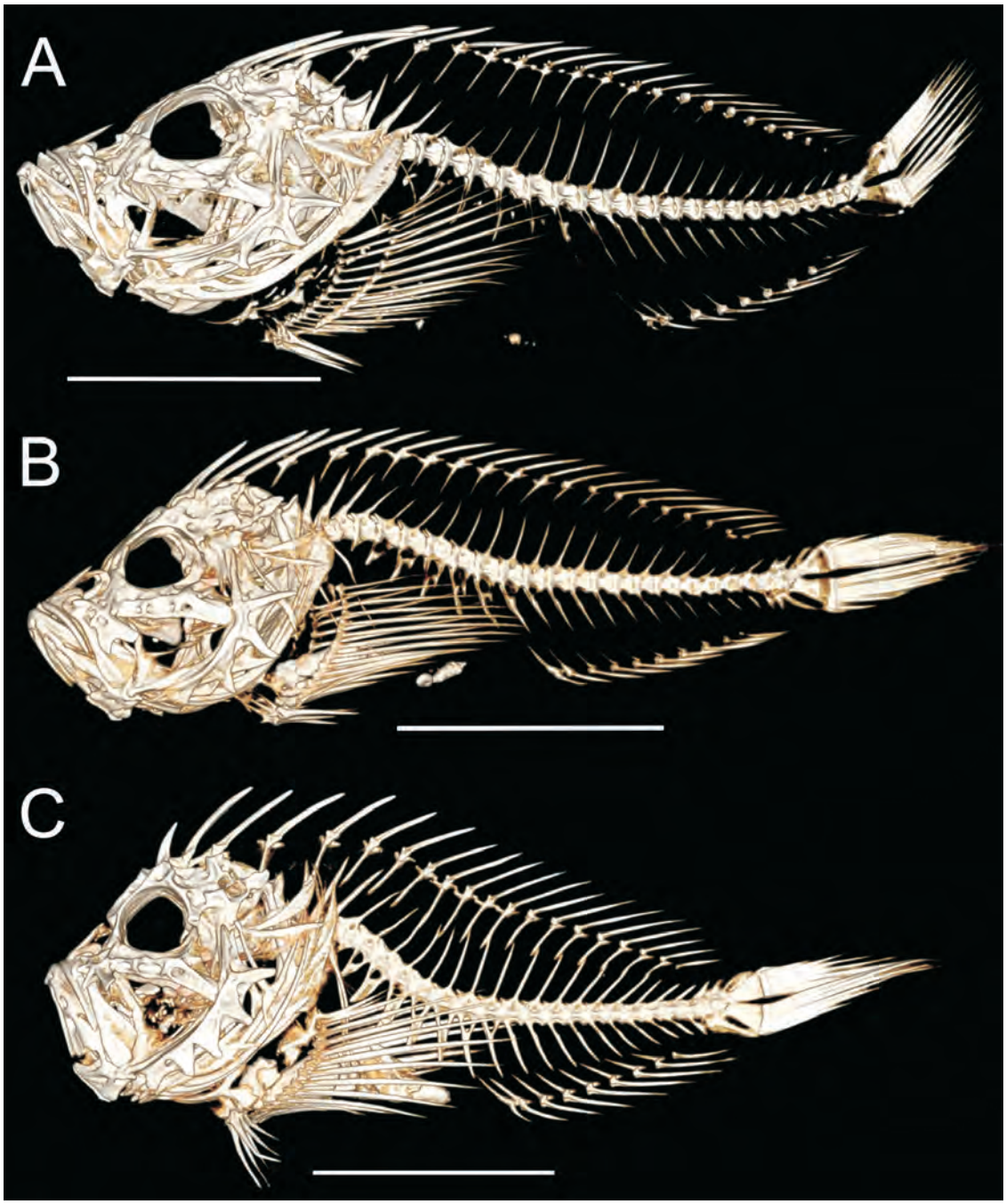

FIG. 6. Computed tomography lateral view of *Kanekonia* species. **A**, *K. leichhardti* sp. nov., holotype, QM-I 30099, 35.8 mm; **B**, *K. florida*, UMMZ-192040, 30.1 mm, vicinity of Nagasaki, Japan; **C**, *K. queenslandica*, QM-I40082, 28.4 mm, off Swain Reefs, Qld. Scale bar = 10 mm. (Images: K. Mardon, CAI, University of Qld).

