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A revision of the Australian handfishes (Lophiiformes: Brachionichthyidae), with descriptions of three new genera and nine new species

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Table of contents

Abstract

The family Brachionichthyidae is represented by at least 14 small, Australian endemic, lophiiform fishes distributed from central eastern Australia to the Great Australian Bight. All but three of these species occur in the seas off Tasmania. The group is comprised of two recognised genera, *Brachionichthys* Bleeker and *Sympterichthys* Gill, and three new genera, *Brachiopsilus* **gen. nov.**, *Pezichthys* **gen. nov.** and *Thymichthys* **gen. nov.** Nine of the 14 species are undescribed. The type genus, *Brachionichthys*, consists of *B. hirsutus* (Lacepède) and *B. australis* Last, Gledhill & Holmes. These species, which are covered with long, unicuspid spinules and a strong colour pattern of dark spots and streaks, typically have 7 pectoral-fin rays. The genus *Sympterichthys* includes one of Australia's earliest described fishes, *S. unipennis* (Cuvier), and a new taxon *S. moultoni* **sp. nov.** Members of the genus lack warts and dermal appendages on the skin but are covered in small embedded scales with adpressed, unicuspid and bicuspid spinules originating from the posterior margin of their bases. *Brachiopsilus* contains three new species: *B. dianthus* **sp. nov.**, *B. dossenus* **sp. nov.** and *B. ziebelli* **sp. nov.** These handfishes, which are amongst the largest members of the family (reaching 117 mm SL), are smooth skinned (without spinules, dermal appendages or fleshy warts), are vividly coloured in life (without extensive blackish markings), and have 9–10 pectoral-fin rays. A fourth genus, *Pezichthys*, is not fully resolved and may be polyphyletic. It provisionally consists of five undescribed species: *P. amplispinus* **sp. nov.**, *P. compressus* **sp. nov.**, *P. eltanini* **sp. nov.**, *P. macropinnis* **sp. nov.** and *P. nigrocilium* **sp. nov.** These species are variably covered in erect, bicuspid spinules, and all have 7 pectoral-fin rays. *Thymichthys* contains two old species-level taxa, *T. politus* (Richardson) and *T. verrucosus* (McCulloch & Waite), both previously placed in *Sympterichthys*. Members of the genus *Thymichthys* have an ornate skin variably covered with wart-like protuberances, dermal appendages and a sparse coverage of scales with their spinules not or barely penetrating the skin surface. Regional morphs exist for *Thymichthys verrucosus* which may represent an unresolved species complex. New study material and a molecular study of these populations across their ranges are needed to determine their relationships. Other characters useful in defining the brachionichthyid genera, and distinguishing species, include illicial morphology, coloration, characteristics of the skin, including the form and degree of coverage and exposure of spiny scales, and selected morphometrics and meristics. Historical and current ecological data confirms that these fishes have specialised habitat requirements, patchy distributions and poor dispersal capabilities, making them amongst the most vulnerable of marine fishes. The fossil record suggests that the group was once much more widespread and their restricted extant distribution in Australia may be linked to regional extinction due to their life history strategy.

Key words: Lophiiformes, Antennarioidei, Brachionichthyidae, handfishes, *Brachionichthys*, *Brachiopsilus*, *Pezichthys*, *Sympterichthys*, *Thymichthys*, new genera, new species, Australia

Introduction

The Australian handfishes (family Brachionichthyidae) were among the first Australian fishes named (Last & Bruce, 1997; Last *et al.*, 2007). In January 1802, the French explorer Baudin entered D'Entrecasteaux channel, Van Diemen's Land (=Tasmania, Australia), to obtain scientific data including specimen collections. During this visit at least three handfish specimens were collected and sent to the Museum Histoire Naturelle in Paris. These were briefly described and figured by Lacepède (1804, see Figs 9 & 22) and assigned to the lophiid genus *Lophius*, as *L. hirsutus* and *L. laevis*. Later, Cuvier (1817) reassigned these taxa to the invalid antennariid genus *Chironectes* Rafinesque, 1814 (objectively invalid as preoccupied by a mammal taxon *Chironectes* Illiger, 1811); see Pietsch, 1984 and Eschmeyer & Fricke, 2009. *Chironectes* (misspelt as *Cheironectes*) was used subsequently by Richardson (1844a, b) for another handfish species from Tasmania, *C. politus*. Bleeker (1855) erected a new genus *Brachionichthys* based on a specimen of *B. hirsutus* from the Derwent River, Hobarttown (Hobart) Tasmania, which he placed in the order Pediculati. However, he did not specify a family and this appears to have created confusion for subsequent authors (e.g. Günther; 1861, Johnston, 1883, 91) who erroneously assigned these genera to a family Pediculati (invalid use of ordinal name). Gill (1878) recognised two subfamilial groups of the Antennariidae that included typical anglerfishes (Antennariinae) and a group containing two genera of handfishes (Brachionichthyinae). He included a newly erected genus-level taxon, *Sympterichthys*, for *Lophius laevis* (= *S. unipennis*). Waite (1904) later included *Brachionichthys* in the Antennariidae but made no mention of a subfamilial split. However, McCulloch and Waite (1918) described a fourth species, *Sympterichthys verrucosus*, from South Australia and elevated the Brachionichthyinae to family level. In his classification of fishes, Jordan (1923) also recognised the familial status of the group. In the same year, another Australian paper (Lord, 1923) used Brachionichthyidae rather than Antennariidae for these fishes, and this allocation has been used by subsequent authors.

Handfishes have provided an ongoing curiosity for artists and natural historians, particularly in the 19th C (Fig. 1). However, despite this interest and conservation concerns for some species, as a group, the family Brachionichthyidae has received little research attention. It has never been the subject of review nor its biogeography discussed. Prior to this study, the group was thought to consist of 5 extant species. *Brachionichthys hirsutus* (Lacepède, 1804), *Sympterichthys politus* (Richardson, 1844), *S. unipennis* (Cuvier, 1817) and *S. verrucosus* McCulloch & Waite, 1918, were listed by Paxton *et al.* (2006) in a checklist of Australian fishes. A new species, *B. australis* Last, Gledhill & Holmes, was described in 2007. However, the Brachionichthyidae, which is considered to be basal in a lineage that also includes the lophiiform families Antennariidae, Tetrabranchiidae, and Lophichthyidae (Pietsch, 1981) and dates back to the early Eocene (Rosen & Patterson, 1969), is more diverse. The existence of at least another 8 extant species was revealed by Last *et al.* (2007). Three of these have been treated in regional fish guides (Edgar *et al.*, 1982; Last *et al.*, 1983). The conservation genetics of the Brachionichthyidae was discussed as part of an unpublished Honours thesis by Lawler (1999), who suggested that a major divergence of extant genera probably occurred around 35 mya and that other unidentified species may exist.

A comprehensive investigation of the group has been impeded by a general lack of research material. Whitley (1949) first recognised this deficiency and formally asked trawl fishermen to donate material to museums. The senior author commenced this review of the group in the late 1970s and, while he has attempted to fill gaps in collection holdings, many of the species are still represented by few individuals. This has created difficulties regarding generic placements as well as for the adequate definition of species. Most of the species are undescribed and additional cryptic species are likely to exist.

In recent years the plight of brachionichthyid populations has been identified as a major conservation issue (e.g. Bruce *at al.*, 1998; Last *et al*., 2007). Several species are listed as threatened at various levels (Bruce *at al.*, 1999) and a taxonomic review of the group was needed urgently to assist researchers and conservation managers. Hence, the primary objective of this paper was to clarify the taxonomy of extant members of the family for these purposes. Nine new species are formally described and three new genera are erected. Redescriptions are provided for three species and two of these are reassigned to new genera. Two

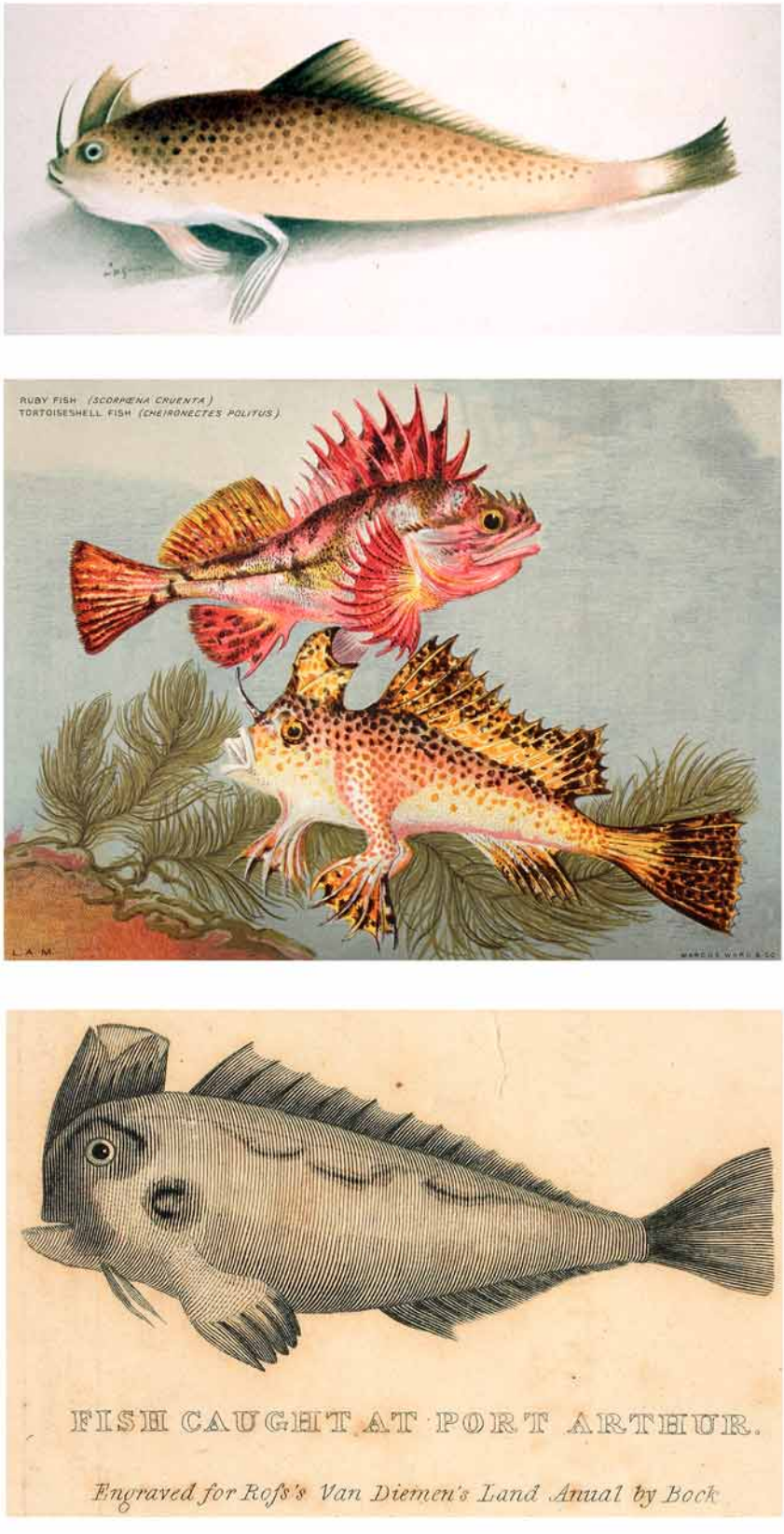


FIGURE 1. Early illustrations of brachionichthyids, reproduced courtesy of the Tasmaniana Library (State Library of Tasmania): A. *Brachionichthys hirsutus* illustrated by W. Gould (ca. 1832), figured as a 'Walking Fish'; B. *Brachionichthys hirsutus* (bottom specimen), illustrated by L. Meredith, figured as a 'Tortoiseshell Fish (*Cheironectes politus*)' in Tasmanian Friends and Foes (1880); and C. *Thymichthys politus*, copper engraving by T. Bock, figured as 'Fish caught at Port Arthur' in Dr Ross's 'Van Diemen's Land Annual' for 1835.

species of *Brachionichthys*, *B. australis* and *B. hirsutus*, were treated recently by Last *et al*. (2007), so only diagnoses and some remarks are provided for these taxa. A neotype was designated and described for *Sympterichthys politus* as the whereabouts of the holotype is unknown (Paxton *et al.*, 2006). Common names are recommended for each of the new species and these are usually related to the epithet; other taxa follow the Standard Names of Australian Fishes (Yearsley *et al*. 2006). Keys are provided to the genera and species and the biogeography of the group is discussed. A detailed osteological study and phylogenetic analysis of the group is the subject of an investigation in progress.

Materials and methods

External measurements and fin-ray counts follow Hubbs & Lagler (1958); however, methods for measuring the following characters differ (based on Last *et al.*, 2007 with minor modification): the first three dorsal-fin elements are unsegmented cephalic spines representing the spinous dorsal fin. The first dorsal-fin spine forms the 'illicium'; the second and third spines are connected by a membrane and are referred to hereafter as the 'first dorsal fin'; the 'soft dorsal fin' (or second dorsal fin), consists of simple segmented rays, and is usually well developed and elongate; a typical 'interdorsal' measurement is unreliable due to variability in the point of insertion of the membrane of the first dorsal fin – an alternative, less subjective, measurement from the anterior point of articulation of the third dorsal-fin spine to the origin of the first ray of the second dorsal fin was used; head length extends to the anteriormost margin of the opercular opening; pectoral-fin length is taken from the posterior end of the radial base to the extremity of the longest fin-ray; interorbital width is the least bony width across the interorbit; illicium length is from the anterior point of articulation of the illicium with its pterygiophore and includes the esca; caudal peduncle length is from the ventral margin of the caudal articulation to the anal-fin membrane; interpelvic distance was measured across the pelvic-fin origins; and pre-illicial length from the snout tip to the anterior point of articulation of the illicium. Measurements for the length of the elements of the first dorsal fin, the longest second dorsal-fin ray, and the distance from the third dorsal-fin spine base to the origin of the soft dorsal fin, were generally taken from radiographs (with care being taken to avoid parallax errors) because their bases are often deeply embedded. Measurements were taken in a straight line, from point to point (rather than horizontally). Handfishes are typically soft-bodied fishes but morphometric data still proved very useful in discriminating species. However, specimen numbers were often low, so morphometric ranges for species are likely to exceed those given herein.

Like many other antennarioid anglerfishes (Pietsch & Grobecker, 1987), the skin of most species is variably covered with dermal spinules. These spinules arise from embedded scales and are either simple (unicuspid) or bifurcate (bicuspid with spinules divided above their bases); we follow Pietsch and Grobecker in referring to the tips of each spinule as spines. Spinules supporting the acoustico-lateralis system are crescent shaped.

Counts of vertebrae (Vt), and first dorsal (D1), second dorsal (D2), anal (A) and caudal (C) fin elements, were made from radiographs. Pelvic (Pv) and pectoral (Pc) fin counts were taken directly from microscopic examination of preserved specimens with the aid of radiographs to confirm the presence of a pelvic spine. The caudal fin, which usually has 9 (very rarely 10) elements, is comprised of 0–2 upper and 1–4 lower simple rays separated by 4–8 branched elements. Vertebrae associated with the abdominal and trunk regions were counted separately; these regions are divided near the position of the vent in fishes (Rojo, 1991), but the presence of a complete haemal arch is usually used to demarcate the position of the first caudal vertebrae. This character sometimes requires the dissection, or clearing and staining of specimens, as it is not generally distinguishable from radiographs in lophiiform fishes (Pietsch, 1972); in this case the position of the first haemal arch does not correspond with the position of the vent (Pietsch, 1981). Most handfishes are represented by only a few specimens, therefore neither dissection nor clearing and staining were practical options to isolate the haemal arch. Instead, we approximated the position of the vent in a repeatable way by defining the first caudal vertebra as 'the element with a haemal spine directly preceding the first (forward most) pterygiophore supporting the anal fin'. The hypural plate was included in the caudal count.

Tables of morphometric and meristic data are provided with important diagnostic data embedded in species treatments. Some specimens were physically damaged, emaciated due to captivity in aquaria, or desiccated due to preservation; in such cases affected measurements and/or counts were removed from datasets. Additional care was taken when extracting morphometric data as most species have soft, flexible bodies and can be difficult to measure accurately.

Precise localities are not given for specimens collected shallower than 20 m depth, or for populations limited to a restricted geographic area, to prevent exploitation of their populations. These data should not be used as point information to demarcate the precise ranges of species. Materials examined are deposited in the Australian National Fish Collection, Hobart (CSIRO), and the ichthyological collections of the Australian Museum, Sydney (AMS), Museum National d'Histoire Naturelle, Paris (MNHN), Museum Victoria, Melbourne (NMV), Natural History Museum of Los Angeles County (LACM), Queensland Museum (QM), Queen Victoria Museum and Art Gallery (QVMT), South Australia Museum (SAMA) and Tasmanian Museum and Art Gallery (TMH); their registration numbers are prefixed with these acronyms.

Family Brachionichthyidae

Subfamily Brachionichthyinae Gill, 1878: 221, 222 (family Antennariidae); elevated to family Brachionichthyidae Gill, 1878 by McCulloch and Waite (1918). Type genus: *Brachionichthys* Bleeker, 1855: 21.

Definition. Lophiiform fishes with spinous fin consisting of three cephalic spines, all emerging from dorsal surface of cranium; illicium not retractable within a cavity but often depressible into a shallow groove on either side of first dorsal fin; esca rudimentary to well developed (Fig. 2); second and third dorsal-fin spines united by membrane to form first dorsal fin; skin naked to variably covered with often deeply embedded, spinulose scales (Figs 3–5); pterygiophores of illicium and third dorsal-fin spine with highly compressed, blade-like dorsal expansions; ectopterygoid roughly oval in shape or absent; interopercle flat and rounded; interhyal with medial, posterolaterally directed processes; parietals meeting in midline and dorsal to supraoccipital; ceratobranchials I–III with one or more tooth plates; hypobranchial II simple; hypobranchial III absent; pectoral-fin radials 2, rays 6–10; pelvic fin consisting of 1 spine and 4 rays; soft-dorsal fin rays 14–19; anal-fin rays 6–11; and vertebrae 20–26.

Recognised genera. *Brachionichthys* Bleeker and *Sympterichthys* Gill, and three new genus-level taxa *Brachiopsilus* **gen. nov.**, *Pezichthys* **gen. nov.** and *Thymichthys* **gen. nov.**

Life history and habitat. Found on both hard and soft substrates (Fig. 6) from the nearshore to about 280 m (possibly to 500 m), however, most species are found only on the continental shelf. All extant species are confined to eastern and southern Australia and most occur in small, disjunct populations. Details of the life history of most species are unknown but some information exists for *Brachionichthys hirsutus* (Bruce *et al.* 1999). Females lay small clusters of large eggs that are encapsulated and connected by filaments. Clusters are attached to the substrate by these filaments and there is evidence of parental care until they hatch. Young handfishes, resembling the adults in morphology, emerge from their egg cases and move around by walking around on the substrate rather than swimming.

Remarks. Osteological characters above are based mainly on Pietsch (1981) and the presence/absence of these characters has not been confirmed for most of the taxa treated herein. A skeletal study is the subject of an investigation in progress. Several of the species are known from very few individuals (some only from the holotype) so the authors are presently attempting to acquire additional material for clearing and staining.

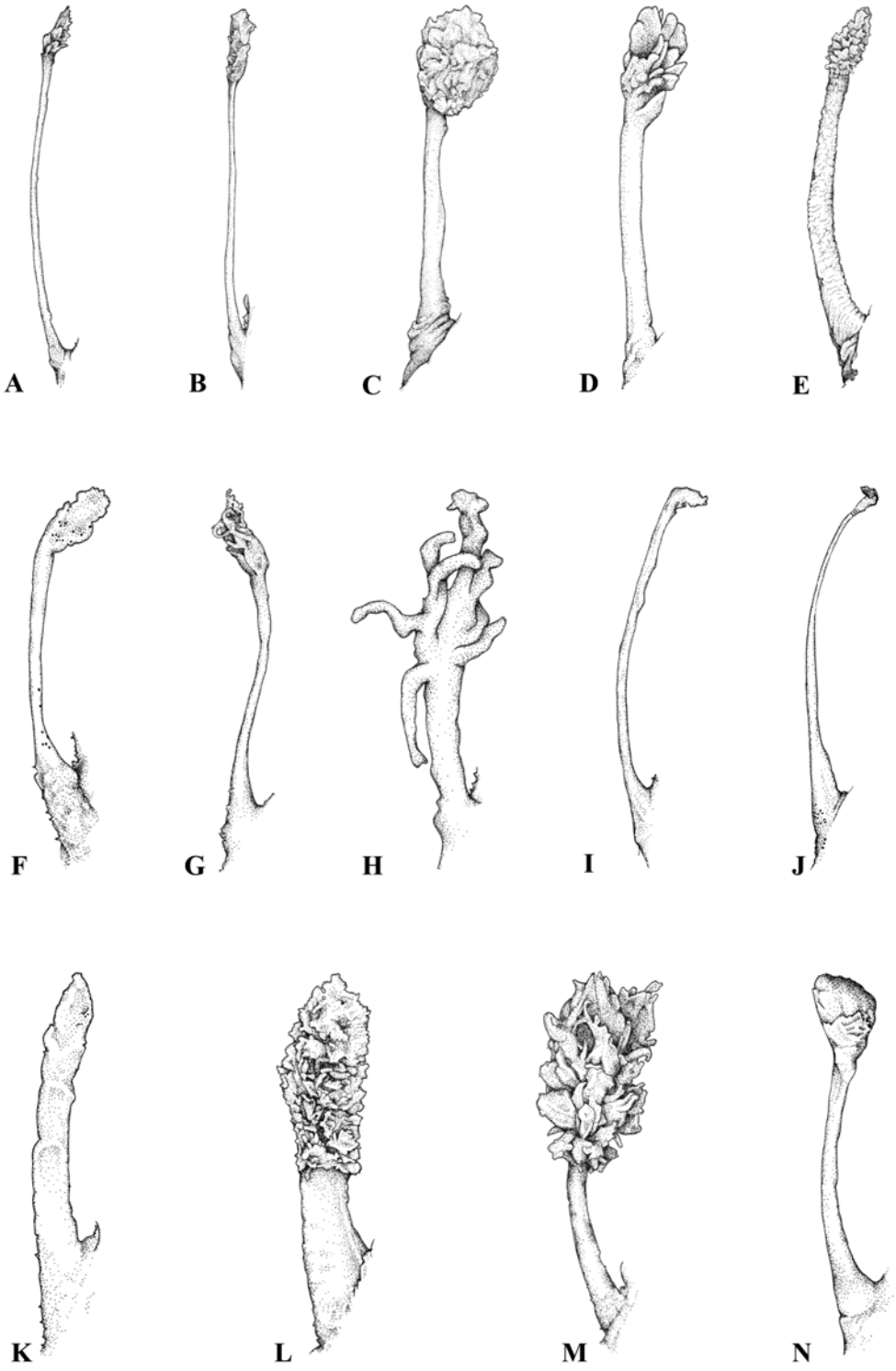


FIGURE 2. Illustrations of the illicium and esca of: A. *Brachionichthys australis*, CSIRO H 4114–07, 55.8 mm SL; B. *Brachionichthys hirsutus*, CSIRO T 7, 78.9 mm SL; C. *Brachiopsilus dianthus* **sp. nov.**, CSIRO H 4995–01, holotype, 99.5 mm SL; D. *Brachiopsilus dossenus* **sp. nov.**, NMV A 29405–002, holotype, 65.0 mm SL; E. *Brachiopsilus ziebelli* **sp. nov.**, CSIRO T 1993–01, holotype, 101.5 mm SL; F. *Pezichthys amplispinus* **sp. nov.**, CSIRO H 4460–01, 37.2 mm SL; G. *Pezichthys compressus* **sp. nov.**, CSIRO H 4447–01, holotype, 42.4 mm SL; H. *Pezichthys eltanini* **sp. nov.**, LACM 11516–1, holotype, 30.0 mm SL; I. *Pezichthys macropinnis* **sp. nov.**, CSIRO H 5317–02, holotype, 20.5 mm SL; J. *Pezichthys nigrocilium* **sp. nov.**, CSIRO H 6154–01, holotype, 40.8 mm SL; K. *Sympterichthys moultoni* **sp. nov.**, CSIRO H 3773–03, holotype, 45.1 mm SL; L. *Thymichthys politus*, CSIRO H 782–01, 67.3 mm SL; M. *Thymichthys verrucosus* (tasselled morph), CSIRO T 5, 51.3 mm SL; and N. *Thymichthys verrucosus* (eastern form) CSIRO H 3781–01, 63.5 mm SL.

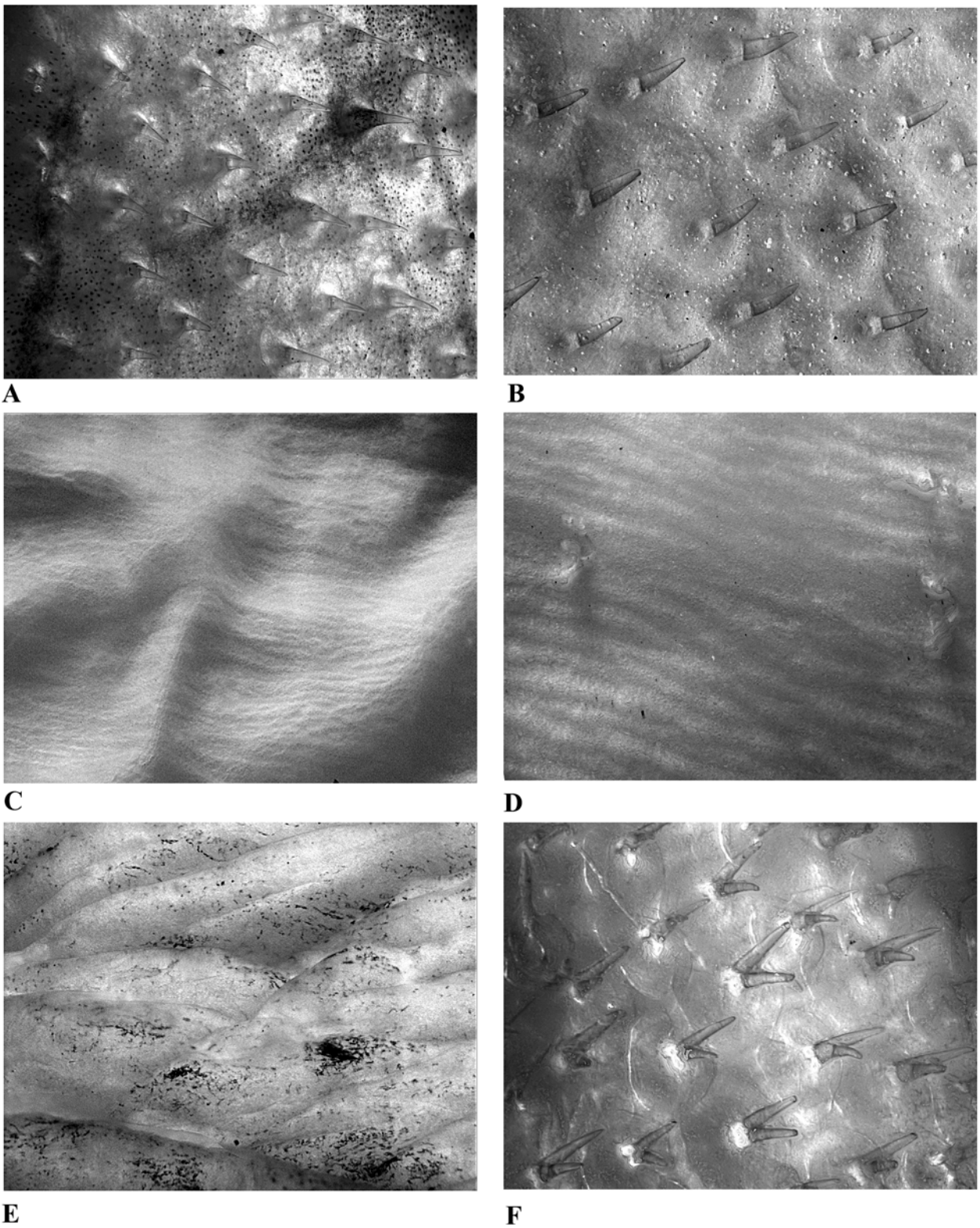


FIGURE 3. Skin morphology of: A. *Brachionichthys australis*, CSIRO H 4451–02 (x40); B. *Brachionichthys hirsutus*, TMH D 640 (x40); C. *Brachiopsilus dianthus* **sp. nov.**, CSIRO H 4995–01, holotype (x20); D. *Brachiopsilus dossenus* **sp. nov.**, NMV 29405–002, holotype (x20); E. *Brachiopsilus ziebelli* **sp. nov.**, CSIRO T 1993–01, holotype (x25); F. *Pezichthys amplispinus* **sp. nov.**, CSIRO H 4448–01, holotype (x50). All images orientated as a view of mid-upper body on left side (i.e. anterior part to left).

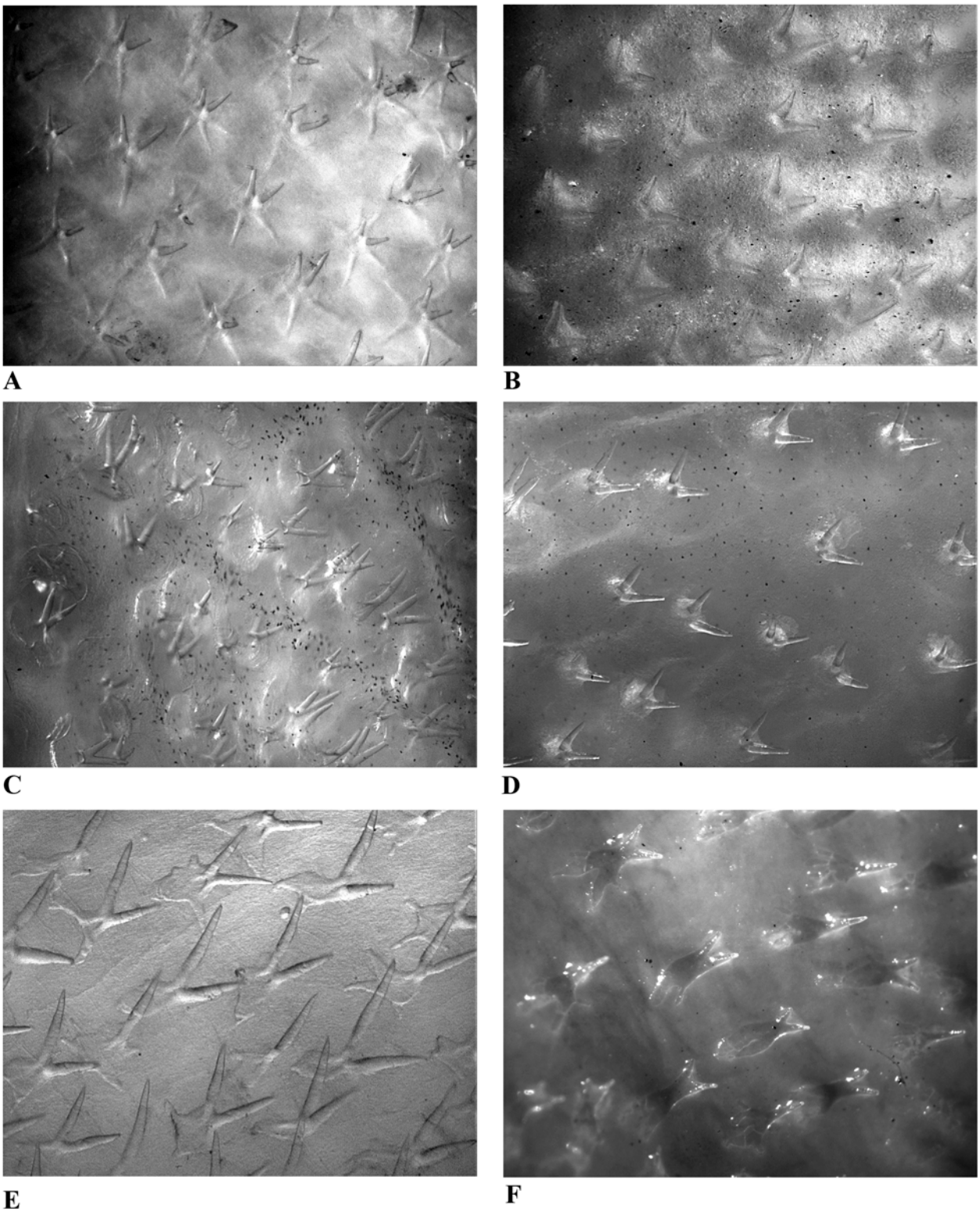


FIGURE 4. Skin morphology of: A. *Pezichthys compressus* **sp. nov.**, CSIRO H 4447–01, holotype (x50); B. *Pezichthys eltanini* **sp. nov.**, LACM 11516–1, holotype (x65); C. *Pezichthys macropinnis* **sp. nov.**, CSIRO H 5317–02, holotype (x40); D. *Pezichthys nigrocilium* **sp. nov.**, CSIRO H 6154–01, holotype (x40); E. *Sympterichthys moultoni* **sp. nov.**, CSIRO H 3773–03, holotype (x50); F. *Sympterichthys unipennis*, MNHN A 4630, holotype (x50). All images orientated as a view of mid-upper body on left side (i.e. anterior part to left).

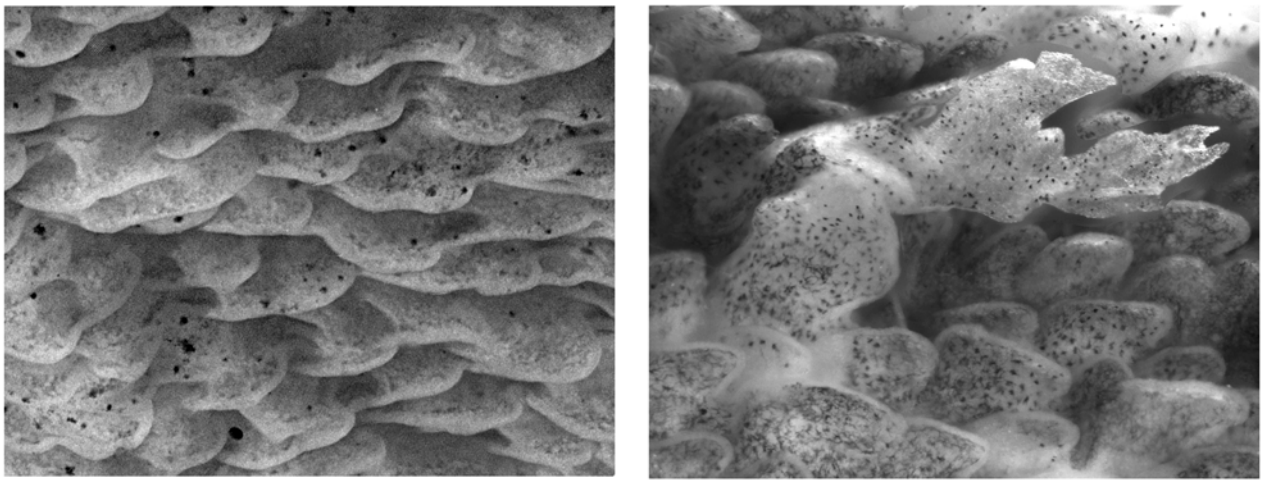
Key to genera of the family Brachionichthyidae

1. Skin smooth to touch; body naked or with patchy coverage of embedded scales with only their spinule tips emerging 2
Skin rough to touch; body almost entirely covered with spiny scales with their spinules clearly emerging and visible 3

2. Body smooth or covered with low cutaneous ridges, but not warty; dermal appendages absent; lacking embedded spinulose scales ..... *Brachiopsilus* **gen. nov.**
Body usually covered with wart-like protuberances; dermal appendages well developed; skin with deeply embedded scales with short spinules, their tips sometimes protruding above the skin surface but usually not visible to the naked eye ..... *Thymichthys* **gen. nov.**

3. Spinules simple (Fig. 3B); body relatively elongate, depth 28–35% SL at second dorsal-fin origin; colour pattern dominated by small dark spots and/or fine horizontal lines ..... *Brachionichthys* Bleeker
Spinules mainly bifurcate (sometimes also with a few unicuspid scales) (Fig. 4); usually relatively deep-bodied, depth 32–48% SL at second dorsal-fin origin; colour pattern plain, floral or weakly marbled 4

4. Spinules both bifurcate and simple (Fig. 4E), adpressed, directed posteriorly, originating at posterior margin of scale base; spinules partly embedded, their tips protruding slightly above skin surface..... *Sympterichthys* Gill
Spinules typically bifurcate (Fig. 4B), upright, originating near middle of scale bases; spinules divided well above skin surface ..... *Pezichthys* **gen. nov.**



A **B**

FIGURE 5. Skin morphology of: A. Thymichthys politus, CSIRO H 782–01 (x50); B. Thymichthys verrucosus, SAMA F 4750 (x40), showing a dermal flap. All images orientated as a view of mid-upper body on left side (i.e. anterior part to left).

Brachionichthys Bleeker

Brachionichthys Bleeker, 1855: 12, 21. Type species: *Lophius hirsutus* Lacepède, 1804, by subsequent designation of Gill, 1878: 222.

Definition. Members of the genus *Brachionichthys* are unique among brachionichthyids in having the following combination of features: body relatively elongate (depth 28–35% SL at second dorsal-fin origin), head weakly compressed, oval in cross section, relatively small, length 45–49% SL; mouth relatively small, caudal peduncle long, 7–11% SL; illicium very slender, 4–12 times length of esca; skin surface rough, densely covered with monospinulate scales; spinules upright, protruding well above skin surface, originating from centre of scale base; scale bases subcircular, not deeply embedded; dermal appendages present on arm of pectoral-fin (sometimes present on ventrolateral surface of body); no enlarged fleshy warts on skin; black

spots and/or streaks over body, and dorsal and caudal fins; pectoral-fin usually with 7 rays; anal-fin rays 8–11 (mainly 9–10); vertebrae 22–26.

Species. Presently includes two valid species, *Brachionichthys australis* Last, Gledhill & Holmes, 2007 and *B. hirsutus* (Lacepède, 1804).

Remarks. Diagnoses of the included taxa (i.e. *Brachionichthys australis* and *B. hirsutus*) by Last *et al.* (2007) were constructed to distinguish these species from the few other nominal brachionichthyids documented at the time, as well as incorporating characters useful for distinguishing undescribed species-level taxa then provisionally considered referable to the genus *Brachionichthys*. Further research has confirmed that these new taxa need to be assigned to new genera erected in this paper. Hence, species diagnoses have been modified herein to include characters useful in distinguishing each of these species.

Members of the genus *Brachionichthys* are distinguishable from all other handfishes in having a relatively elongate body, a colour pattern of dark streaks and/or spots, and rough skin that is densely covered with monospinulate scales. The scales have upright spinules that protrude well above the skin surface and originate centrally from their bases. *Pezichthys* has spiny scales with spinules originating centrally but their spinules are bifid; other genera are smooth and naked, warty or have monospinulate or bicuspid scales with oblique spinules originating at the posterior margin of the scale base.

Pectoral-fin ray counts are reasonably stable in this group but aberrations can occur. The typical count for *Brachionichthys* is 7 rays (based on 114 specimens with both left and right pectoral counted). However, two specimens of *B. hirsutus*, CSIRO T 1989–01 (one of three individuals) and CSIRO H 2629–04 (one of 7 individuals), had 6 and 8 rays respectively on one side of the body (the other side had a typical count of 7 rays). *Pezichthys* (5 species) also has 7 pectoral-fin rays, and some species of *Sympterichthys* (2 species) and *Thymichthys* (2 species) also can have 7 rays.

Additional material has been examined since Last *et al.* (2007) which has extended geographic ranges and shed light on possible regional extinctions of species.