papillae containing modified scales, most conspicuous on nape and body above lateral line. Lateral line with 8 (8–9) tubes on body and additional 2 (1–2) on caudal fin, gently and evenly sloping posteroventrally to caudal-fin base. First 2 (2–3) tubes conjoined, remainder distinctly separated. Tubed scales without cirri. Dorsal fin originating directly above posterior margin of eye (slightly anterior to posterior margin of eye in smaller paratypes). Second dorsal-fin spine longest, third only slightly shorter (third spine slightly longer than second in one paratype), fourth spine subequal to first spine, fifth to tenth spines similar in length. Dorsal-fin membrane very weakly incised. Last dorsal-fin ray adnate for most of length by membrane to caudal peduncle, gap posteriorly between dorsal-fin membrane and upper caudal-fin ray barely discernable. Fifth (fifth or sixth) dorsal-fin ray longest. Pectoral fin rounded, membrane deeply incised but extending almost to tip of each ray, fourth or fifth ray longest, reaching vertical between base of first and third anal-fin ray. Pelvic-fin insertion opposite base of lowermost pectoral-fin ray; length of pelvic fins short, 2.7 (2.0–2.2) in distance from base to anus; with flexible spine and 2 equal rays; longest pelvic-fin ray subequal to first dorsal-fin spine; pelvic-fin membrane not adnate to body. Anal fin with single short flexible spine; rays gradually increasing in length to sixth (seventh) ray, last one or two rays shorter; fin membranes distinctly incised; last anal-fin ray connected to caudal peduncle by membrane, latter incised, leaving gap of about half length of last ray posteriorly between membrane and base of lower caudal-fin ray. Caudal fin slightly rounded, with 14 segmented rays, total i7/7i, tips of rays protruding slightly from membrane. All fin rays simple. Vertebrae 26 (25–26).

Colour in alcohol. Holotype and paratypes with ground colouration pale greyish brown, slightly darker on upper sides and head, including suborbital region. A few small scattered diffuse dark brown spots on upper two-thirds of body, suborbital area and mid-section of pectoral fins. Underside of head, chest and belly pale greyish white. Dorsal fin with a few short, vague, oblique brownish bands. Pectoral, pelvic, anal and caudal fins pale to semitransparent (Fig. 1A–B).

Fresh colouration. Based on field notes of holotype ground colouration pale greyish cream, faintly diffused with a pinkish blush. A few small scattered diffuse dark brown spots on upper two-thirds of body. Suborbital area speckled with dark brown dots. Several small dark brown spots on midsection of pectoral fins. Underside of head, chest and belly white. Dorsal fin with faint oblique brownish bands. Pectoral, pelvic, anal and caudal fins semi-transparent.

Etymology. The species is named *leichhardti*, in honour of the Prussian naturalist and explorer, Friedrich Wilhelm Ludwig Leichhardt (1813–*c.*1848). During the years 1844–1845, he achieved one of the longest journeys of exploration by land in Australia, from the Darling Downs, Queensland to Port Essington, Northern Territory, a distance of about 4,800 km. He was the first European to traverse the southern edge of the Gulf of Carpentaria overland and to report on its fauna, flora and geology.

Distribution and habitat. Known from the types, collected from the Gulf of Carpentaria, Qld, in depths of 45–63 m. Notes on Smith-McIntyre grab samples taken in the vicinity of the dredge tows indicated that substrate near two of collecting sites was composed of 'sandy mud with clay grit' and 'slightly gritty, very fine sandy mud'. Composition of the catch of the three church dredge samples included significant quantities of seagrass (Stn 38); soft corals, ascidians and sponges (Stn 47); and seagrass and soft corals (Stn 53).