Key to species of *Brachionichthys*

Illicium particularly elongate (length 23–28% SL), 1.8–2.1 times in head length; when depressed, illicium tip reaching well behind base of third dorsal-fin spine; horizontal diameter of eye 8.6–9.4% SL; length of second dorsal-fin spine 1.1–1.4 times length of longest ray of second dorsal fin; caudal fin with sparse coverage of large dark spots not forming a broad submarginal bar ..... *B. australis* Last, Gledhill & Holmes

Illicium shorter (length 19–20% SL), 2.3–2.4 times in head length; when depressed, illicium tip reaching to or just behind base of third dorsal-fin spine, horizontal diameter of eye 7.0–8.5% SL; length of second dorsal-fin spine 0.7–1.0 times length of longest ray of second dorsal fin; caudal fin with dense coverage of fine spots, forming a dark submarginal bar in juveniles ..... *B. hirsutus* (Lacepède)

***Brachionichthys australis* Last, Gledhill & Holmes**
Figs 2, 3, 7, 8; Tables 7–10

Brachionichthys hirsutus (not Lacepède): Günther, 1880: 28 [misidentification]
Brachionichthys sp. 2: Last, Scott & Talbot, 1983: 252–253, fig. 22.4.
Brachionichthys sp.: Hutchins & Swainston, 1986: 34, fig. 111.
Brachionichthys sp.: Gomon, Glover & Kuiter, 1994: 283–284, fig. 252.
Brachionichthys australis Last, Gledhill & Holmes, 2007: 55–60, figs 1, 2; Disaster Bay, southeastern Australia [original description].

Holotype. CSIRO H 4451–02, 45.9 mm SL, E of Disaster Bay, New South Wales, 37° 18′S, 150° 17E, 125 m, 7 Dec. 1996.

Additional material. 50 specimens (28–65 mm SL): AMS I 23869–001, 46.4 mm SL, east of Batemans Bay, New South Wales, 35° 44'S, 150° 36'E, 216 m, 1 Dec. 1976; AMS I 27253–003, 40 mm SL, south-east of Ulladulla, New South Wales, 35° 29'S, 150° 46'E, 219 m, 2 Aug. 1977; AMS I 38077–001, 45.6 mm SL, south-west of Lakes Entrance, Bass Strait, Victoria, 38° 25'S, 147° 19'E, 120 m, 29 Aug. 1994; AMS I 40310–003, 2 specimens, 50.1 and 58.4 mm SL, south-east of Bermagui, New South Wales, 36° 44'S, 150° 08'E, 97–101 m, 12 Apr. 2000; AMS I 40310–004, 50.6 mm SL, south-east of Bermagui, New South Wales, 36° 44'S, 150° 08'E, 97–101 m, 12 Apr. 2000; AMS I 40311–004, 2 specimens, 50.9 and 51 mm SL, south-east of Bermagui, New South Wales, 36° 37'S, 150° 10'E, 115 m, 13 Apr. 2000; AMS I 40314–001, 2 specimens, 41.2 and 41.6 mm SL, data as for previous lot; AMS I 43755–009, 40.7 mm SL, no other data; MNHN 1960–0338, 3 specimens, 60–65 mm SL, Tuggerah Lakes, New South Wales, 33° 20'S, 151° 31'E, date unknown; NMV A 13023, 2 specimens, 46.8 and 49.4 mm SL, south-east of Merimbula, New South Wales, 36° 53'S, 150° 12'E, 119–117 m, 5 Aug. 1993; NMV A 13024, 7 specimens, 29.4–42.9 mm SL, Disaster Bay, New South Wales, 37° 16'S, 149° 58'E, 24–29 m, 11 Aug. 1993; NMV A 13025, 3 specimens, 28.2–45.9 mm SL, Disaster Bay, New South Wales, 37° 17'S, 149° 59'E, 26–33 m, 11 Aug. 1993; NMV A 20795, 2 specimens, 32.2 and 42.5 mm SL, east of Lakes Entrance, Victoria, 37° 53'S, 148° 00'E, 1 Oct. 1983; NMV A 22170, 50.8 mm SL, south-west of Portland, Victoria, 38° 36'S, 141° 11'E, 30 Mar. 2001; QM I 21040, 2 specimens, 39.5 and 44.1 mm SL, east of Stradbroke Island, Queensland, 27° 35'S, 153° 50'E, 210 m, 15 Dec. 1982; QM I 33334, 2 specimens, 39.2 and 39.3 mm SL, east of Stradbroke Island, Queensland, 27° 43'S, 153° 49'E, 165 m, 24 Jul. 2002; QM I 33949, 2 specimens, 36.5 and 39.8 mm SL, east of Stradbroke Island, Queensland, 27° 46'S, 153° 49'E, 163 m, 24 Jul. 2002; QM I 34045, 51.6 mm SL, east of Stradbroke Island, Queensland, 27° 49'S, 153° 50'E, 161–165 m, 24 Jul. 2002; QVMT 1979.5.48, 47.8 mm SL, off Eddystone Point, Tasmania, ca. 41° 00'S, 148° 22'E, 37 m, QVMT 1979.5.142, 28.1 mm SL, off St Helens, Tasmania, ca. 41° 18'S, 148° 20'E, Jun. 1975; QVMT 2005.5.1, 53.3 mm SL, north-east Tasmania, 40° 53'S, 148° 20'E, 100 m, 16 Mar. 2005; SAMA F 10465, 5 specimens, 30.3–34.6 mm SL, south-west of Eucla, Western Australia, 33° 17'S, 128° 12'E; SAMA F 10482, 6 specimens, 29.2–41.3, Murray Canyons, south of Kangaroo Island, South Australia, 36° 30'S, 136° 42'E.

Material from Last *et al.* (2007). 39 paratypes (13–64 mm SL): CSIRO A 4316, CSIRO H 3505–03, CSIRO H 3530–02, CSIRO H 3794–01, CSIRO H 3795–02, CSIRO H 4114–06, CSIRO H 4114–07, CSIRO H 4259–02, CSIRO H 4259–03, CSIRO H 4448–03, CSIRO H 4460–02, CSIRO H 4465–01, CSIRO H 4465–02, CSIRO H 4466–02, CSIRO H 5699–01, CSIRO T 1991–01, CSIRO T 1992–01, NMV A 226, NMV A 1619, NMV A 2617, NMV A 2668, NMV A 2670, NMV A 2675, NMV A 4314, NMV A 8765, NMV A 9043, NMV A 11462, NMV A 29406–001, NMV A 29410–001, NMV A 29411–001, NMV A 29412–001, TMH D 246.

Diagnosis. Member of the genus *Brachionichthys* with a combination of the following characters: esca small, 8–24 (mean 14)% of illicium length (including esca); illicium very elongate, length 23–28% SL, 1.8–2.1 times in head length; apex of adpressed illicium reaching well behind base of third dorsal-fin spine; esca narrowly filamentous, barely thicker than illicial stem, its filaments multiple, dense, obscure to somewhat globate; eye large, horizontal diameter mainly less than 5.4 times in head, 8.6–9.4% SL; upper lip fleshy; long first dorsal-fin base (length 25–30% SL); second dorsal-fin rays 16–18 (mean 17), length of fin base 55–61 (mean 58)% SL; length of second dorsal-fin spine 1.1–1.4 times length of longest ray of second dorsal fin; vertebrae 22–23; upper body lightly covered with longitudinal streak-like markings rather than spots; caudal fin with sparse coverage of large dark spots, not forming a broad submarginal bar.

Size. To at least 65 mm SL (about 85 mm TL), more commonly 35–50 mm SL; smallest specimen examined 13.4 mm SL. Newly hatched young and undamaged, fully developed egg capsule diameter unknown; egg diameter 1.7–1.9 mm.

Distribution. Demersal on the continental shelf and upper slope off southern and eastern Australia; east of Stradbroke Island, Queensland (27° 35′S, 153° 50′E), to Middini Beach, in the Great Australian Bight, Western Australia (33° 17′S, 127° 31′E); south to at least the D'Entrecasteaux Channel, Tasmania (near 43° 03′S, 147° 20E), but not yet recorded from the west coast. Occurs most frequently on soft substrates in 40–

150 m depth, but to at least 220 m and inshore to 18 m; a specimen taken off Bermagui (New South Wales) was trawled in 123–277 m but the exact depth of capture cannot be determined.

Etymology. Epithet based on *australis* Latin for southern, in reference to its widespread temperate distribution. Vernacular name: Australian spotted handfish (Last *et al.*, 2007).

Comparisons. *Brachionichthys australis* and *B. hirsutus* are superficially similar, but can be distinguished by a combination of coloration, meristics and selected morphometrics, as well as by molecular analysis (Last *et al.*, 2007). *Brachionichthys australis* has a longer illicium (length 23–28% vs. 19–20% SL; 1.8–2.1 vs. 2.3–2.4 in head length) with a relatively smaller esca (length 8–24%, mean 14% vs. 15–26%, mean 20% of illicium length), longer second dorsal-fin spine (length 1.1–1.4 vs. 0.7–1.0 times length of longest ray of second dorsal fin), larger eye (diameter mainly less than 5.4 rather than exceeding 5.4 in head), and a shorter second dorsal-fin base (55–61, mean 58% vs. 61–64, mean 62% SL) with fewer fin rays (16–18, mainly 17 vs. 17–19, mainly 18). In adults of *B. australis*, the upper body is lightly covered with thin streak-like markings (rather than spotted as in *B. hirsutus*) and the caudal fin is sparsely spotted (densely covered with fine spots). Juveniles of *B. australis* are similar to adults in form and colour, but differ from similar-size juveniles of *B. hirsutus* in having much larger caudal and pelvic fins, and a larger eye (Last *et al.*, 2007). Juveniles of *B. australis* have large dark spots over the caudal fin (with a dark submarginal caudal bar in *B. hirsutus* juveniles), spots are evenly distributed over the soft dorsal fin (rather than largely absent on central fin, markings concentrated anteriorly and posteriorly and coalescing with dark saddles on body), slightly longer, thinner scale spination, and the second dorsal-fin spine (when depressed) reaches to (or just behind) the second dorsal-fin origin (rather than falling well short of second dorsal fin).

Remarks. The eastern distribution of *Brachionichthys australis* has been extended greatly based on a summary of all available data. Last *et al.* (2007) give a northern limit off the south coast of New South Wales (i.e. off Bermagui, 36° 23′S). However, material provided by Jeff Johnson from the Queensland Museum (QM I 21040, QM I 33334, QM I 33949 and QM I 34045) has extended its range north to southern Queensland (i.e. off Stradbroke Island, 27° 35′S). Additional material was collected by the FRV *Kapala* between these locations off New South Wales (Ken Graham, pers. comm.) with a northern limit of Newcastle (ca. 33° 11′S), and another three specimens held at the MNHN, Paris, were collected off the Tuggerah Lakes (ca. 33° 20′S 151° 31′E). The FRV *Kapala* data is based on 21 individuals, some of which have been deposited in the Australian Museum, and their capture depths ranged from 55–120 m. Deepwater specimens (ca. 200 m depth) reported as *B. hirsutus* by Günther (1880) off Twofold Bay (New South Wales), and historical records off New South Wales (McCulloch, 1929) and Victoria (Whitley, 1949), are most likely to be of *B. australis*.

Some morphological differences exist in populations of *B. australis*. Specimens from southern Queensland have a more strongly contrasted colour pattern, being variably brownish above and almost white below (vs. more uniform with prominent linear markings in material from South Australia and Western Australia), a large and pronounced, dark brown opercular blotch (opercular blotch obscure or absent); taller first dorsal-fin spines, relatively larger spots on fins (spots on dorsal fins and caudal fins much smaller and less pronounced), and very elongate spinules without fleshy bases (spinules appearing shorter and with fleshy bases). A molecular study of populations across the range of *B. australis* may provide evidence of additional species.

Brachionichthys hirsutus **(Lacepède)**

Figs 1, 2, 3, 6, 7, 9; Tables 7–10

Lophius hirsutus Lacepède, 1804: 202, 210, pl. 55 (3); type not designated; southern coast of Australia, presumably Tasmania [original description].

Chironectes punctatus Cuvier, 1817: 434, pl. 18 (2, 5); lectotype MNHN A 4627, by subsequent designation of Le Danois (1964: 139), paralectotype apparently skeletonised and subsequently lost, see Pietsch, 1985; southern Australia, presumably Tasmania [new name for *Lophius hirsutus* Lacepède].

Chironectes hirsutus: Valenciennes, 1837: 434 [new combination].

Brachionichthys hirsutus: Bleeker, 1855: 22–23 [new combination].
Brachionichthys politus (not Richardson): Whitley, 1949: 403 [misidentification].

Lectotype. MNHN A 4627, 78.7 mm SL, coast of southern Australia (probably Tasmania), voyage de Péron (1800–1804), no other data.

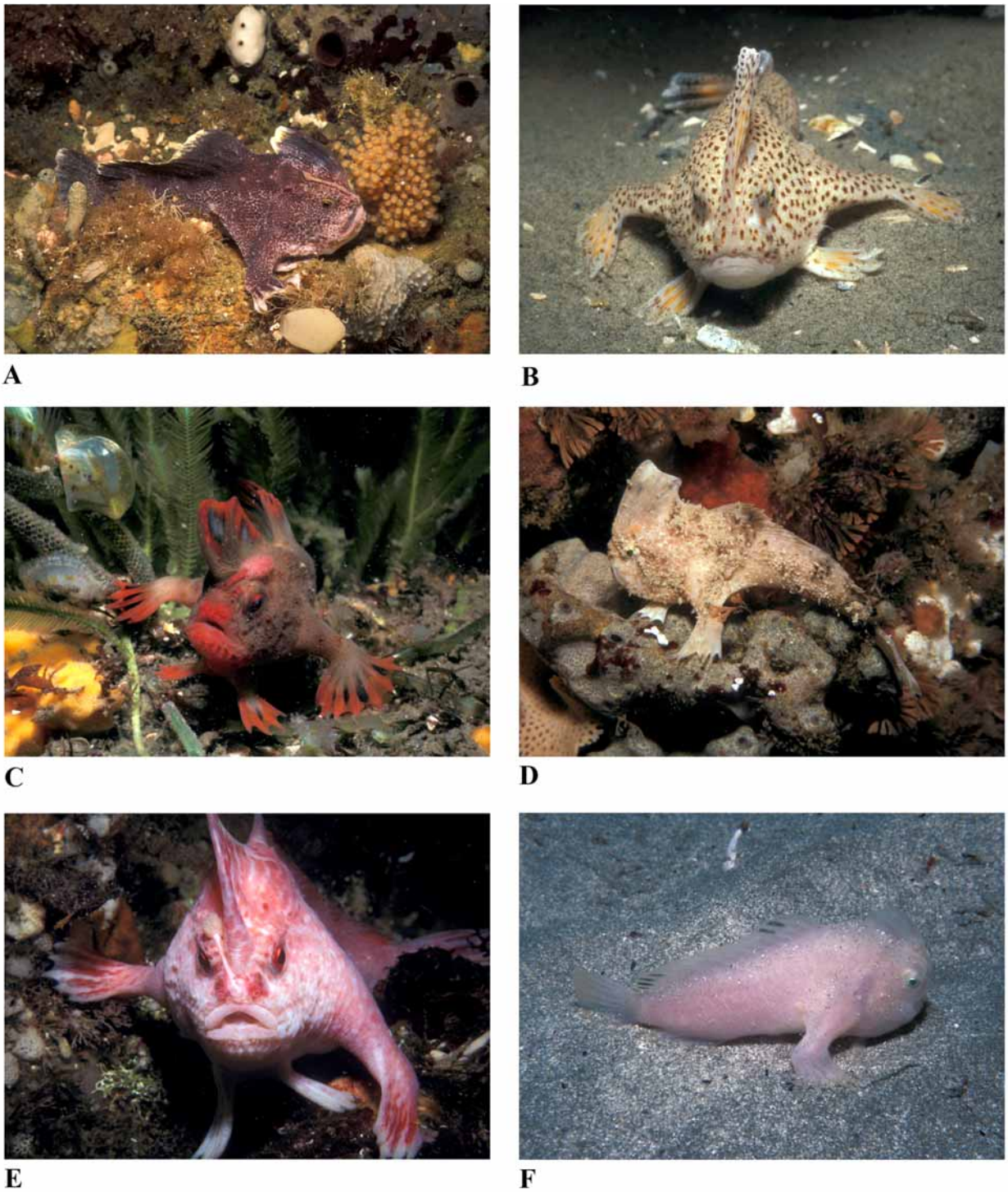


FIGURE 6. Underwater images of live handfishes (photographer K. Gowlett-Holmes): A. *Brachiopsilus ziebelli* **sp. nov.** (Loney's morph) with egg mass, Waterfall Bay, Tasmania, not retained; B. *Brachionichthys hirsutus*, Derwent Estuary, Tasmania, not retained; C. *Thymichthys politus*, Primrose Bay, Tasmania, not retained; D. *Thymichthys verrucosus* (tasselled morph), habitat artificial, Tasmania; E. *Brachiopsilus dianthus* **sp. nov.**, CSIRO 4995–01, holotype, 99.5 mm SL, habitat artificial, Tasmania; F. *Sympterichthys moultoni* **sp. nov.**, CSIRO H 4461–01, paratype, 39.3 mm SL, habitat artificial, Tasmania.

Additional material. 5 specimens (63–101 mm SL): NMV A 21672, 62.6 mm SL, Derwent Estuary, Tasmania, 42° 57'S, 147° 21'E, 10 Mar. 1997; NMV A 21687, 66 mm SL, Derwent Estuary, Tasmania, 42° 55'S, 147° 21'E, 1997; QVMT 1974.5.165, 2 specimens, 84.4 and 89.4 mm SL, off Cape Portland, Tasmania, ca. 40° 43'S, 148° 00'E, 8 Sep. 1974. QVMT 2009.5.1, 100.6 mm SL, off St Helens, Tasmania, ca. 41° 18'S, 148° 20'E, no other data.

Material from Last *et al.* (2007). 81 specimens (21–83 mm SL): CSIRO C 2986, CSIRO H 797–01, CSIRO H 2629–01, CSIRO H 2629–02, CSIRO H 2629–03, CSIRO H 2629–04, CSIRO H 4114–01, CSIRO H 4114–02, CSIRO H 4114–03, CSIRO H 4114–04, CSIRO H 4114–05, CSIRO H 4115–01, CSIRO H 6564–01, CSIRO T 2, CSIRO T 3, CSIRO T 7, CSIRO T 10, CSIRO T 11, CSIRO T 1989–01, CSIRO T 1990–01, NMV A 2305, NMV A 29404–001, TMH D 80, TMH D 81, TMH D 237, TMH D 240, TMH D 254, TMH D 269, TMH D 364, TMH D 640, TMH D 650, TMH D 746, TMH D 962, TMH D 965, TMH D 966, TMH D 1309, TMH D 1333, TMH D 1775, TMH D 1892, TMH D 1929, TMH D 1938.

Diagnosis. Member of the genus *Brachionichthys* with a combination of the following characters: esca small, 15–26 (mean 20)% of illicium length (including esca); illicium very slender, length 19–20% SL, 2.3–2.4 times in head length; apex of adpressed illicium reaching to or just behind base of third dorsal-fin spine; esca barely thicker than illicial stem, its filamentous branches multiple, irregular, dense, short thallate; eye moderate-sized, horizontal diameter exceeding 5.4 times in head, 7.0–8.5% SL; upper lip very fleshy; relatively short first dorsal-fin base (length 23–26% SL); second dorsal-fin rays 17–19 (mean 18), length of fin base 61–64 (mean 62)% SL; length of second dorsal-fin spine 0.7–1.0 times length of longest ray of second dorsal fin; vertebrae 22–26; upper body usually covered with fine, dark spots or short streaks (rarely with long streaks on head); caudal fin with dense coverage of fine spots, forming a dark submarginal bar in juveniles.

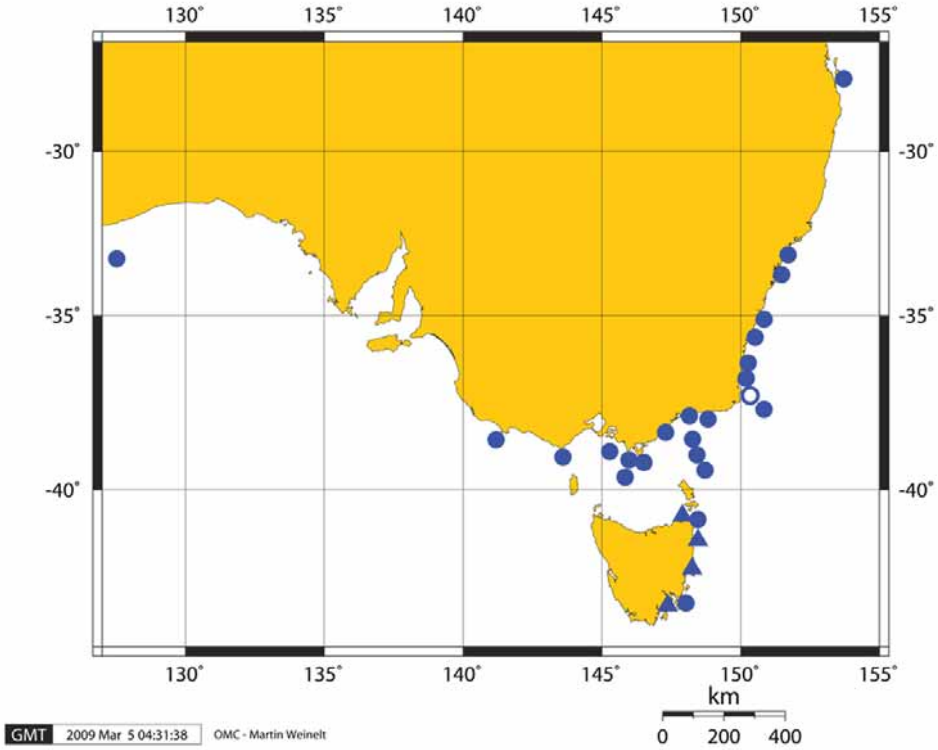


FIGURE 7. Collection localities for: A. *Brachionichthys australis* holotype (○) and additional material (●); and B. all material of *B. hirsutus* (▲). Locations are approximate, and may represent multiple records; they include registered collection, and verified, non-retained material.

Size. To 100.6 mm SL (ca. 143 mm TL), adults more commonly ~60–75 mm SL; juveniles hatch at about 6–7 mm SL (the caption for figure 8 in Last *et al.* (2007) erroneously states that the newly hatched juvenile is 30 mm TL, this should read ca. 6 mm TL). Egg masses contain about 80–250 eggs (1.8–2 mm diameter); egg capsules about 3–4 mm diameter and connected by strands.

Distribution. Now confined to southeastern Tasmania (Derwent River estuary mouth and adjacent marine embayments) but once more widespread in disjunct populations off eastern Tasmania; mainly demersal inshore (ca. 5–15 m) on the continental shelf, but probably occurred at depths of 1–60 m. Appears to have undergone a major range reduction and its populations have declined significantly since its discovery; now considered to be Critically Endangered (Bruce & Last, 2006) and Endangered (Australian Government *Environment Protection and Biodiversity Conservation Act, 1999* and the State Government of Tasmania *Threatened Species Protection Act, 1995*, Anon 2005, 07). Specimens were collected in Great Oyster Bay, central eastern Tasmania (ca. 42° 06′S, 148° 09′E) between 1909 and 1957, the Huon Estuary (ca. 43° 12′S, 147° 04′E) in the 1940s, and more widely in the D'Entrecasteaux Channel (ca. 43° 03′S, 147° 20′E) in the 1960's and 1980s, but have not been collected from these regions since. In 1974, two specimens (QVMT 1974.5.165) were obtained from Cape Portland, eastern Bass Strait (ca. 40° 43'S, 148° 00'E), and an additional specimen (QVMT 2009.5.1, date unspecified) was collected from off St Helens, eastern Tasmania (ca. 41° 18'S, 148° 20'E). No other records of this species exist from Bass Strait or off eastern Tasmania despite extensive commercial and recreational dive effort, a scallop fishery and several biological surveys of the region in the past half century.

Etymology. The epithet is based on the Latin *hirsutus* (hairy) with reference to its rough, hairy skin. Vernacular name: Spotted Handfish (Yearsley *et al.*, 2006, Last *et al.*, 2007).

FIGURE 8. *Brachionichthys australis*, lateral view of: A. CSIRO H 4451–02, holotype, 45.9 mm SL; and B. composite illustration by R. Swainston.

Comparisons. *Brachionichthys hirsutus* can be distinguished from *B. australis* based on its colour pattern which is more densely spotted, particularly on the caudal fin, and usually lacks thin longitudinal yellowish streaks. It also has typically shorter fins (illicium length 19–20% vs. 23–28% SL; 42–44% vs. 49–57% of head length; length of second dorsal-fin spine 0.7–1.0 vs. 1.1–1.4 times length of longest ray of second dorsal fin), a smaller eye (diameter mainly exceeding 5.4, rather than less than 5.4, in head), more second dorsal-fin rays (17–19 mainly 18 vs. 16–18, mainly 17) with a longer dorsal-fin base (61–64% vs. 55–61% SL).

Remarks. The conservation biology and population status of this species have been discussed in some detail (Green & Bruce, 1998; Bruce *et al.*, 1998, 1999; Last *et al.*, 2007). Museum data indicates that *B. hirsutus* was probably reasonably common in Great Oyster Bay before the First World War. Similarly, handfishes taken by early French explorers suggest that *B. hirsutus* was likely to be abundant in the D'Entrecasteaux Channel in the early 19th C. Periodic sightings throughout the 20th C indicate that these populations remained viable up until at least the mid 1980s. Dredges are very efficient in catching small, slow-moving benthic fishes, such as adult handfishes, and can impact on breeding populations by damaging critical spawning substrate (see Bruce *et al.*, 1998, 1999). These areas were subjected to aggressive harvesting of the commercial scallop (*Pecten fumatus*), from the 1960s through to the 1980s, using dredges (Dix, 1982), and *B. hirsutus* has not been collected in either area since (apart from North West Bay, near the Derwent Estuary mouth) despite several scallop surveys and special requests to fishers to report sightings. The likely extirpation of *B. hirsutus* from these regions flags the need for strong management approaches to be put in place to conserve the remaining populations.

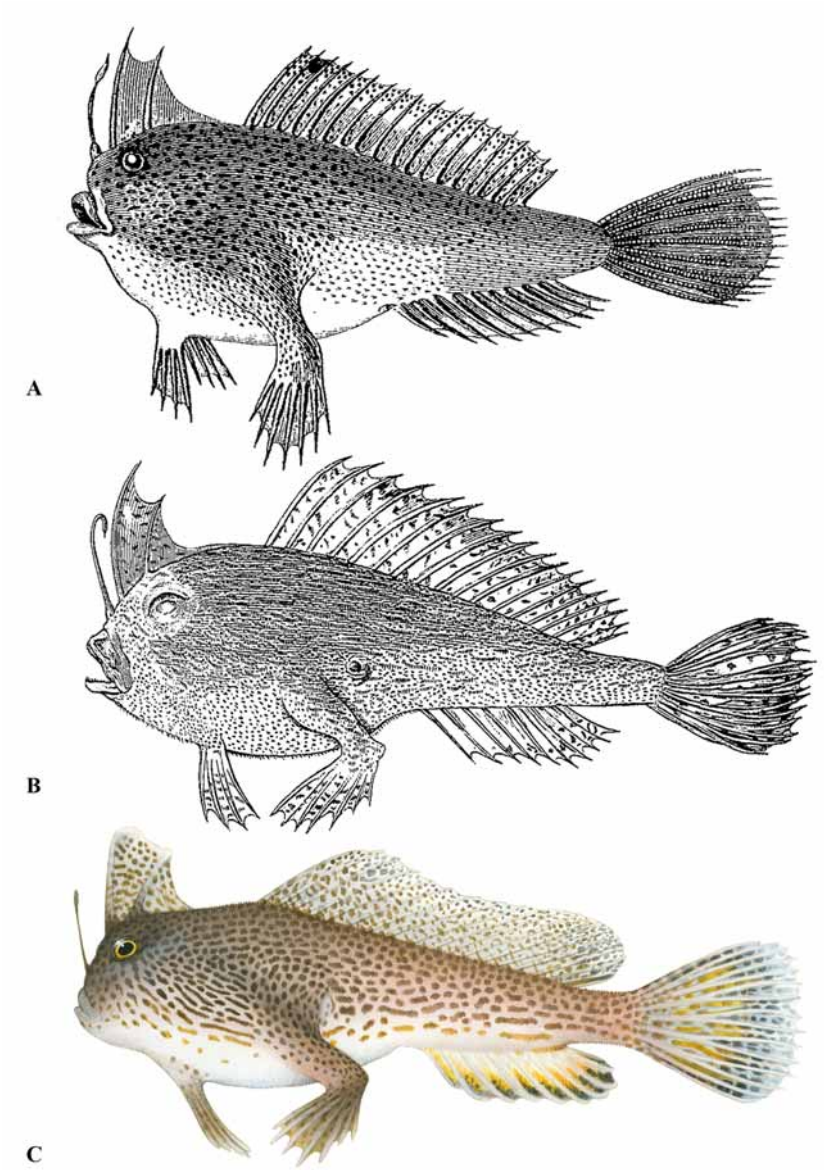


FIGURE 9. Illustrations of Brachionichthys hirsutus: A. lectotype MNHN A 4627, 78.7 mm SL, figured as le Lophie hérissé (reproduced from Lacepède 1804, pl. 55, fig. 3, image reversed); B. lectotype MNHN A 4627, figured as Chironectes punctatus (reproduced from Cuvier 1817, pl. 18, fig. 2); and C. composite illustration by R. Swainston.

***Brachiopsilus* gen. nov.**

Type species: *Brachiopsilus ziebelli* **sp. nov.**, by original designation.

Definition. Members of the genus *Brachiopsilus* are unique among brachionichthyids in having the following combination of features: body relatively deep, 31–43% SL at second dorsal-fin origin; head robust, suboval to slightly compressed in cross section, large, 47–58% SL; caudal peduncle very short, 1–5% SL; illicium short to long and slender (2.2–3.6 in head length), 3–5 times length of esca; skin thick, surface smooth or covered with low, cutaneous ridges, but lacking enlarged, fleshy, wart-like protuberances; no surface scales or protruding spinules apart from sensory scales (deeply embedded scale fragments sometimes present); dermal appendages absent; either body or fins brightly coloured or with a strongly speckled pattern; pectoral-fin rays 9–10 (mainly 9); anal-fin rays 9–10; vertebrae 22–25 (mainly 23 or 24).

Etymology. Combination of the Latin *brachium* (arm) and Greek *psilos* (bare or smooth) in allusion to the smooth surfaces of their body and arm-like pectoral fins.

Species. Presently contains three valid nominal species: *Brachiopsilus ziebelli* **sp. nov.**, *B. dianthus* **sp. nov.** and *B. dossenus* **sp. nov.** Another form provisionally placed within *B. ziebelli* needs further investigation to determine its validity.

Remarks. *Brachiopsilus* is unique among handfishes in having thick, smooth skin lacking warty protuberances (unlike *Thymichthys*), protruding spinules (unlike *Brachionichthys*, *Pezichthys*, and *Sympterichthys*), and dermal appendages. Deeply embedded scale fragments are sometimes present but these are difficult to find without transmitted light and microscopic magnification. Species of *Brachiopsilus* are high count forms with the highest pectoral-fin counts (i.e. 9–10, only *Thymichthys* and *Sympterichthys* have 9 or more), vertebral counts (i.e. shares usually 23 or more with *Brachionichthys* vs. generally 20–23 in other genera), and second dorsal-fin (i.e. shares usually 17–19 with *Brachionichthys* vs. generally 17 or fewer in the other genera) and anal-fin (i.e. 9–10 vs. 8–11 in *Brachionichthys*, 7–9 in *Pezichthys* and *Sympterichthys*) ray counts. Two of the three species are the largest and most robust of all extant handfishes (reaching at least 117 mm SL vs. about 100 mm in *Brachionichthys*, 46 mm in *Pezichthys*, 45 mm in *Sympterichthys*, and 90 mm SL in *Thymichthys*). Members of this genus are confined to southern Victoria and Tasmania.

Key to species of *Brachiopsilus*

1. Illicium thick and fleshy, length 18–24% SL, 1.2–1.4 in length of second dorsal-fin spine; eye small, horizontal diameter 5–6% SL; first dorsal-fin base length 21–25% SL; second dorsal-fin base length 63–70% SL; length of anal-fin base 34–38% SL; dorsal-fin edges usually vivid yellow..... *Brachiopsilus ziebelli* **sp. nov.**
Illicium relatively thin, length 13–16% SL, 2.0–2.3 in length of second dorsal-fin spine; horizontal diameter of eye 6–9% SL; first dorsal-fin base length 26–30% SL; second dorsal-fin base length 73–79% SL; length of anal-fin base 38–44% SL; fins whitish or pinkish, without vivid yellow edges 2

2. Body pinkish red; with illicium adpressed, apex of esca above posterior half of eye; esca much wider than illicial stem; eye of moderate size, horizontal diameter 6–7% SL; second dorsal-fin base 73–76% SL; length of second dorsal-fin spine 1.3–1.5 times length of longest ray of second dorsal fin; length of anal-fin base 38–39% SL; caudal-fin length 3.2–4.0 times caudal peduncle depth..... *Brachiopsilus dianthus* **sp. nov.**
Body whitish with yellow patches; with illicium adpressed, apex of esca above anterior half of eye; esca slightly wider than illicial stem; eye relatively larger, horizontal diameter 7–9% SL; second dorsal-fin base 77–79% SL;

length of second dorsal-fin spine 1.1–1.2 times length of longest ray of second dorsal fin; length of anal-fin base 40–44% SL; caudal-fin length 4.1–5.2 times caudal peduncle depth ..... *Brachiopsilus dossenus* **sp. nov.**

***Brachiopsilus dianthus* sp. nov.**

Figs 2, 3, 6, 10, 11; Tables 1, 7–10

Holotype. CSIRO H 4995–01, 99.5 mm SL, Tasman Peninsula, Tasmania, ca. 43° 13'S, 147° 57'E, 38 m, Feb. 1999.

Paratypes. 3 specimens (69–90 mm SL): CSIRO A 1901, 68.5 mm SL, mouth of Huon River, D'Entrecasteaux Channel, Tasmania, ca. 43° 20'S, 147° 08'E, 4 Feb. 1958; TMH D 123, 2 specimens, 79.7 and 90.4 mm SL, off Dennes Point, D'Entrecasteaux Channel, Tasmania, 43° 03'S, 147° 21'E, 1 Apr. 1947.

Diagnosis. Member of the genus *Brachiopsilus* with a combination of the following characters: esca of medium size, 29–38% of illicium length; illicium smooth, thin, not exceedingly fleshy, length 15–16% SL, 3–3.5 times in head length, 2.0–2.3 times in length of second dorsal-fin spine; with illicium adpressed, apex of esca situated above posterior half of eye; esca much wider than illicial stem, covered with dense, short, filaments; head slightly compressed; moderate-sized eye (horizontal diameter 6–7% SL); mouth narrow; lips fleshy with irregular folds; body and fins entirely naked in adults (except for scales associated with pores of the acoustico-lateralis system); 5 sensory pores above eye; long first dorsal-fin base (length 26–30% SL); second dorsal-fin rays 17–18, fin base 73–76% SL; length of second dorsal-fin spine 1.3–1.5 times length of longest ray of second dorsal fin; 9–10 anal-fin rays, length of anal-fin base 38–39% SL; 9–10 pectoral-fin rays; very short caudal peduncle (length 1–2% SL); caudal fin of medium size, its length much longer than fin rays of pectoral fin, length 3.2–4.0 times caudal peduncle depth; body pinkish red, darker reddish brown markings along dorsal fin margins remnant in preservative.

Description. D1 2 (2, n=3 paratypes); D2 18 (17–18); A 10 (9–10); Pc 9 (9–10); Pv i, 4 (i, 4); C 1 (1) + 6 (6–7) + 2 (2) = 9 (9–10); Vt 11 (10–11) + 13 (12–13) = 24 (22–24).

Body moderately elongate, slightly compressed anteriorly (more so in paratypes), not bulbous; upper anterior profile strongly convex, well elevated before second dorsal fin; upper margin of eye well below dorsal margin of head, well above level of illicial base; head oval when viewed anteriorly; nape humped prominently; anterior ventral profile weakly convex, much less so than dorsal profile; abdomen little expanded; caudal peduncle short, length 2 (1–2)% SL. Head length 47 (51–55)% SL; snout short, length 6.1 (5.7–7.3) times in head; eye of moderate size, lateral, somewhat embedded, diameter 8.1 (7.7–8.8) times in head length; gill opening small, aperture slightly larger than pupil, located adjacent and directly posterior of insertion of pectoral fin. Nostrils enlarged to greatly enlarged, openings usually obvious; anterior opening close to upper jaw; posterior opening expanded, posterodorsal to anterior opening, relatively well separated from orbit, its upper edge above mid orbit. Mouth narrow, terminal, moderately protrusible; upper jaw weakly oblique, 4.3 (4.0–4.3) in head; lips fleshy, densely covered with papillose longitudinal folds; angle of jaw deeply recessed into groove (less so on smallest paratype), positioned below anterior half of eye; jaws connected by a membrane about a third of their length from angle; tongue broadly rounded apically. Teeth dense, villiform, in subcrescentic bands, similar in shape and size in both jaws; bands narrow anteriorly (3–5 teeth wide in smallest paratype, but not in defined rows), becoming narrower posteriorly (terminating in a single row), extending barely half way to angle of jaw; vomer edentate.

TABLE 1. Morphometric data for the holotype (CSIRO H 4995–01) and paratypes of *Brachiopsilus dianthus* **sp. nov.**, and the holotype (NMV A 29405–002) and paratypes of *B. dossenus* **sp. nov.** Standard and total lengths are recorded in mm, other values expressed as percentages of standard length.

	B. dianthus					*B. dossenus*				
	Holotype	Paratypes (n=3)				Holotype	Paratypes (n=2)			
		Mean	Min	Max	S.D.		Mean	Min	Max	S.D.
Standard length (mm)	99.5	79.5	68.5	90.4	11.0	65.0	53.4	52.4	54.4	1.4
Total length (mm)	136.0	107.5	94.0	118.8	12.6	89.1	76.0	73.9	78.2	3.0
First dorsal-fin base length	25.8	29.3	28.5	30.2	0.9	29.7	28.9	28.6	29.3	0.4
Second dorsal-fin base length	74.9	74.7	73.3	75.6	1.2	76.8	78.1	77.5	78.8	0.9
Distance from snout to second dorsal-fin origin	31.7	33.1	31.1	34.5	1.8	36.3	35.1	34.3	35.8	1.1
Anal-fin base length	38.8	38.0	38.0	38.0	0.1	41.2	42.0	40.4	43.7	2.3
Distance from snout to anal-fin origin	68.8	63.9	61.1	66.4	2.7	55.4	58.0	56.7	59.3	1.8
Head length	47.1	53.7	51.1	55.4	2.3	47.8	49.9	49.4	50.3	0.7
Pectoral-fin length	24.9	28.3	26.2	30.6	2.2	25.2	28.3	26.8	29.7	2.0
Pelvic-fin length	21.2	19.6	16.6	21.3	2.6	20.3	20.1	19.5	20.6	0.8
Body depth (at origin of anal fin)	23.3	22.9	21.6	24.8	1.7	22.5	21.5	20.0	22.9	2.0
Body depth (at origin of second dorsal fin)	38.2	36.3	34.8	37.5	1.4	38.0	38.8	38.6	39.0	0.3
Maximum body width	37.0	31.8	29.5	34.0	3.2	31.0	31.3	30.0	32.7	1.9
Eye (horizontal diameter)	5.8	6.6	6.2	7.1	0.4	7.1	8.1	7.7	8.6	0.6
Snout length	7.7	8.4	7.5	8.9	0.7	7.5	8.8	8.7	8.8	0.1
Interorbital width	8.4	8.1	6.9	9.3	1.2	8.6	9.9	9.7	10.1	0.3
Maxillary length	11.0	13.2	12.9	13.7	0.5	11.7	12.9	12.8	12.9	0.1
Illicium length	15.9	15.4	14.7	16.0	0.6	13.2	15.5	15.0	16.0	0.7
Esca length	5.1	5.0	4.7	5.6	0.5	3.1	4.1	3.8	4.5	0.6
Length of second dorsal-fin spine	31.7	34.2	31.7	35.6	2.2	-	33.9	33.8	34.0	0.2
Length of third dorsal-fin spine	24.3	27.2	24.7	30.1	2.7	24.2	29.1	29.1	29.1	0.1
Interdorsal distance*	22.4	22.6	21.2	23.7	1.3	22.4	22.8	21.8	23.9	1.5
Length of longest second dorsal-fin ray	24.1	25.0	23.8	26.9	1.7	24.4	30.1	28.8	31.4	1.9
Caudal peduncle length	1.8	1.6	0.8	2.1	0.7	1.5	1.7	1.7	1.7	-
Caudal peduncle depth	10.5	9.7	9.4	10.0	0.3	8.9	9.1	8.4	9.9	1.1
Caudal-fin length	36.7	35.5	31.3	37.9	3.6	37.0	42.3	40.8	43.8	2.1
Interpelvic distance	6.9	11.0	9.5	14.0	2.6	9.7	10.2	8.8	11.6	2.0
Pre-illicial distance	1.7	1.6	1.0	2.7	0.9	1.9	1.0	0.0	2.0	-

*Distance from the base of the third dorsal-fin spine to the origin of the second dorsal fin.