Discussion. *Kanekonia leichhardti* sp. nov. (Fig. 1A–B) is clearly most closely related to *K. florida* (Fig. 2A–B) from Japan, sharing with the latter smooth skin armed with minute sparsely-distributed velvety prickles, the most conspicuous of which are on the nape and body above the lateral line; smooth convergent interorbital ridges that meet over the orbit and continue posteriorly as a single ridge to the base of the first dorsal-fin; strongly overlapping pectoral-fin ray, lateral-line tube and gill-raker counts; and similar proportional measurements. *Kanekonia leichhardti* may be distinguished from the latter by narrower head and body (body width 2.0–2.2 versus 1.5–1.9 in HL), longer third to fifth dorsal fin spines and shorter first anal-fin spine length (Table 1), modally fewer

Table 1. Counts and proportional measurements of four species of *Kanekonia* (measurements as percentage of standard length). Data for *K. florida* and *K. pelta* is mostly from Poss (1982), except for values marked*, which are from material examined.

Species	***K. leichhardti***		***K. florida***	***K. pelta***	***K. queenslandica***
Specimens examined	Holotype (QM-I30099)	Paratypes (n = 2)	(n = 31)	Holotype (USNM 227361)	(n = 26)
Standard length (mm)	35.8	25.9–27.0	12.2–45.7	28.5	21.8–42.0
Dorsal-fin rays	XII,8	XII–XIII,8	XI–XIII,8–10	XII,9	XI–XIII,6–8
Anal-fin rays	i,7	i,7–8	i–ii,8–9	i,9	i,6–8
Pectoral-fin rays	15	15	13–16	14	13–15
Caudal-fin rays	14	14	14–16	15	15–16
Gill rakers	1+7=8; 1+6=7	1–2+5–6=6–7	1–2+4–8=6–10	1+5–6=6–7	1–3+5–10=7–12
Lateral-line tubes	8	8–9	7–10	10–11	9–11
Pelvic-fin rays	I/2	I/2	I/1–2	I/2	I/2
Vertebrae (with urostyle)	26	25–26	25–26	26	24–25
Head length	41.6	40.5–40.7	35–42	37.2	41.9–46.5
Snout length	14.2	13.3–13.5	10–13	10.2	11.7–14.3
Orbit diameter	7.8	8.9–9.7	7–11	9.8	8.6–10.5
Interorbital width	5.6	7.4–8.1	6–9	8.8	7.4–11.8
Jaw length	14.8	13.0–15.4	13–16	15.4	17.1–21.9
Postorbital length	18.4	17.8–18.5	16–19	18.2	21.0–23.2
Body depth	33.5	30.9–31.1	29–34	31.2	36.0–42.9
Body width	19.0	19.6–20.1	20–26*	22.1*	22.5–31.9
Predorsal length	22.1	22.2–22.4	18–24	18.9	15.6–19.7
Dorsal-fin base	75.7	77.6–77.8	72–81*	74.4*	77.8–81.0
Anal-fin base	27.4	31.1–32.8	27–31*	33.7*	24.3–30.5
Caudal-fin length	24.0	25.9–27.4	23–31	27.0	28.8–30.2
Pectoral-fin length	32.1	32.6–34.4	25–35	33.3	35.9–42.4
Pelvic-fin length	14.8	14.8–15.4	13–19	14.0	15.8–18.0
1st dorsal-fin spine length	15.4	15.2–15.8	10–16	11.6	6.0–8.5
2nd dorsal-fin spine length	18.7	17.8–20.1	15–19	15.1	11.2–15.4
3rd dorsal-fin spine length	16.5	18.5–19.7	10–16	14.4	11.2–15.8
4th dorsal-fin spine length	15.1	14.1–18.9	9–14	7.7	10.7–14.1
5th dorsal-fin spine length	12.0	11.5–14.3	6–10	6.7	10.0–14.1
penultimate dorsal-fin spine length	9.5	10.0–12.0	7–13	7.0	7.9–13.4
last dorsal-fin spine length	9.7	10.4–12.4	7–12	7.0	11.0–13.7
longest dorsal-fin ray	12.8	12.2–16.6	10–14*	14.7*	13.0–17.5
1st anal-fin spine length	2.8	3.9–4.1	4–7	2.5	2.4–5.3
longest anal-fin ray	11.7	11.9–13.5	10–14*	14.7*	13.8–16.3
least depth of caudal peduncle	10.1	9.6–11.2	9–12	10.5	10.5–11.7