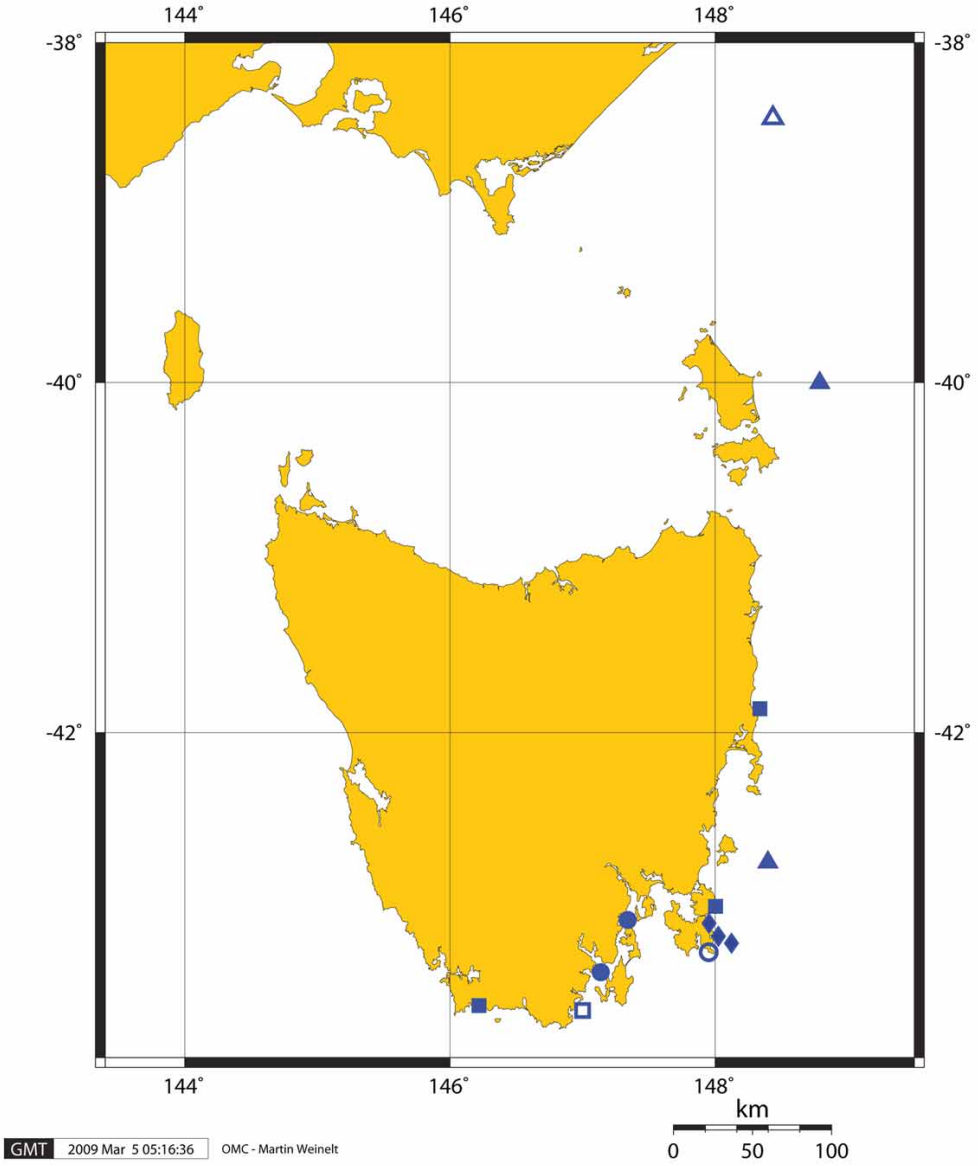


FIGURE 10. Collection localities for: A. *Brachiopsilus dianthus* **sp. nov.**, holotype (○) and paratypes (●); B. *B. dossenus* **sp. nov.**, holotype (△) and paratypes (▲); C. *B. ziebelli* **sp. nov.**, holotype (□), paratypes and other typical specimens (■); and D. *B. ziebelli* **sp. nov.**, Loney's morph (◆). Locations are approximate, and may represent multiple records.

Skin thick, highly mobile, uniformly naked on body and fins; no embedded scales or spinules evident in skin (apart from scales associated with sensory pores); skin lacking wart-like patches in holotype (smallest paratype with patches of indistinct warts on tail), instead smooth or heavily wrinkled, no specimens bloated; no obvious dermal flap present on mid-arm of pectoral-fin; dermal flaps absent from body. Illicium with covering of thick, smooth skin; skin not papillose, forming a narrow, pouch-like cover around supporting ray, almost uniform in width along length of illicium. Acoustico-lateralis system well developed; scales bicuspid; spinules elevated, evident without staining, spine apices overlain with subtriangular integument; sensory scales variably separated, more evenly spaced on tail, 5 above eye; sensory canals indistinct; canals demarcated by scales on head, prominent around mouth, side of head, forehead, and on tail; lateral line extending from above eye horizontally along middle of tail to basal caudal-fin rays.

Illicium moderately elongate, terminal on snout, not asparagus-shaped, 3.0 (3.5) times in head, 2.0 (2.2–2.3) times in length of second dorsal-fin spine; apex of esca extending to base of third dorsal-fin spine when

fin depressed; partly retractable into distinct groove on either side of first dorsal fin; esca enlarged slightly to bulbous, densely covered with small filaments, 3.1 (2.6–3.4) times in length of illicium, emanating from a much narrower stem; illicial base enlarged slightly in holotype (less so in paratypes). First dorsal fin well developed, tall, base elongate; spines thickened slightly, second dorsal-fin spine almost confluent with base of illicium, much longer than third spine; fin membrane thickened slightly, not expanded over basal rays; membrane usually connected to second dorsal fin by low membranous ridge; anterior rays of both fins weakly recurved; first dorsal-fin base 2.9 (2.5–2.6) times in second dorsal-fin base. Second dorsal fin well elevated, not incised; rays simple; fin base very elongate, 75 (73–76) % SL; longest ray 1.3 (1.3–1.5) times in longest dorsal-fin spine; basal membrane not thickened, partly concealing bases of fin rays. Anal-fin margin weakly incised, rays elongate, penultimate posterior rays longest; anal-fin base fleshy, 1.9 (1.9–2.0) times in second dorsal-fin base. Pectoral fin elongate, enlarged, prominently arm-like, elbow extending well beyond gill opening; arm of holotype broadly connected to side of body by skin restricting extension anteriorly; fin rays weakly digitiform, membranes weakly incised, tips short, flexible, narrowly triangular. Pelvic fin moderately well developed; rays narrow, moderately incised; anterior spine short, indistinct; all rays embedded in thick skin; fin located on ventral surface, directed posterolaterally, base aligned horizontally; interpelvic space variable, narrow in holotype (broader in most paratypes), almost flat. Caudal fin moderate in size, its length much longer than fin rays of pectoral fin; length 3.5 (3.2–4.0) times caudal peduncle depth; margin broadly rounded.

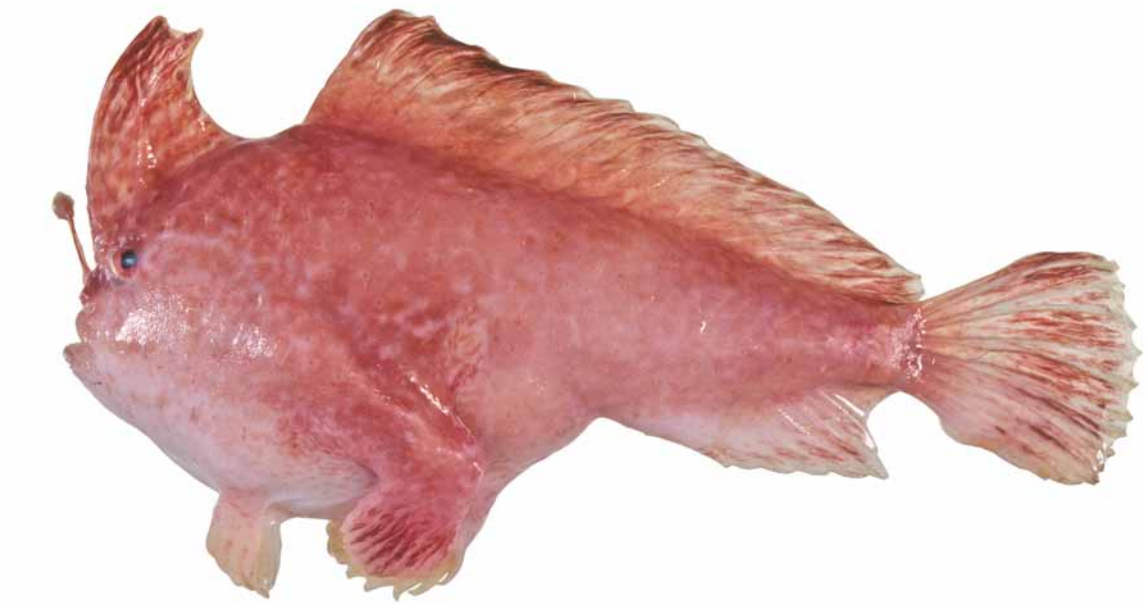


FIGURE 11. *Brachiopsilus dianthus* **sp. nov.**, lateral view of CSIRO H 4995–01, holotype, 99.5 mm SL.

Coloration. In life (based on the holotype and only specimen for which the coloration has been observed): body with reddish and pink blotches dorsally and on head; pink on chin and belly; dorsal fins similar to upper body coloration, fin margins reddish brown; rayed portion of pectoral fin, and caudal and anal fins paler with reddish brown marks on fin membranes; pelvic fin and illicium pinkish; eyes bluish black.

In preservative: Plain whitish, yellowish greenish or pink; dark streaks evident along margins of dorsal fins and on membranes of caudal and pectoral fins in holotype; dark markings on dorsal and caudal fins persistent in all paratypes.

Size. Attains at least 99.5 mm SL (ca. 136 mm TL); smallest specimen examined 68.5 mm SL. Size at maturity, newly hatched young and egg capsule diameter unknown.

Distribution. Demersal, recorded from southeastern Tasmania, from the Tasman Peninsula and the northern and central waters of the D'Entrecasteaux Channel. Bathymetric data only recorded for the holotype, collected at 38 m depth.

Etymology. Epithet based on the New Latin *dianthus* (carnation, pink) in allusion to its striking body coloration. Proposed vernacular name: Pink Handfish.

Comparisons. This species is compared with the two other new *Brachiopsilus* species in the following treatments of those species.

Remarks. This is a surprisingly poorly known species that occurs within scuba diving limits. Possibly a conservation concern as few specimens have either been caught or observed despite considerable activity by commercial, recreational and scientific interests across its defined geographic range. Any specimens observed should, if possible, be photographed *in situ* and the sighting reported to a local research agency.

***Brachiopsilus dossenus* sp. nov.**
Figs 2, 3, 10, 12; Tables 1, 7–10

Holotype. NMV A 29405–002, 65.0 mm SL, off Marlo, Bass Strait, Victoria, 38° 27'S, 148° 26'E, 226 m, 10 Sep. 1984.

Paratypes. 2 specimens (52–54 mm SL): CSIRO H 4119–02, 54.4 mm SL, east of Maria Island, Tasmania, 42° 43'S, 148° 24'E, 87–152 m, 5 Nov. 1984; CSIRO T 195, 52.4 mm SL, east of Flinders Island, Tasmania, 40° 00'S, 148° 47'E, 20 m, 13 Apr. 1984.

FIGURE 12. *Brachiopsilus dossenus* **sp. nov.**, lateral view of NMV A 29405–002, holotype, 65.0 mm SL, preserved.

Diagnosis. Member of the genus *Brachiopsilus* with a combination of the following characters: esca small, 23–30% of illicium length; illicium smooth, thin, not exceedingly fleshy, length 13–16% SL, 3.1–3.6 times in head length, 2.1–2.3 times in length of second dorsal-fin spine; apex of esca situated above anterior half of eye when illicium adpressed; esca slightly wider than illicial stem, covered with dense, short, filaments; head slightly compressed; eye large (horizontal diameter 7–9% SL); mouth narrow; lips fleshy with prominent vertical folds; body and fins entirely naked (except for scales associated with pores of the acoustico-lateralis system and minute, deeply embedded scale and spinule fragments); long first dorsal-fin base (length 29–30% SL); second dorsal-fin rays 17, fin base 77–79% SL; length of second dorsal-fin spine 1.1–1.2 times length of longest ray of second dorsal fin; 10 anal-fin rays, length of anal-fin base 40–44% SL; 9 pectoral-fin rays; caudal peduncle short, length about 2% SL; caudal fin elongate, its length much longer than fin rays of pectoral fin, length 4.1–5.2 times caudal peduncle depth; body colour off white with yellowish patches on sides, uniformly white in preservative.

Description. D1 2 (2, n=2 paratypes); D2 17 (17); A 10 (10); Pc 9 (9); Pv i, 4 (i, 4); C 1 (1) + 6 (5–6) + 2 (2–3) = 9 (9); Vt 9 (9–10) + 13 (13–14) = 22 (23).

Body elongate, moderately compressed anteriorly, not bulbous; upper anterior profile strongly convex, blunt, almost truncate anteriorly; upper eye slightly below anterodorsal margin; all of eye above level of illicial base; head subtriangular to dome-shaped when viewed anteriorly; nape humped prominently; anterior ventral profile almost straight to pelvic fin; abdomen not expanded; caudal peduncle short, length 2 (0–2)% SL. Head length 48 (49–50)% SL; snout short, 6.4 (5.7) times in head; eye medium-sized, lateral, not embedded or protruding, 6.7 (5.8–6.6) times in head length; gill opening small, aperture slightly smaller than pupil, located adjacent and directly posterior to insertion of pectoral fin. Nostrils enlarged, openings usually obvious; anterior opening tubular, almost abutting upper jaw; posterior opening not expanded, almost dorsal to anterior opening, close to orbit, upper edge just below level of mid orbit. Mouth very narrow, terminal, moderately protrusible; upper jaw almost horizontal, 4.1 (3.8–3.9) in head; lips fleshy, densely covered with papillose folds; angle of jaw recessed into groove, situated below hind margin of eye; jaws connected by narrow membrane at about a third of their length from angle; tongue broadly rounded apically. Teeth small villiform to subconical, similar in shape and size in both jaws; in bands, moderately broad anteriorly (4–6 teeth wide in holotype, but not in defined rows), becoming narrower posteriorly, extending almost to angle of jaw in paratype CSIRO H 4119–02; vomer edentate.

Skin thickened, flabby in paratypes, surface uniformly naked (apart from scales associated with sensory pores) on body and fins; minute, deeply embedded scale and spinule fragments evident under skin of semi-translucent paratype CSIRO H 4119–02; skin without wart-like patches, instead smooth or with low dermal ridges (appearing as wrinkles); dermal ridges mostly arranged horizontally on dorsal surface and tail, mostly vertically on sides of head; no obvious dermal flap present on mid-arm of pectoral fin; dermal flaps absent from body. Illicium with covering of thin, smooth skin; skin not papillose nor forming a loose covering around supporting ray; stem almost uniform in width along length of illicium. Acoustico-lateralis system well developed; scales bicuspid; spinules strongly elevated, evident without staining, spine apices overlain with papillose integument; sensory scales separated more or less evenly on tail; sensory scales highly prominent around mouth, on side of head and forehead (4 above eye), and on tail; sensory canals barely detectable; lateral line raised slightly over pectoral-fin base, extending along middle of tail to basal caudal rays.

Illicium relatively short, terminal on snout, 3.6 (3.1–3.4) times in head, (2.1–2.3) times in length of second dorsal-fin spine; apex of esca extending to just above eye when fin depressed; partly retractable into distinct groove on either side of first dorsal fin; esca small, sparsely covered with short globular filaments, 4.2 (3.3–4.3) times in length of illicium, emanating from a narrower stem; illicial base not enlarged. First dorsal fin low, base moderately elongate; spines thickened slightly; second dorsal-fin spine (damaged in holotype) distinctly separate from base of illicium, longer than third spine; fin membrane thickened, expanded over bases of spines; membrane weakly connected by fleshy ridge or separated slightly from second dorsal fin; anterior elements of both fins very strongly recurved; first dorsal-fin base 2.6 (2.7) times in second dorsal-fin base. Second dorsal fin not well elevated, nor incised; rays simple; fin base very elongate, 77 (78–79)% SL; longest ray of second dorsal fin 1.1–1.2 times in longest dorsal-fin spine; basal membrane thickened, concealing bases of fin rays. Anal-fin margin weakly incised, rays moderately elongate, penultimate posterior rays longest; anal-fin base covered with well-developed membrane, 1.9 (1.8–1.9) times in second dorsal-fin base. Pectoral fin very elongate, enlarged, prominently arm-like, elbow extending well beyond gill opening, arm broadly connected to side of body by skin restricting extension anteriorly; fin rays slender, membranes deeply incised, tips long, flexible. Pelvic fin moderately well developed; rays narrow, deeply incised; anterior spine short, indistinct; rays not deeply embedded; fin located on ventral surface, directed ventrolaterally, base aligned horizontally, extended below ventral profile; interpelvic space narrow, almost flat. Caudal fin elongate, margin narrowly rounded; much larger than rayed portion of pectoral fin, length 4.1 (4.1–5.2) times caudal peduncle depth.

Coloration. In life (based on the holotype and only specimen for which the coloration has been observed): Reported by collector Peter Moulton as being ‘off white with light yellow patches on sides’.

In preservative: Uniformly plain white; fins and body semi-translucent in paratype CSIRO H 4119–02; eye bluish black.

Size. Attains at least 65.0 mm SL; smallest specimen examined 52.4 mm SL (ca. 89 mm TL). Size of newly hatched young and egg capsule diameter unknown.

Distribution. Demersal, recorded from off Marlo, Victoria (ca. 38° 27'S, 148° 26'E), and Flinders Island, Tasmania, in eastern Bass Strait (ca. 40° 00'S, 148° 47'E); and from off Maria Island, eastern Tasmania (ca. 42° 43'S, 148° 24'E). Collected at depths of 20–226 m.

Etymology. Epithet based on the Latin *dossenus* (humpback or hunchback) in reference to the pronounced fleshy hump on its back between the snout and second dorsal fin. Proposed vernacular name: Humpback Handfish.

Comparisons. The two species, *Brachiopsilus dossenus* and *B. dianthus*, differ from each other in coloration, and in some meristic and morphometric characters. The only colour details for *B. dossenus* indicate that it is whitish with yellowish markings on the sides whereas *B. dianthus* is almost uniformly bright pink with a dark margin on the second dorsal fin. As its name implies, the nape of *B. dossenus* is strongly humped in all specimens. A similar-sized individual of *B. dianthus* (CSIRO A 1901, 68 mm SL), while possibly affected by preservation, is more compressed, has a much longer snout, smaller eye and shorter fin bases than the *B. dossenus* types. The following proportions can be used to distinguish available specimens of these species: total length 137–144 vs. 131–138% SL in *B. dianthus*, esca length 3.1–4.5 vs. 4.7–5.6% SL, second dorsal-fin base 77–79 vs. 73–76% SL, distance from snout to second dorsal-fin origin 34–36 vs. 31–35% SL, length of anal-fin base 40–44 vs. 38–39% SL, distance from snout to anal-fin origin 55–59 vs. 61–69% SL, body depth (at origin of second dorsal fin) 38–39 vs. 35–38% SL, eye (horizontal diameter) 7.1–8.6 vs. 5.8–7.1% SL; and esca length 23–30 vs. 29–38 times illicium length, head length 5.8–6.7 vs. 7.7–8.8 times eye length, longest dorsal-fin spine 1.1–1.2 vs. 1.3–1.5 times longest ray of second dorsal fin, and caudal-fin length 4.1–5.2 vs. 3.3–4.0 times caudal peduncle depth. *Brachiopsilus dossenus* has 9 (rather than mainly 10) pectoral-fin rays, 10 (rather than 9–10) anal-fin rays, 17 (rather than 17–18) dorsal-fin rays, and 13–14 (rather than 12–13) caudal vertebrae.

Remarks. A paratype of *Brachiopsilus dossenus* (CSIRO H 4119–01) was collected on station 168 of FRV *Soela* voyage 05/1984, on November 4th, 1984, along with a specimen of *Thymichthys verrucosus* (CSIRO H 4119–02). It was fortuitously caught off Maria Island, eastern Tasmania, on the final station of a four week research voyage using a midwater trawl at 88–153 m, over an average bottom depth of 480 m; three handfish specimens (two above and a third unlocated) were caught (based on a detailed catch composition list) when the net grounded near the shelf break. The survey, which included sampling with a benthic sled and numerous demersal trawl stations, yielded only one other handfish specimen (paratype of *Pezichthys eltanini* **sp. nov.**, NMV A 4282), but no other handfishes were recorded. The continental shelf and slope of southeastern Australia has been sampled on numerous occasions with benthic sleds and trawl nets. The incidental catch of three rarely caught fishes in a wayward pelagic trawl reflects the patchy distribution of handfishes.

***Brachiopsilus ziebelli* sp. nov.**

Figs 2, 3, 6, 10, 13; Tables 2, 7–10

Brachionichthys sp. 1: Edgar, Last & Wells, 1982: 38, fig. 23 [Ziebell's morph].
Brachionichthys sp. 2: Edgar, Last & Wells, 1982: 38, fig. 24 [Loney's morph].
Brachionichthys sp. 1: Last, Scott & Talbot, 1983: 251–252, fig. 22.3.
Sympterichthys sp.: Anonymous, 2005: 2.

Holotype. CSIRO T 1993–01, 101.5 mm SL, Actaeon Islands, D'Entrecasteaux Channel, Tasmania, ca. 43° 32'S, 147° 00'E, 12 m, 22 Apr. 1980.

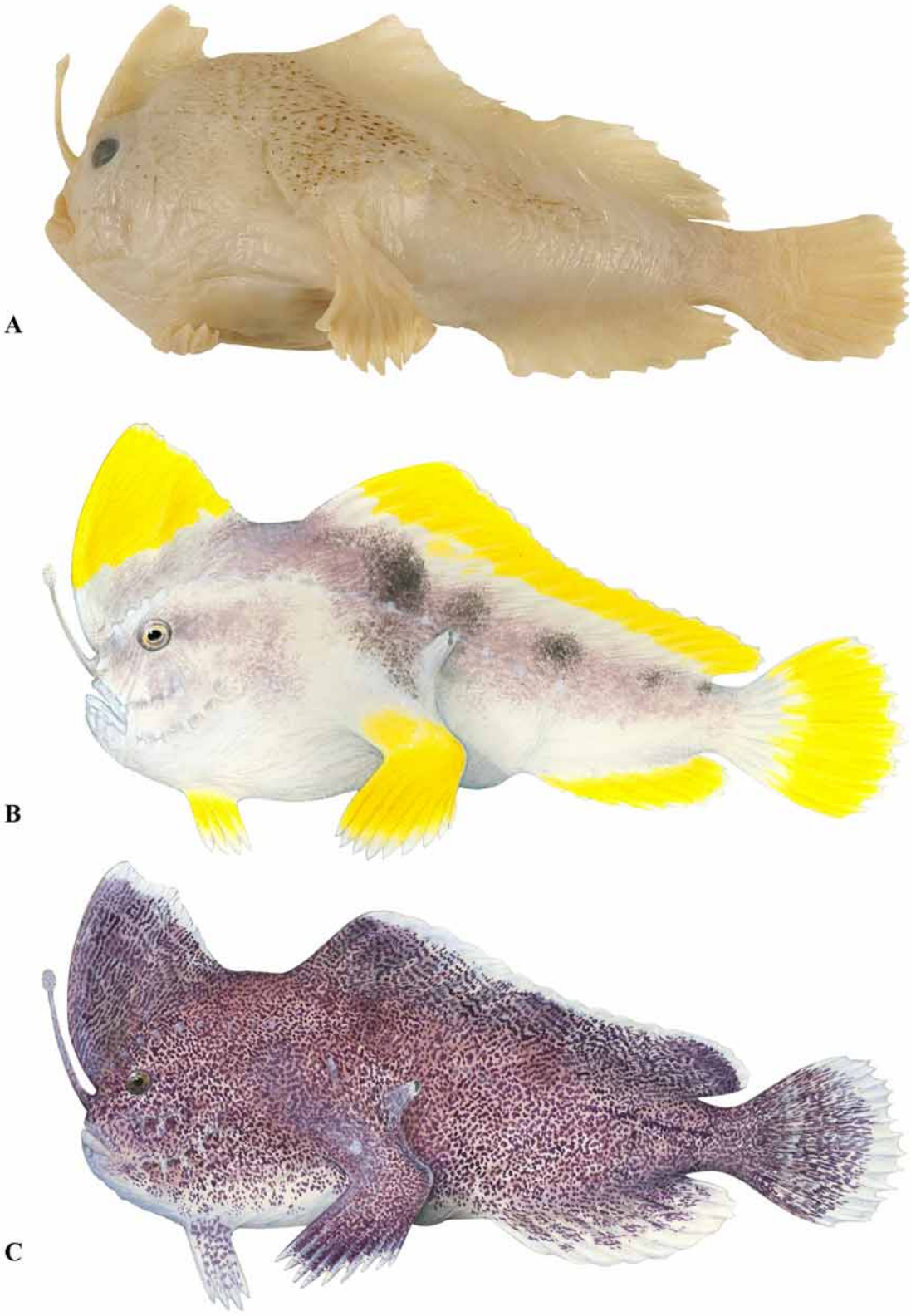


FIGURE 13. *Brachiopsilus ziebelli* **sp. nov.**, lateral view of: A. CSIRO T 1993–01, holotype, 101.5 mm SL, preserved; and composite illustrations of B. typical form and C. Loney's form by R. Swainston.

Paratypes. 10 specimens (42–117 mm SL): CSIRO H 4116–01, 94.4 mm SL, Actaeon Islands, D'Entrecasteaux Channel, Tasmania, ca. 43° 32'S, 147° 00'E, 10 m, 1985; CSIRO H 6821–01, 42.6 mm, off Forestier Peninsula, Tasmania, ca. 42° 58'S, 148° 00'E, 20 m, 18 Mar. 2003; CSIRO T 6, 95.4 mm SL,

Actaeon Islands, D'Entrecasteaux Channel, Tasmania, ca. 43° 32'S, 147° 00'E, 15 m, 1 Jul. 1983; CSIRO T 8, 116.8 mm SL, near Southport Island, D'Entrecasteaux Channel, Tasmania, ca. 43° 29'S, 147° 01'E, 15 m, 19 Jun. 1981; CSIRO T 1993–02, two specimens, 86.3 and 104.8 mm SL, same data as holotype; CSIRO T 1994–01, damaged, Actaeon Islands, D'Entrecasteaux Channel, Tasmania, ca. 43° 32'S, 147° 00'E, no other data; CSIRO T 1995–01, 93.1 mm SL, Actaeon Islands, D'Entrecasteaux Channel, Tasmania, ca. 43° 32'S, 147° 00'E, 15 m, Apr. 1980; QVMT 2009.5.3, 102.3 mm SL, Cox Bight, Tasmania, ca. 43° 31'S, 146° 13'E, no other data; TMH D 738, 89.1 mm SL, Recherche Bay, D'Entrecasteaux Channel, Tasmania, ca. 43° 33'S, 146° 45'E, 12 m, 15 Nov. 1965.

TABLE 2. Morphometric data for the holotype (CSIRO T 1993–01) and paratypes of *Brachiopsilus ziebelli* **sp. nov.**, and additional specimens of Loney's morph. Standard and total lengths are recorded in mm, other values expressed as percentages of standard length.

	B. ziebelli								
	Holotype	Paratypes (n=6)				Loney's morph (n=3)			
		Mean	Min	Max	S.D.	Mean	Min	Max	S.D.
Standard length (mm)	101.5	90.1	42.6	116.8	25.3	104.0	95.3	112.0	8.4
Total length (mm)	134.4	118.1	59.2	150.7	31.7	133.5	132.1	135.2	1.6
First dorsal-fin base length	23.4	22.7	21.1	24.7	1.4	25.3	23.2	28.2	2.6
Second dorsal-fin base length	63.8	66.1	63.0	70.4	2.7	70.0	66.4	73.7	3.7
Distance from snout to second dorsal-fin origin	34.4	35.1	33.2	40.5	2.7	38.9	38.5	39.5	0.6
Anal-fin base length	33.9	37.1	35.2	37.9	1.0	37.0	36.1	38.7	1.5
Distance from snout to anal-fin origin	63.1	62.7	60.5	63.4	1.1	62.0	60.5	62.9	1.3
Head length	57.1	53.9	50.7	57.1	2.4	56.2	54.7	58.2	1.8
Pectoral-fin length	25.7	26.1	23.5	28.3	2.0	28.8	27.5	30.9	1.8
Pelvic-fin length	19.1	21.1	19.1	23.7	1.9	20.7	17.7	22.8	2.6
Body depth (at origin of anal fin)	22.8	23.5	22.6	24.7	0.8	20.6	18.3	23.1	2.4
Body depth (at origin of second dorsal fin)	38.8	37.5	31.4	40.3	3.3	40.4	36.6	42.5	3.2
Maximum body width	36.1	30.7	28.7	35.0	2.6	32.6	27.8	38.5	5.4
Eye (horizontal diameter)	5.0	5.3	4.6	6.0	0.6	5.2	5.0	5.6	0.4
Snout length	8.6	8.4	7.6	8.9	0.5	9.6	9.2	9.8	0.3
Interorbital width	7.8	7.9	6.9	8.8	0.8	8.9	8.0	9.7	0.9
Maxillary length	13.1	13.9	11.1	16.0	1.7	14.7	13.8	15.9	1.1
Illicium length	19.2	19.8	18.0	23.8	2.1	23.6	22.1	25.0	2.1
Esca length	5.0	5.4	4.2	6.3	0.9	5.0	5.0	5.1	0.1
Length of second dorsal-fin spine	23.1	25.0	22.0	30.8	3.3	30.4	29.3	32.1	1.5
Length of third dorsal-fin spine	20.5	18.2	16.0	21.7	2.3	25.0	22.6	27.5	2.4
Interdorsal distance*	24.2	22.9	21.7	24.2	0.9	23.0	20.3	25.5	2.6
Length of longest second dorsal-fin ray	23.7	24.6	21.6	27.5	2.2	27.5	25.2	29.1	2.0
Caudal peduncle length	4.5	3.3	2.3	5.3	1.3	2.8	1.9	4.0	1.1
Caudal peduncle depth	11.0	10.6	9.8	11.6	0.6	11.0	10.2	12.3	1.1
Caudal-fin length	32.4	31.5	28.5	37.5	3.3	33.5	32.1	35.2	1.6
Interpelvic distance	11.0	10.7	9.8	12.7	1.1	11.3	9.6	12.8	1.6
Pre-illicial distance	1.9	1.9	0.4	4.6	1.4	41.9	37.9	45.8	5.6

*Distance from the base of the third dorsal-fin spine to the origin of the second dorsal fin.

Additional material. 3 specimens (95–112 mm SL). CSIRO H 669–01, 95.3 mm SL, north of Fortescue Bay, Tasman Peninsula, Tasmania, ca. 43° 05'S, 147° 58'E, 10 m, Oct. 1986; CSIRO H 4117–01, 104.6 mm SL, off Cape Hauy, Tasman Peninsula, Tasmania, ca. 43° 09'S, 148° 01'E, 16 m, 21 Sep. 1985; CSIRO T 1996–01, 112.0 mm SL, Waterfall Bay, Tasman Peninsula, Tasmania, ca. 43° 04'S, 147° 57'E, 10 m, May 1983.

Diagnosis. Member of the genus *Brachiopsilus* with a combination of the following characters: esca small, 19–32% of illicium length; illicium thick, fleshy, length 18–24% SL, 2.4–3.0 times in head length, 1.2–1.4 times in length of second dorsal-fin spine; apex of esca situated well posterior of hind margin of eye when illicium adpressed; esca slightly wider than illicial stem, covered with dense, short papillae; head bulbous; eye small (horizontal diameter 5–6% SL); mouth broad; lips very fleshy with vertical folds; body and fins entirely naked in adults (except for scales associated with pores of the acoustico-lateralis system); 4 sensory pores above eye; short first dorsal-fin base (length 21–25% SL); second dorsal-fin rays 16–18, length of fin base 63–70% SL; length of second dorsal-fin spine 0.8–1.2 times length of longest ray of second dorsal fin; 9–10 anal-fin rays, length of anal-fin base 34–38% SL; 9 pectoral-fin rays; short caudal peduncle (length 2–5% SL); caudal fin small, its length barely longer than fin rays of pectoral fin, length 2.7–3.4 times caudal peduncle depth; body whitish with fine, greyish purple peppering; fins vivid yellow.

Description. D1 2 (2, n=10 paratypes); D2 17 (16–18, n=9); A 9 (9–10, n=9); Pc 9 (9, n=10); Pv i, 4 (i, 4, n=8); C 1 (1) + 6 (5–6) + 2 (2–3) = 9 (9, n=9); Vt 10 (9–11, mainly 10) + 13 (13–14) = 23 (22–25, mainly 23, n=9).

Body moderately short, robust anteriorly, bulbous, suboval in cross section (paratype CSIRO T 8 laterally flattened due to preservation); upper anterior profile strongly convex, not truncate before second dorsal fin; upper margin of eye well below dorsal margin of head, just above level of illicial base; head subcircular when viewed anteriorly; nape humped prominently; anterior ventral profile weakly convex; abdomen sometimes expanded slightly; caudal peduncle short, length 4 (2–5)% SL. Head length 57 (51–57)% SL; snout short, 6.6 (6.1–6.7) times in head; eye very small, lateral, somewhat embedded, 11.5 (8.6–12.3) times in head length; gill opening small, aperture subequal to pupil, located posterodorsal to and well away from insertion of pectoral fin. Nostrils relatively small, openings obvious; anterior opening close to mouth; posterior opening small, almost posterodorsal to anterior opening, very well separated from orbit, situated slightly below level of mid eye. Mouth broad, terminal, slightly protrusible; upper jaw short, oblique to subhorizontal, 4.4 (3.5–4.7) in head; lips appearing fleshy, covered with dense arrangement of deep, longitudinal folds; angle of jaw not deeply recessed into groove, situated below anterior half of eye; tongue narrowly rounded apically. Teeth dense, villiform, similar in shape and size in both jaws; in bands, broad, irregular anteriorly (5–7 teeth wide, but not in rows), becoming narrower posteriorly, extending almost to angle of jaw; vomer edentate.

Skin thick, very flabby, uniformly naked (apart from sensory pores) on body and fins; no scales or spinules embedded in skin of adults; skin lacking wart-like patches, instead usually heavily wrinkled, some specimens heavily bloated with smooth skin (probably from osmotic effects during preservation); no obvious dermal flap present on mid-arm of pectoral-fin; dermal flaps absent from body. Illicium covered with thick, wrinkled or papillose skin; skin forming a broad, pouch-like covering, much broader near its base. Acoustico-lateralis system variably developed; scales bicuspid; spinules barely detectable without staining, spine apices overlain with broad, lobe-like integument (often elevated well above surrounding skin); sensory scales variably separated, more evenly spaced on tail; sensory canals obvious to indistinct, demarcated by surface lines and papillae; canals usually arranged in very obvious series on head, particularly around mouth and on forehead, usually less obvious on tail; 4 sensory pores above eye; sometimes as well-defined line extending from above eye horizontally to gill opening, descending abruptly then continuing along middle of tail to basal caudal rays.

Illicium long, terminal on snout, vaguely asparagus-shaped, 3.0 (2.4–2.9) times in head, 1.2 (1.2–1.4) times in length of second dorsal-fin spine; apex of esca well posterior of base of third dorsal-fin spine when fin depressed; partly retractable into distinct groove on either side of first dorsal fin; esca small, narrow, densely covered with small papillae, 3.9 (3.1–4.3 in adults; 5.4 in juvenile paratype, CSIRO H 6821–01) times

in length of illicium, emanating from a slightly narrower, tubular stem; illicial base slightly bulbous. First dorsal fin well developed, base moderate, not connected to second dorsal fin; spines thickened, second dorsal-fin spine almost confluent with base of illicium, much longer than third spine; fin membrane greatly thickened, fleshy, not expanded over spine bases; membrane variably extended onto nape, terminating slightly posterior to apex of erect third dorsal-fin spine; anterior elements of both fins weakly recurved; first dorsal-fin base 2.7 (2.6–3.3) times in second dorsal-fin base. Second dorsal fin elevated, incised slightly, anterior and penultimate posterior rays longest; rays usually simple (4th and 7th last rays of holotype branched to their mid-points); fin base elongate, 64 (63–70)% SL; longest ray of second dorsal fin 1.0 (0.8–1.2) times in longest dorsal-fin spine; basal membrane relatively thick, sometimes concealing bases of fin rays. Anal-fin margin weakly incised, rays elongate, penultimate posterior rays longest; anal-fin base fleshy, 1.9 (1.7–1.9) times in second dorsal-fin base. Pectoral fin elongate, enlarged, prominently arm-like, elbow extending well beyond gill opening; fin rays broadly digitiform, membranes deeply and uniformly incised, tips flexible, broadly triangular. Pelvic fin well developed; rays broad, weakly incised; anterior spine short, distinct; all rays embedded in thick skin; fin located on ventral surface, directed laterally, base aligned horizontally; interpelvic space broad, almost flat. Caudal fin small, margin narrowly rounded; barely larger than rayed portion of pectoral fin, length 2.9 (2.7–3.4) times caudal peduncle depth.

Coloration. In life: Body pale with variable covering of greyish pink flecks on back, along upper tail, and on head behind eyes; fins brilliant yellow, coverage variable, usually over most of dorsal, caudal, pectoral and pelvic fins, usually present on anal fin, sometimes extending beyond fin bases onto body.

In preservative: Yellowish markings lost and dark markings less distinct, body often almost uniformly white.

Size. Attains at least 116.8 mm SL (ca. 151 mm TL); smallest specimen examined 42.6 mm SL. Paratype CSIRO T 1993–02 (104.8 mm SL) is gravid, capsule diameter of ca. 1.9 mm. Newly hatched young unknown.

Distribution. Restricted to eastern and southern Tasmania in widely disjunct populations; in the southern parts of the D'Entrecasteaux Channel (ca. 43° 30'S, 147° 03'E), Cox Bight, south-west Tasmania (ca. 43° 31'S, 146° 13'E), and the Forestier and Tasman Peninsulas (ca. 43° S, 148° E). Also photographed by scuba divers *in situ* off Bicheno, eastern Tasmania. Demersal in about 10–20 m depth.

Etymology. Named in honour of Alan Ziebell, a professional diver, who hand collected some of the first specimens near the Actaeon Islands (D'Entrecasteaux Channel) when fishing for abalone. These specimens were initially displayed in a marine aquarium at his home and later donated to us for research. Proposed vernacular name: Ziebell's Handfish.

Comparisons. Differs from other large handfish occurring off southern Tasmania, *Brachiopsilus dianthus,* in coloration and morphometrics, and is slightly different in meristics. *Brachiopsilus ziebelli* has a shorter first dorsal-fin base (length 21–25 vs. 26–30% SL in *B. dianthus*), second dorsal-fin base (length 63–70 vs. 73–76% SL), anal-fin base (length 34–38 vs. 38–39% SL), a smaller eye (horizontal diameter 4.6–6.0 vs. 5.8–7.1% SL), and shorter first dorsal-fin spines (second spine 22–31 vs. 32–36% SL; third spine 16–22 vs. 24–30% SL). However, the illicium (length 18–24 vs. 15–16% SL) and caudal peduncle (length 2.3–5.3 vs. 0.8–2.1% SL) are both longer in *B. ziebelli*. These differences are reflected in the following non-standard ratios: head length 2.4–3.0 vs. 3.0–3.5 times illicium length; second dorsal-fin spine 1.2–1.4 vs. 2.0–2.3 times illicium length; longest dorsal-fin spine 0.8–1.2 vs. 1.3–1.5 times longest ray of second dorsal fin; second dorsal-fin base 1.7–1.9 vs. 1.9–2.0 times anal-fin base length; head length 8.6–12 vs. 7.7–8.8 times eye diameter; and illicium length 34–43 vs. 28–34% of head length. *Brachiopsilus ziebelli* is primarily whitish (purplish in Loney's form) with yellowish fins whereas the only fresh specimen of *B. dianthus* was almost uniformly pink. Both species are high count forms with similar second dorsal and anal-fin counts but differ slightly in pectoral-fin ray counts (9, n=22 including both fins of each specimen vs. 9–10, mean 9.6, n=8 in *B. dianthus*) and caudal vertebral counts (13–14, mean 13.3, n=10 vs. 12–13, mean 12.8, n=4).