Table 2. Frequency distribution of dorsal, anal and pectoral-fin rays, lateral-line tubes and gill rakers in specimens of *Kanekonia* examined (✦ indicates counts for both sides of holotype are included; + indicates range has been taken from Poss (1982); * denotes holotype).

Dorsal-fin Rays								
Species	**Spines**			**Soft Rays**				
	XI	XII	XIII	6	7	8	9	10
florida	1	23*	7	–	–	7	20*	4
leichhardti	–	2*	1	–	–	3*	–	–
pelta	–	1*	–	–	–	–	1*	–
queenslandica	2	23*	1	1	20*	5	–	–

Anal-fin Rays				
	6	**7**	**8**	**9**
florida	–	–	14	17*
leichhardti	–	1*	2	–
pelta	–	–	–	1*
queenslandica	1	22*	3	–

Pectoral-fin Rays				
	13	**14**	**15**	**16**
florida	1	1	26*	3
leichhardti	–	–	3*	–
pelta	–	1*	–	–
queenslandica	3	20*	3	–

Lateral-line Tubes ✦					
	7	**8**	**9**	**10**	**11**
florida	+	+*	+*	+	–
leichhardti	–	3*	1	–	–
pelta	–	–	–	1*	1*
queenslandica	–	–	2	17	8*

Gill Rakers ✦																	
	Upper			**Lower**							**Total**						
	1	2	3	4	5	6	7	8	9	10	6	7	8	9	10	11	12
florida	+	+*	–	+	+	+*	+	+	–	–	+	+	+*	+	+	–	–
leichhardti	3*	1	–	–	1	2*	1*	–	–	–	–	3*	1*	–	–	–	–
pelta	2*	–	–	–	1*	1*	–	–	–	–	1*	1*	–	–	–	–	–
queenslandica	1	21*	5	–	2	3	9	10*	2	1	–	2	3	6	12*	3	1

anal-fin rays (I, 7–8 versus I, 8–9, modally I, 9), modally fewer soft dorsal-fin rays (8 versus 8–10, modally 9) (Table 2) and the configuration of the interorbital ridges (space between ridges conspicuously broader anteriorly, ridges merging above middle of orbit (Fig. 4A–C) versus space between ridges narrower anteriorly, merging above anterior margin of orbit (Fig. 5A–B). The new species also has generally more prominent and rugose supraocular, suborbital, lacrimal, nuchal, pterotic, posttemporal, supracleithral and other spines and ridges on the head (see Fig. 6A–B).

Kanekonia leichhardti differs from *K. pelta* (Fig. 3B–C) most obviously by the straight to slightly notched (versus slightly rounded) dorsal profile of the head. In addition, in *K. pelta* the interorbital ridges are notably sculptured and do not merge, the space between the ridges being narrow medially, but expanded anteriorly and

posteriorly (Poss, 1982, 1999). The latter also has a greater number of dorsal-fin rays (9 versus 8), anal-fin rays (I, 9 versus I, 7–8) and lateral-line tubes (10–11 versus 8–9), however the apparent differences in fin-ray counts should be treated with caution due to the limited number of specimens of both species currently available for examination (Table 2). There are also numerous differences in proportional measurements, *K. pelta* having a shorter head and snout, a greater body width, and much shorter dorsal-fin spines (Table 1).