Brachiopsilus ziebelli differs from *B. dossenus* mainly in body shape and morphometrics. Available specimens of *B. ziebelli* are typically much larger (86–112 mm SL) than the *B. dossenus* types (52–65 mm SL). However, a small paratype of B. *ziebelli* (CSIRO H 6821–01, 43 mm SL) closely resembles the adult in

body shape being much more elongate with a dorsal profile that is not strongly humped as in *B. dossenus*. The two species differ in several body proportions that do not appear to be size related: snout to anal-fin origin (61–63 vs. 55–59% SL in *B. dossenus*), head length (51–57 vs. 48–50% SL), interorbital width (6.9–8.8 vs. 8.6–10% SL), illicium length (18–24 vs. 13–16% SL), caudal-fin length (29–38 vs. 37–44% SL); caudal peduncle length (2.3–5.3 vs. 1.5–1.7% SL) and depth (9.8–12 vs. 8.4–9.9% SL), total length (129–139 vs. 137–144% SL), first dorsal-fin base (length 21–25 vs. 29–30% SL), second dorsal-fin base (length 63–70 vs. 77–79% SL), anal-fin base (length 34–38 vs. 40–44% SL), eye (horizontal diameter 4.6–6.0 vs. 7.1–8.6% SL), length of second dorsal-fin spine (22–31 vs. about 34% SL), and length of third dorsal-fin spine (16–22 vs. 24–29% SL); and non-standard ratios including head length 8.6–12 vs. 5.8–6.7 times eye length and 2.4–3.0 vs. 3.1–3.6 times illicium length, second dorsal-fin spine 1.2–1.4 vs. 2.1–2.3 times illicium length, caudal-fin length 2.7–3.4 vs. 4.1–5.2 times caudal peduncle depth, and illicium length 34–43 vs. 28–32% head length.

Remarks. In 1980, the first photographs of this species alive were taken *in situ* in the Derwent Estuary (figured in Edgar *et al.*, 1982, p. 39 as *Brachionichthys* sp. 1) of a relocated specimen collected earlier by abalone diver, Alan Ziebell, near the Actaeon Islands (D'Entrecasteaux Channel, Tasmania). This specimen, having a pale body, purplish patches dorsally, and striking, yellow-edged fins, typifies the Ziebell's colour morph. In 1981, a local underwater photographer, Ian Loney, captured an image of a large, densely mottled, purplish handfish at Waterfall Bay (Tasman Peninsula) at about 10 m depth – this form has been subsequently referred to as Loney's Handfish (figured in Edgar *et al.*, 1982, p. 39 as *Brachionichthys* sp. 2). Occasional specimens of this colour morph have been taken and/or observed by divers in recent decades at the Tasman Peninsula. These forms, which are similar morphologically, differ mainly in colour but there are subtle variations within and between forms. Collection material of the typical Ziebell's morph tend to have flabby skin (firmer in preserved specimens of Loney's morph) and the dark body and yellow fin markings are no longer evident (i.e. now uniformly white whereas the purplish coloration is retained by the Loney's morph) – these differences may be artefacts of preservation. Similarly, some type specimens of *B. ziebelli* kept for several weeks in aquaria before fixation had apparently metabolized some axial musculature before death biasing their morphometrics. A compressed body was rarely evident in undamaged specimens (e.g. CSIRO T 8).

These forms have been regarded as separate species (Edgar *et al*., 1982) or variants (Last *et al.*, 1983) but given their morphological similarity and the presence of specimens off Tasman Peninsula with a colour pattern intermediate between the forms (i.e. a mottled purplish body with yellowish fin tips), this needs to be substantiated. In the past two years, as part of a larger project to investigate conservation issues in handfishes, CSIRO biologist, Mark Green, has searched without luck for additional material of both forms to obtain tissues for molecular analysis. Given these uncertainties, Loney's morph has been provisionally assigned to *B. ziebelli* pending further investigation. As such, specimens of Loney's morph were omitted from the type series.

Only one juvenile specimen of *B. ziebelli* (CSIRO H 6821–01) is known. It was collected by a scuba diver off Tasman Peninsula (southeastern Tasmania) after it had been sequentially ingested and regurgitated by two Butterfly Perch (*Caesioperca lepidoptera*). This handfish was initially mottled purplish grey on the body and the margins of at least the dorsal fins were yellowish (M. Baron, pers. comm.). It also resembles adult *B. ziebelli* in general morphology and most counts but, unlike them, it has long dermal filaments over its body and fins and a light scattering of minute, embedded, unicuspid and bicuspid spinules that are visible only under high magnification and good lighting. Spinules are densest on the head. Also, the skin is very thin and partly sloughed off, presumably through damage from its encounter with the Butterfly Perch.

The regurgitation of the young handfish by two serranids is interesting as these fish might produce toxins to deter predators. One of the paratypes (CSIRO T 1994–01), while being held in a small bucket of seawater awaiting transfer to an aquarium, was caught by the householder's cat and most of its tail (about 5 grams) eaten. The cat, which reportedly became sleepy, coughed, vomited and then suffered paralysis of its hind legs, finally suffered respiratory failure and died within 1.5 hours. There are observations in the literature that

suggest frogfishes (Antennariidae) may be toxic but these have been guardedly rejected by Pietsch & Grobecker (1987). We know of no other confirmed reports of toxicity of the flesh of lophiiform fishes.

Pezichthys gen. nov.

Type species. *Pezichthys amplispinus* **sp. nov.** (by original designation)

Definition. *Pezichthys* is unique among brachionichthyids in having the following combination of features: body depth relatively deep, 32–48% SL at second dorsal-fin origin; head variably compressed and large, length 49–55% SL; caudal peduncle short to long, 4–11% SL; illicium short and stout to very slender and long (1.9–3.5 in head length), 1–9 times length of esca; skin surface very rough, almost completely covered with small spiny scales; spinules mainly bifurcate, upright, originating near middle of scale bases; scale bases stellate or subcircular, and embedded but spinules divided well above skin surface; dermal appendages present or absent (usually confined to arm of pectoral-fin); lacking wart-like protuberances; sensory scales variably demarcated; body coloration simple, with fine markings or with a floral pattern; pectoral-fin rays 7; anal-fin rays 7–9 (mainly 8); vertebrae 20–22.

Etymology. A combination of the Greek *pezo* (walking) and *ichthys* (fish) in allusion to the ability of these fishes to walk on the sea floor using their hand-like pelvic fins and arm-like pectoral fins.

Species. A variable group needing further resolution and presently consisting of five new species: *Pezichthys amplispinus* **sp. nov.**, *P. compressus* **sp. nov.**, *P. eltanini* **sp. nov.**, *P. macropinnis* **sp. nov.**, and *P. nigrocilium* **sp. nov.**

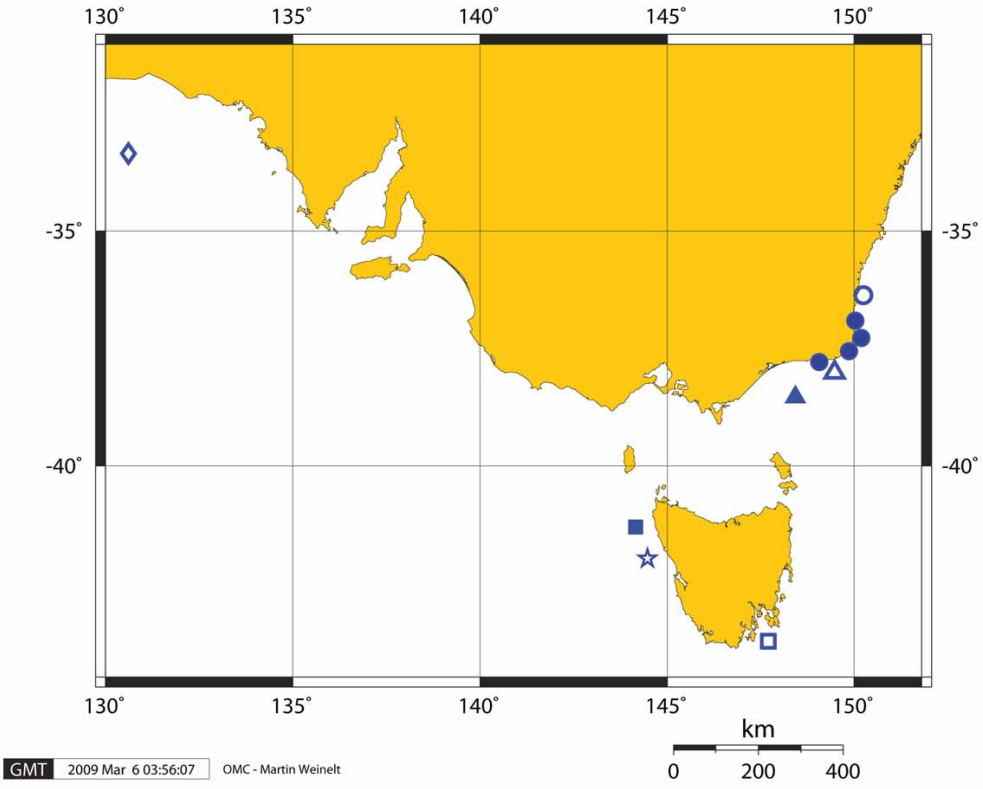


FIGURE 14. Collection localities for: A. *Pezichthys amplispinus* **sp. nov.**, holotype (○) and paratypes (●); B. *P. compressus* **sp. nov.**, holotype (△) and paratype (▲); C. *P. eltanini* **sp. nov.**, holotype (□) and paratype (■); D. *P. macropinnis* **sp. nov.**, holotype (◇); and E. *P. nigrocilium* **sp. nov.**, holotype (☆). Locations are approximate, and may represent multiple records.

Remarks. This possibly polyphyletic group contains a mixed suite of variably shaped species. They are unique within handfishes in having a dense coverage of upright, bifurcate (and monospinulate in *Pezichthys nigrocilium*) spinules that originate near the centre of their scale bases and divide external to the skin surface. Species of *Thymichthys* also have a dense coverage of spiny scales but their spinules are more adpressed and originate from the posterior edges of their scale bases. *Pezichthys* scale bases are usually shallowly embedded and have either stellate or subcircular bases rather than deeply embedded and irregular bases as in *Thymichthys* and *Sympterichthys*. The spinules of *Brachionichthys* originate from the centre of each scale but are monospinulate. *Pezichthys* is also the only group apart from *Brachionichthys* whose members all have 7 pectoral-fin rays. Most of the species are plain coloured or with only a few linear markings (except *P. amplispinus* which has a complex but variable floral pattern). The form of the illicium, and the extent to which the sensory pores are defined and the dermal appendages are developed, vary greatly between species.

Key to species of *Pezichthys*

1. Illicium very elongate, length about 26% SL, 1.9 times in head length; esca very small, about 12% of illicium length; fin elements very elongate, longest ray of second dorsal fin about 35% SL; body pale with a network of reddish streaks ..... *Pezichthys macropinnis* **sp. nov.**
Illicium relatively short, length 15–23% SL, 2.4–3.5 times in head length; esca small to large, 19–82% of illicium length (about 11% SL in *P. nigrocilium*); fin elements much shorter, longest ray of second dorsal fin 16–25% SL; body coloration not as above 2

2. Esca small, 11–21% of illicium length; scale bases subcircular 3
Esca large or very large, 35–82% of illicium length; scale bases stellate 4

3. Illicium length about 2.5 in head length; esca 19–21% of illicium length; eye 7–8.5% SL; head length 5–6 times snout length; coloration strongly variegated, no eyelash-like markings around eye ..... *Pezichthys amplispinus* **sp. nov.**
Illicium length about 3.5 in head length; esca about 11% of illicium length; eye about 10% SL; head length about 9 times snout length; pale pinkish with prominent eyelash-like markings radiating from eye ..... *Pezichthys nigrocilium* **sp. nov.**

4. Esca very large, more than half (54–82%) of illicium length, 11–18% SL; illicium short and stout; eye large, diameter 7.5–9% SL, 6–7 in head length; longest ray of second dorsal-fin 20–22% SL; body depth at origin of second dorsal fin 35–44% SL ..... *Pezichthys eltanini* **sp. nov.**
Esca large, less than half (about 35%) of illicium length, 7–8% SL; illicium slender; eye small, diameter about 6.5% SL, 8–8.5 in head length; longest ray of second dorsal-fin 16–18% SL; body depth at origin of second dorsal fin 47–48% SL ..... *Pezichthys compressus* **sp. nov.**

***Pezichthys amplispinus* sp. nov.**
Figs 2, 3, 14, 15; Tables 3, 7–10

Holotype. CSIRO H 4448–01, 43.8 mm SL, east of Bermagui, New South Wales, 36° 29'S, 150° 12'E, 118–121 m, 1 Dec. 1996.

Paratypes. 6 specimens (30–46 mm SL): CSIRO H 4448–02, 30.1 mm SL, same data as holotype; CSIRO H 4449–01, 45.2 mm SL, east of Bermagui, New South Wales, 36° 22'S, 150° 12'E, 78–84 m, 30 Nov. 1996; CSIRO H 4450–01, 40.5 mm SL, east of Disaster Bay, New South Wales, 37° 19'S, 150° 12'E, 112 m, 2 Dec. 1996; CSIRO H 4459–01, 45.7 mm SL, north-east of Eden, New South Wales, 36° 56'S, 150° 03'E, 74 m, 3 Dec. 1996; CSIRO H 4460–01, 37.2 mm SL, east of Mallacoota, Victoria, 37° 36'S, 149° 52'E, 78–80 m, 27 Nov. 1996; NMV A 29408–001, 36.2 mm SL, off Cape Conran, Bass Strait, Victoria, 38° 00'S, 149° 09'E, 118 m, 22 Sep. 1983.

Diagnosis. Member of the genus *Pezichthys* with a bold colour pattern, long dermal spinules, a humped nape and the posterior extension of the first dorsal-fin membrane is very short (i.e. interdorsal distance long).

It also differs from its congeners in a combination of the following characters: esca small, 19–21% of illicium length; illicium very slender, without dermal spinules, its length 16–20% SL, 2.5–3.1 times in head length in adults; head length 4.9–6.2 times snout length; snout long, length 8–10% SL; eye 6.2–7.7 times in head length; body moderately robust, maximum width 30–38% SL; interorbital width 8–11% SL; scale bases subcircular with relatively long bifurcate spinules (except for those closely associated with pores of the acoustico-lateralis system); spinules variable in length over body; dorsal-fin elements with spinules, membranes of fins mostly naked; first dorsal-fin base length 18–20% SL; second dorsal-fin rays 15–16 (usually 16), fin base 55–63% SL; length of second dorsal-fin spine 1.4–1.9 times length of longest ray of second dorsal fin; anal-fin rays 7–9; upper body variegated, lacking dark spots or streaks; caudal fin not covered with fine spots.

Description. D1 2 (2, n= 6 paratypes); D2 15 (15–16, mainly 16); A 8 (7–9, rarely 7); Pc 7 (7); Pv i, 4 (i, 4); C 1 (1) + 6 (6–7) + 2 (1–2) = 9 (9); Vt 9 (9) + 12 (12) = 21 (21).

Body moderately robust, weakly compressed; upper anterior profile slightly convex, not elevated, dorsal margin of eye well below top of head; not triangular when viewed anteriorly; nape humped slightly; anterior ventral profile strongly convex; abdomen globose; caudal peduncle elongate, length 8.6 (6.8–10.6)% SL. Head length 54 (50–52)% SL; snout short, 6.0 (4.9–6.2) times in head; eye very small, 7.7 (6.2–7.1) times in head length; gill opening small, aperture smaller than pupil, located slightly above and behind insertion of pectoral fin; nostrils very small, openings not protruding; posterior opening posterodorsal to anterior opening, separated slightly from orbit. Mouth small, terminal, moderately protractile; upper jaw oblique, 4.5 (3.6–4.3) in head; upper lip fleshy; lower lip fleshy medially, connected laterally to lower jaw by fleshy dorsoventrally flattened fold; angle of jaw partly recessing into groove, situated below middle of eye; tongue well developed, rounded apically. Teeth minute, villiform, in long broad bands in both jaws; vomer edentate.

Skin rather thick, covered with bifid, spinulose scales; no separate wart-like patches of skin; small dermal flap present on mid-arm of pectoral-fin; flap tentacular, strongly compressed, sub-equal in size to gill opening; several long, delicate, tentacular dermal flaps on body and leading elements of dorsal fins (size and position of flaps variable). Body scales close-set, not arranged in defined rows, distributed over entire body; scale bases embedded but not within raised mound of thickened skin. Spinules relatively long, erect, well exposed, bifurcating well above skin (spines of each spinule subequal to or slightly longer than distance between their tips); connected by integument when undamaged; much smaller on belly, semi-erect; present on orbital membrane; scale bases usually subcircular with weakly irregular margins, their width slightly shorter or subequal to spinule length; spinules arising from near middle of scale base. First dorsal-fin spines and leading ray of second dorsal fin densely covered with small spinulose scales; similar spinules in rows along anterolateral margins of other rays of second dorsal fin; 1–2 rows of small spinules usually on upper surfaces of pectoral, pelvic and caudal-fin rays; anal fin with or without spinulose scales; fin membranes mostly naked. Illicium with thin, naked cutaneous sheath; its base spinulose. Scales of acoustico-lateralis system bicuspid, not particularly obvious from main spinules; scales widely separated and arranged in barely discernable rows; pronounced at chin apex, otherwise indistinct on head.

Illicium terminal on snout, very slender; length 2.5–3.1 times in head, 1.7–2.2 times in length of second dorsal-fin spine; apex of esca just short of, or reaching to, base of third dorsal-fin spine when fin depressed; partly retractable into shallow groove on either side of first dorsal fin; esca small, not bulbous (a small fleshy expansion in holotype but with multiple short filamentous branches in some paratypes), 5–6 times in length of illicium; illicial base bulbous. First dorsal fin rather small; second dorsal-fin spine almost confluent with base of illicium, longer than third spine; fin membrane thick, greatly expanded basally around each spine, posterior extension short; membrane terminating above to just behind level of insertion of pelvic fin; anterior elements of both fins strongly recurved; first dorsal-fin base 2.9 (2.9–3.4) times in second dorsal-fin base. Second dorsal fin low, weakly incised, anterior and penultimate posterior rays longest; rays simple; fin base moderately elongate, 59 (55–63)% SL; longest ray of second dorsal fin 1.5 (1.4–1.9) times in longest dorsal-fin spine; basal membrane relatively thick, concealing bases of all fin rays, covering almost a third of anterior fin rays. Anal fin short, rays fleshy, moderately incised; penultimate posterior rays longest; anal-fin base 2.3

(2.0–2.4) times in second dorsal-fin base. Pectoral fin weakly arm-like, radials moderately elongate, barely extending beyond gill opening; fin rays digitiform, slender, membranes deeply incised, not increasingly so posteriorly, tips flexible, slightly flattened (often recurved distally). Pelvic fin short; rays digitiform, slender, deeply incised; anterior spine short, embedded and indistinct; fin located on ventral surface, usually directed ventrolaterally, base aligned horizontally; interpelvic space broad, almost flat. Caudal fin deep, narrowly rounded; length 3.6 (3.4–4.6) times caudal peduncle depth.

TABLE 3. Morphometric data for the holotype (CSIRO H 4448–01) and paratypes of *Pezichthys amplispinus* **sp. nov.**, and the holotype (CSIRO H 4447–01) and paratype of *P. compressus* **sp. nov.** Standard and total lengths are recorded in mm, other values expressed as percentages of standard length.