Kanekonia queenslandica is the most distinctive species of the genus, clearly differing from *K. leichhardti* sp. nov. and its other two congeners by a profuse, well-developed (versus a sparse, poorly-developed) covering of modified scales with spinous points that form velvety prickles on the head, body and fin membranes (Figs. 2C, 3A); gibbous head, with thick interorbital ridges fused to form a honeycomb pattern of bony pits and depressions (Figs. 4D, 6C); proportionately larger and more robust head, jaw, body depth, body width and pectoral fin, and shorter first and second dorsal-fin spines (Table 1). It also has 5 (versus 4) preopercular spines (Fig. 6C), and generally fewer numbers of dorsal, anal and pectoral-fin rays and a greater number of lateral-line tubes and gill rakers (Table 2). In the original description, Whitley (1952) quoted from the holotype of *K. queenslandica*, AMS-IA.3742, counts of pelvic-fin rays as 'i, 3' and lateral-line tubes as '8 or 9'. These counts were inconsistent with those from numerous non-type specimens examined, including some collected very close to the type locality, in Torres Strait. The actual counts of the holotype were checked and found to be I, 2 and 11 respectively, consistent with data presented here (Tables 1, 2).

Despite quite extensive collecting in northern Australia over the past twenty years, in the depth range where the new species was found, using various forms of dredges and epibenthic sleds over similar soft and rubbly bottom, no additional material has been collected. The new species thus appears to be rare, and may be endemic to Gulf of Carpentaria waters.

Comparative material. *Kanekonia florida*: BSKU-40098, 32.2 mm, Tosa Bay, 33°24.95′N 133°31.14′E to 33°25.99′N 133°32.78′E, 45 m, otter trawl, RV *Kotaka-maru*, 10.04.1984; BSKU-45041, 36.5 mm, Tosa Bay, 33°27.45′N, 133°33.42′E to 33°26.59′N, 133°31.89′E, 31 m, beam trawl, RV *Toyohata-maru*, 29.08.1988; UMMZ-192040, 3: 25.4–30.1 mm, vicinity of Nagasaki, Nagasaki fish market, Japan, Hubbs & Hiraiwa, 16.07.1929.

Kanekonia pelta: USNM-227361, holotype, 28.5 mm, off Teluk Kau, Halmahera, Indonesia, 1°08′36"N, 128°01′E, 46–55 m, beam trawl, R.L. Bolin, 25.09.1963 (radiograph).

Kanekonia queenslandica: AMS-IA3742, holotype, 30 mm, Albany Passage, Qld, 10°44′S, 142°36′E, M. Ward, 1928 (radiograph); NMV-A29227-001, 22.8 mm, Off Wallaroo, Spencer Gulf, SA, 33°49′51″S 137°32′12″E, 29–40 m, trawl, D.J. Bray, 10.10.2005; QM-I17525, 36.3 mm, PD Sand Cay, Torres Strait, Qld, trawl, Queensland Fisheries Service, 18.10.1974; QM-I17526, 34.1 mm, Torres Strait, Qld, 10°00′S, 142°42′E, 13.7–15.5 m, trawl, Queensland Fisheries Service, 8.04.1974; QM-I26116, 33.4 mm, Torres Strait, Qld, 9°45′S, 142°50′E, 16 m, trawl, CSIRO, 4.10.1988; QM-I27726, 37.1 mm, Gulf of Carpentaria, Qld, 10°20.2′S, 141°09.7′E, 23 m, dredge, J. Johnson & S. Cook, 13.12.1990; QM-I29953, 31.3 mm, NE of Shelburne Bay, Qld, 11°39′S, 143°35′E, 18 m, trawl, S. Cook, 3.03.1994; QM-I34095, 38.0 mm, NE of Burnett Heads, Qld, 24°31′S, 152°44′E, 30 m, trawl, Queensland Fisheries Service, 8.10.2000; QM-I34184, 40.5 mm, East of Moreton Island, Qld, 27°20′S, 153°30′E, 50 m, trawl, Queensland Fisheries Service, 15.10.2001; QM-I34876, 28.3 mm, Gulf of Carpentaria, 11°24′S, 136°28′E, NT, 23 m, dredge, J. Johnson, 20.11.1991; QM-I35335, 34.5 mm, North of Cape Bowling Green, Qld, 19°05.1′S, 147°23.7′E, epibenthic sled, Great Barrier Reef Seabed Biodiversity Project (GBRSBP), 21.09.2003; QM-I 36592, 34.9 mm, East of Prudhoe Island, Qld, 21°20.1′S, 149°45.9′E, 26 m, epibenthic sled, GBRSBP, 28.09.2004; QM-I36634, 30.6 mm, South of Black Reef, 19°51.3′S, 149°27.9′E, Qld, 56 m, epibenthic sled, GBRSBP, 14.09.2004; QM-I36705, 37.4 mm, South of Square Reef, Qld, 20°14.7′S, 149°49.5′E, 56 m, epibenthic sled, GBRSBP, 30.09.2004; QM-I36919, 26.6 mm, SW of John Brewer Reef, Qld, 18°40′S, 146°58.1′E, 40 m, epibenthic sled, GBRSBP, 20.03.2005; QM-I37260, 21.8 mm, North of Cockburn Reef, Qld, 11°46.5′S, 143°20.7′E, 17 m, epibenthic sled, GBRSBP, 4.02.2005; QM-I 37555, 36.1 mm, East of Keeper Reef, Qld, 18°44.7′S, 147°18.9′E, epibenthic sled, GBRSBP, 22.09.2003; QM-I37774, 30.8 mm, Hydrographers Passage, South of Reef 20-167, Qld, 20°17.1′S, 150°31.5′E, 63 m, epibenthic sled, GBRSBP, 25.11.2005; QM-I37881, 19.1 mm, South of Gould Reef, Qld, 19°33.3′S, 148°44.7′E, 62 m, epibenthic sled, GBRSBP, 26.11.2005; QM-I37962, 37.7 mm, South of Lady Elliot Island, Qld, 24°15.9′S, 152°39.9′E, 30 m, epibenthic sled, GBRSBP, 6.11.2005; QM-I38997, 33.6 mm, North of Dugong Island, Torres Strait, Qld, 10°15′S, 143°09′E, trawl, CSIRO, 8.09.1985; QM-I40020, 33.3 mm, West of Hoskyn

Island, Bunker Group, Qld, 23°47.1′S, 152°08.7′E, 43 m, epibenthic sled, GBRSBP, 5.11.2005; QM-I 40048, 25.2 mm, NE of Keppel Islands, Qld, 22°54.3′S, 151°28.5′E, 50 m, epibenthic sled, GBRSBP, 4.11.2005; QM-I40082, 28.4 mm, North of Reef 21-466, Swain Reefs, Qld, 21°48.3′S, 151°57.3′E, 57 m, epibenthic sled, GBRSBP, 31.10.2005; SAM-F10477, 26.9 mm, Yarraville Shoal, off Wallaroo, Spencer Gulf, SA, 33°17′S, 137°36′E, K. Branden, 4.04.1972; SAM-F11591, 42.0 mm, Spencer Gulf, SA, T. Fowler, 7.04.2008.

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LITERATURE CITED

Blaber, S.J.M., Brewer, D.T. & Harris, A.N. 1994. Distribution, biomass and community structure of demersal fishes of the Gulf of Carpentaria, Australia. *Australian Journal of Marine and Freshwater Research* **45**: 375–396.

Eschmeyer, W.N. 1969. A systematic review of the scorpionfishes of the Atlantic Ocean (Pisces: Scorpaenidae). *Occasional Papers of the California Academy of Sciences* **79**: 1–130.

2013. *Catalog of Fishes*, electronic version (updated 10 March 2013), California Academy of Sciences. (http://research.calacademy.org/ichthyology/catalog/fishcatmain.asp (accessed 26 March 2013).

Fricke, R. & Eschmeyer, W.N. 2013. *Guide to Fish Collections*. (http://research.calacademy.org/research/ichthyology/catalog/collections.asp). Electronic version accessed 26 March 2013.

Hoese, D.F., Bray, D.J., Paxton, J.R. & Allen, G.R. 2006. Fishes. *In*, Beesley, P.L. & Wells, A (Eds), *Zoological Catalogue of Australia* **35**: 1–3 (CSIRO Publishing: Melbourne).

Johnson, J.W. 2004. Two new species and two new records of aploactinid fishes (Pisces: Scorpaeniformes) from Australia. *Records of the Australian Museum* **56**: 179–188.

Johnson, J.W. 2012. *Pseudopataecus carnatobarbatus*, a new species of velvetfish (Teleostei: Scorpaeniformes: Aploactinidae) from the Kimberley coast of Western Australia. *Zootaxa* **3245**: 54–62.

Martin, T.J., Brewer, D.T. & Blaber, S.J.M. 1995. Factors affecting distribution and abundance of small demersal fishes of the Gulf of Carpentaria, Australia. *Australian Journal of Marine and Freshwater Research* **46**: 909–920.

Nakabo, T. 2002. *Fishes of Japan with pictorial keys to the species*. (English ed.). Vol. 1: 1–866. (Tokai University Press).

Pitcher, C.R., Doherty, P., Arnold, P., Hooper, J., Gribble, N., Bartlett, C., Browne, M., Campbell, N., Cannard, T., Cappo, M., Carini, G., Chalmers, S., Cheers, S., Chetwynd, D., Colefax, A., Coles, R., Cook, S., Davie, P., De'ath, G., Devereux, D., Done, B., Donovan, T., Ehrke, B., Ellis, N., Ericson, G., Fellegara, I., Forcey, K., Furey, M., Gledhill, D., Good, N., Gordon, S., Haywood, M., Hendriks, P., Jacobsen, I., Johnson, J., Jones, M., Kinninmoth, S., Kistle, S., Last, P., Leite, A., Marks, S., McLeod, I., Oczkowicz, S., Robinson, M., Rose, C., Seabright, D., Sheils, J., Sherlock, M., Skelton, P., Smith, D., Smith, G., Speare, P., Stowar, M., Strickland, C., Van der Geest, C., Venables, W., Walsh, C., Wassenberg, T., Welna, A., Yearsley, G. 2007. *Seabed Biodiversity on the Continental Shelf of the Great Barrier Reef World Heritage Area*. AIMS/CSIRO/QM/QDPI Final Report to CRC Reef Research. 315 pp.
ISBN 978-1-921232-87-9.

Poss, S. G. 1982. A new aploactinid fish of the genus *Kanekonia* from Indonesia and redescription of *K. florida*. *Japanese Journal of Ichthyology* **28**(4): 375–380.

1999. Aploactinidae. Velvetfishes. pp. 2354–2358. *In*, Carpenter, K.E. & Niem, V.H. (Eds), *FAO species identification guide for fishery purposes. The living marine resources of the Western Central Pacific*. Vol. 4. Bony fishes, Part 2 (Mugilidae to Carangidae). (FAO: Rome). Pp. 2069–2790.

Poss, S.G. & Eschmeyer, W.N. 1978. Two new Australian velvetfishes, genus *Paraploactis* (Scorpaeniformes: Aploactinidae), with a revision of the genus and comments on the genera and species of the Aploactinidae. *Proceedings of the California Academy of Sciences* **41**(18): 401–426.

Tanaka, S. 1915. Ten new species of Japanese fishes. *Dobutsugaku Zasshi* = *Zoological Magazine Tokyo* 27 (325): 565–568.

1918. *Figures and descriptions of the fishes of Japan, including Riukiu Islands, Bonin Islands, Formosa, Kurile Islands, Korea and southern Sakhalin*. **28**: 510–513. (Maruzen Co. Ltd: Tokyo).

Whitley, G.P. 1952. Some noteworthy fishes from eastern Australia. *Proceedings of the Royal Zoological Society of New South Wales* **1950–51**: 27–32.