	P. amplispinus					*P. compressus*	
	Holotype	Paratypes (n=6)				Holotype	Paratype
		Mean	Min	Max	S.D.		
Standard length (mm)	43.8	39.1	30.1	45.7	5.9	42.4	33.9
Total length (mm)	59.8	52.9	41.1	60.8	7.3	57.8	45.0
First dorsal-fin base length	19.9	18.8	17.6	20.3	1.1	26.0	27.5
Second dorsal-fin base length	58.8	58.9	55.3	62.8	2.4	62.4	57.2
Distance from snout to second dorsal-fin origin	37.2	38.6	35.1	41.7	2.2	39.2	41.0
Anal-fin base length	26.0	26.4	24.9	27.6	1.2	26.6	29.7
Distance from snout to anal-fin origin	68.4	63.9	62.2	65.8	1.6	72.0	64.2
Head length	53.6	50.9	49.9	52.1	0.9	51.9	54.9
Pectoral-fin length	21.7	27.1	22.5	30.0	2.9	24.0	18.8
Pelvic-fin length	26.1	24.2	22.6	27.4	2.1	23.3	23.0
Body depth (at origin of anal fin)	24.4	24.4	22.5	26.2	1.5	25.2	25.6
Body depth (at origin of second dorsal fin)	41.7	35.0	32.4	41.2	3.5	46.7	48.2
Maximum body width	34.4	35.5	29.5	38.4	4.0	31.9	24.9
Eye (horizontal diameter)	7.0	7.8	7.1	8.5	0.4	6.4	6.6
Snout length	8.9	9.0	8.4	10.2	0.8	9.6	10.5
Interorbital width	9.1	9.7	8.1	11.1	1.2	11.5	12.5
Maxillary length	11.9	13.0	11.8	13.9	0.8	14.5	16.2
Illicium length	-	18.6	16.3	19.9	2.0	18.7	22.9
Esca length	-	3.8	3.1	4.2	0.6	6.8	8.0
Length of second dorsal-fin spine	32.1	34.9	33.8	36.2	1.1	24.2	25.8
Length of third dorsal-fin spine	23.7	23.9	19.3	26.3	2.8	16.2	19.1
Interdorsal distance*	25.5	25.5	23.3	27.6	1.6	28.0	29.7
Length of longest second dorsal-fin ray	20.9	20.3	17.2	25.3	4.4	16.2	17.7
Caudal peduncle length	8.6	9.2	6.8	10.6	1.4	3.5	5.9
Caudal peduncle depth	10.1	10.3	9.3	10.9	0.6	11.0	12.0
Caudal-fin length	36.5	40.2	34.7	46.5	4.9	36.5	32.9
Interpelvic distance	15.2	13.5	11.3	16.0	1.6	11.9	10.4
Pre-illicial distance	0.8	0.7	0.2	1.4	0.5	3.6	5.8

*Distance from the base of the third dorsal-fin spine to the origin of the second dorsal fin.

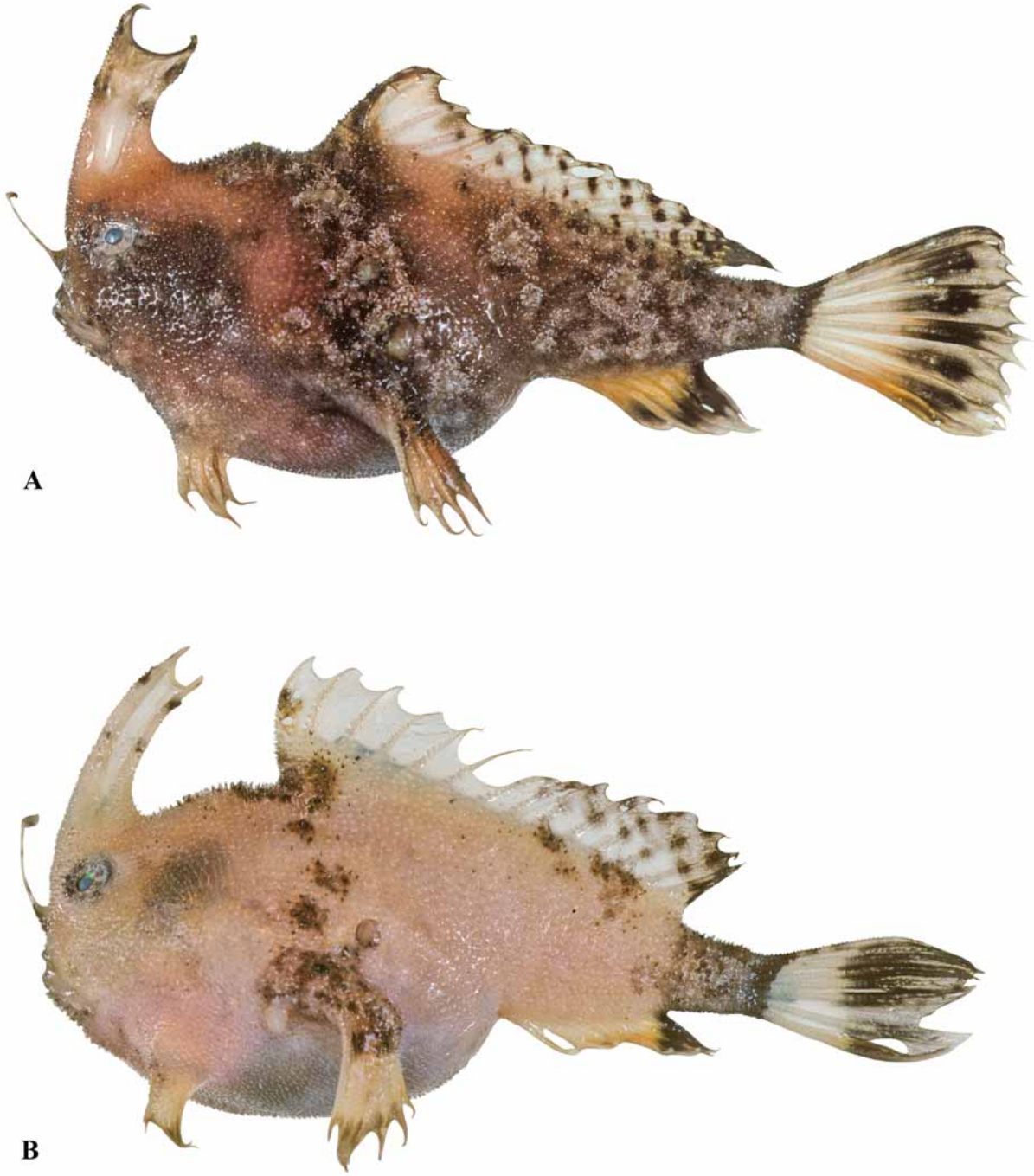


FIGURE 15. *Pezichthys amplispinus* **sp. nov.**, lateral view of: A. CSIRO H 4448–01, holotype, 43.8 mm SL; and B. CSIRO H 4449–01, paratype, 45.2 mm SL.

Coloration. In life: Body of holotype pale brownish pink with lighter and darker floral blotches; broad pale areas over eye (extending from first dorsal-fin base in an arc to pectoral-fin base) and as a saddle below rays 3–5 of second dorsal fin; a large, darker brown blotch on cheek and a broad, diagonal, brown and silvery white band between these pale areas (extending from region of nape and anterior portion of soft dorsal fin); tail with brown and silvery white mottled pattern; eye bluish black; gill opening pale brown, strongly demarcated. Illicium with faint brown and whitish bands. First dorsal fin pink or translucent basally, with darker brownish areas distally (speckled in some paratypes); margin of membrane between rays brownish. Second dorsal fin with 3–4 horizontal rows of small, brownish spots; spots diffuse-edged, situated mainly on fin rays, densest on posterior portion of fin; margin of fin dark. Caudal fin with a narrow, dark, vertical band at

its base, and a submarginal, vertical row of large brownish black botches (centred on fin rays and appearing as a continuous band when fin collapsed); rest of fin translucent pink, basal rays yellowish in holotype only. Anal fin yellowish anteriorly (white in paratypes), with broad diagonal dark bar posteriorly; dark spots confined to posterior third of fin (except in paratype CSIRO H 4448–02). Pectoral arm blotched, similar to dark markings on body; distal portion of fin and pelvic fin yellowish (whitish in paratypes).

In preservative: Body and fin markings faded, brownish and white.

Size. Attains at least 45.7 mm SL (ca. 60 mm TL); smallest specimen examined 30.1 mm SL. Two paratypes (CSIRO H 4460–01, 37.2 mm SL and NMV A 29408–001, 36.2 mm SL) gravid, egg capsule diameter ranges from ca. 1.4–2.0 mm.

Distribution. Demersal, off southeastern Australia; from off Bermagui, southern New South Wales (36° 22′S, 150° 12′E), to off Cape Conran, eastern Bass Strait, Victoria (38° 00′S, 149° 09′E). Collected in depths of 74–121 m.

Etymology. A combination of the Latin *amplus* (large) and *spina* (spine, thorn) in allusion to the dense covering of long dermal spinules over its skin. Proposed vernacular name: Cockatoo Handfish.

Comparisons. Comparisons of this species with other members of the genus are provided in the following treatments.

Remarks. *Pezichthys amplispinus*, which has long, erect dermal spinules and rougher skin than other handfishes, also has an atypically tall, short-based first dorsal fin resembling the crest of a cockatoo. It may have special habitat requirements given its apparent rarity and narrow distributional range. It was only caught in a small area off southeastern Australia despite broad survey coverage across southern Australia using appropriate fishing methods.

***Pezichthys compressus* sp. nov.**
Figs 2, 4, 14, 16; Tables 3, 7–10

Holotype. CSIRO H 4447–01, 42.4 mm SL, south of Cape Everard, Victoria, 37° 58'S, 149° 12'E, 112 m, 13 Dec. 1996.

Paratype. NMV 29409–001, 33.9 mm SL, south-east of Lakes Entrance, Bass Strait, Victoria, 38° 33'S, 148° 24'E, 218 m, 6 Jun. 1984.

Diagnosis. Member of the genus *Pezichthys* with a combination of the following characters: esca large, 35–36% of illicium length; illicium slender, without dermal spinules, its length 19–23% SL, 2.4–2.8 times in head length; head length 5.2–5.4 times snout length; snout short 10–11% SL; eye 8.1–8.3 times in head length; maximum width of body 25–32% SL; interorbital broad, width 12–13% SL; scale bases stellate with short, weakly divergent, bifurcate spinules (except for those closely associated with pores of the acousticolateralis system); dorsal-fin rays and membranes with full or partial coverage of spiny scales; first dorsal-fin base length 26–28% SL; second dorsal-fin rays 14–15, fin base 57–62% SL; length of second dorsal-fin spine 1.5 times length of longest ray of second dorsal fin; anal-fin rays 8–9; body and fins uniform pale pink in life.

Description. D1 2 (2, n=1 paratype); D2 15 (14); A 9 (8); Pc 7 (7); Pv i, 4 (i, 4); C 1 (1) + 6 (5) + 2 (3) = 9 (9); Vt 10 (10) + 11 (11) = 21 (21).

Body short, deep, moderately to strongly compressed; upper anterior profile strongly convex, upright before second dorsal fin; upper margin of eye well below top of head, at level of illicial base; almost oval when viewed anteriorly; nape humped very slightly; anterior ventral profile strongly convex; abdomen expanded; caudal peduncle short, length 3.5 (5.9)% SL. Head length 52 (55)% SL; snout variable in length, 5.4 (5.2) times in head; eye very small, lateral, somewhat embedded, 8.3 (6.9) times in head length; gill opening small, aperture subequal to pupil, located closely adjacent insertion of pectoral fin; nostrils indistinct, overlain with spinules in holotype, enlarged with protruding, tubular anterior opening in paratype; posterior opening almost dorsal to anterior opening, separated slightly from orbit. Mouth small, very narrow, terminal to slightly inferior, weakly protractile; upper jaw strongly oblique, 3.6 (3.4) in head; lips fleshy; angle of jaw

deeply recessed into groove, situated below posterior eye; tongue rounded apically. Teeth minute, villiform, in narrow bands in both jaws; vomer apparently edentate (mouth not dissected - roof covered with long papillae obscuring dentition).

FIGURE 16. *Pezichthys compressus* **sp. nov.**, lateral view of CSIRO H 4447–01, holotype, 42.4 mm SL.

Skin thick, uniformly covered with short, bifid, spinulose scales; no separate wart-like patches of skin; no obvious dermal flap present on mid-arm of pectoral-fin; dermal flaps absent from body. Body scales close-set, distributed over entire body and widely over fins; spinules on body not arranged in defined rows, more or less equidistant from each other; scale bases embedded, not within raised mound of thickened skin. Spinules short, well exposed, bifurcating above skin, apical spines diverging slightly (spines of each spinule subequal to or slightly longer than the distance between their tips), not connected distally by integument; erect on upper surface and tail, mainly directed posteroventrally; those on belly not significantly smaller than those above, semi-erect; scale bases stellate, variable in shape, with strongly irregular margins, their width usually greatly exceeding spinule length; scale base extremities usually blunt; spinules arising from near middle of scale base. Entire surfaces of both dorsal fins (including membranes) and upper surface of pectoral fin covered with spinulose scales; similar spinules in rows along fin rays of other fins. Illicium base spinulose, main stem naked; covering of skin thin. Scales of acoustico-lateralis system bicuspid, well demarcated from main spinules; anterior spine apices overlain with broad, flattened, lobe-like integument; scales widely separated and arranged in indistinct rows; most pronounced around mouth.

Illicium terminal on snout, slender, 2.8 (2.4) times in head, 1.3 (1.1) times in length of second dorsal-fin spine; apex of esca just short of base of third dorsal-fin spine when fin depressed; partly retractable into shallow groove on either side of first dorsal fin; esca moderately large, finely filamentous, about 3 times in length of illicium; filaments consolidated in holotype, free filamentous branches in paratype; illicial base not bulbous. First dorsal fin very small, short; spines close together, second spine almost confluent with base of illicium, longer than third spine; fin membrane extremely thick, fleshy, expanded almost to apex of each spine (second spine barely visible); posterior extension of membrane very short, terminating forward or only slightly behind apex of erect, third dorsal-fin spine; anterior elements of both fins very strongly recurved; first dorsal-fin base 2.4 (2.1) times in second dorsal-fin base. Second dorsal fin very low, weakly incised, anterior and penultimate posterior rays longest; rays simple; fin base elongate, 62 (57) % SL; longest ray of second dorsal fin 1.5 (1.5) times in length of second dorsal-fin spine; basal membrane relatively thick, concealing bases of all fin rays, covering almost three-quarters of anterior fin rays and about half of posterior rays. Anal fin short, base fleshy, margin weakly incised; penultimate posterior rays slightly longer than those anteriorly; anal-fin base 2.3 (1.9) times in second dorsal-fin base. Pectoral fin short, very weakly arm-like, elbow

extending just beyond gill opening; fin rays digitiform, slender, membranes moderately incised, not increasingly so posteriorly, tips flexible, slightly flattened (often recurved distally). Pelvic fin very short, narrow; rays fine digitiform, slender, moderately incised; anterior spine short, embedded and indistinct; fin located on ventral surface, directed ventrally, base aligned horizontally; interpelvic space narrow, convex. Caudal fin small, narrowly rounded; length 3.3 (2.8) times caudal peduncle depth.

Coloration. In life: Uniformly pale pink (fading to white in preservative), no evidence of spots or other markings in types.

Size. Attains at least 42.4 mm SL (ca. 58 mm TL); single paratype 33.9 mm SL. Size of newly hatched young and egg capsule diameter unknown.

Distribution. Demersal off southeastern Australia, known from two specimens, collected from eastern Bass Strait, south of Cape Everard (37° 58'S, 149° 12'E) at 112 m depth, and south-east of Lakes Entrance (38° 33'S, 148° 24'E), Bass Strait, Victoria at ca. 220 m depth.

Etymology. Derived from the Late Latin *compressare* (to press hard) in reference to its laterally flattened body shape. Proposed vernacular name: Narrowbody Handfish.

Comparisons. Differs from similarly sized *P. amplispinus* in having a much deeper (depth at origin of second dorsal fin 47–48 vs. 32–42% SL) and more compressed body shape; a longer first dorsal-fin base (26–28 vs. 18–20% SL), maxilla (length 15–16 vs. 12–14% SL), esca (length 6.8–8.0 vs. 3.1–4.2% SL), distance from base of third dorsal-fin spine to origin of second dorsal fin (28–30 vs. 23–28% SL) and pre-illicial distance 3.6–5.8 vs. 0.2–1.4% SL; a wider interorbit (width 12–13 vs. 8.1–11% SL); deeper caudal peduncle (11–12 vs. 9.3–11% SL); relatively larger esca (35–36 vs. 19–21% of illicium length); a narrower eye (horizontal diameter 6.4–6.6 vs. 7.0–8.5% SL); shorter caudal peduncle (length 3.5–5.9 vs. 6.8–11% SL); and shorter second (length 24–26 vs. 32–36% SL) and third dorsal-fin spines (length 16–19 vs. 19–26% SL). It also differs in the following ratios: head 8.1–8.3 vs. 6.2–7.7 times eye length; second dorsal fin spine 1.1–1.3 vs. 1.7–2.2 times illicium length; illicium 2.7–2.9 vs. 4.7–5.3 times esca length; length of second dorsal-fin base 2.1–2.4 vs. 2.9–3.4 times first dorsal-fin base; caudal-fin length 2.8–3.3 vs. 3.5–4.6 times caudal peduncle depth. *Pezichthys compressus* also has a much plainer coloration (almost plain vs. strong pattern of bars and mottling). It belongs to a subgroup of *Pezichthys* that also contains *P. eltanini*. These species have a large esca (exceeding a third of illicial length) and scales with stellate bases.

Remarks. Known from only two specimens collected off southeastern Victoria. The geographic and depth ranges for this species overlap with other handfishes in an area that has been subjected to substantial commercial fishing and research surveys (Smith & Wayte, 2002). The lack of material collected possibly reflects a scarce and patchy distribution, rather than biases due to sampling methods. While nothing is known of the breeding ecology, or the preferred habitat of *Pezichthys compressus*, it is likely that the prolonged trawl and dredge effort in this area has impacted on the distribution and abundance of this species.

***Pezichthys eltanini* sp. nov.**
Figs 2, 4, 14, 17; Tables 4, 7–10

Holotype. LACM 11516–1, 30.0 mm SL, ca. 40 km east of Bruny Island, southeastern Tasmania, 43° 26'S, 147° 52'E, ca. 135 m, 5 Jul. 1968.

Paratype. NMV A 4282, 36.1 mm SL, possibly off Temma, northwestern Tasmania, 41° 14'S, 144° 06'E, 520 m, 19 Oct. 1984.

Diagnosis. Member of the genus *Pezichthys* with a combination of the following characters: esca very large, 54–82% of illicium length; illicium short, stout, with or without dermal spinules, its length 21–22% SL, 2.4–2.6 times in head length; head length 5.4–5.5 times snout length; snout length about 10% SL; eye diameter 6.1–7.0 times in head length; maximum width of body 31–39% SL; interorbital broad, width 12–15% SL; scale bases stellate with short bicuspid spinules (except for those closely associated with pores of the acoustico-lateralis system); dorsal-fin elements and membranes with full or partial coverage of spiny scales;

first dorsal-fin base long, length 25–30% SL; second dorsal-fin rays 15–16, fin base 62–63% SL; length of second dorsal-fin spine 0.9–1.5 times length of longest ray of second dorsal fin; anal-fin rays 7–8; body and fins uniformly white.

TABLE 4. Morphometric data for the holotype (LACM 11516–1) and paratype of *Pezichthys eltanini* **sp. nov.**, the holotype (CSIRO H 5317–02) of *P. macropinnis* **sp. nov.**, and the holotype (CSIRO H 6154–01) of *P. nigrocilium* **sp. nov.** Standard and total lengths are recorded in mm, other values expressed as percentages of standard length.

	P. eltanini		*P. macropinnis*	*P. nigrocilium*
	Holotype	Paratype	Holotype	Holotype
Standard length (mm)	30.0	36.1	20.5	40.8
Total length (mm)	41.6	47.9	28.8	54.0
First dorsal-fin base length	25.1	29.9	17.8	14.8
Second dorsal-fin base length	61.5	62.9	62.5	56.5
Distance from snout to second dorsal-fin origin	61.5	39.2	43.2	38.7
Anal-fin base length	25.1	32.8	24.4	21.3
Distance from snout to anal-fin origin	70.5	63.4	66.1	67.9
Head length	55.2	52.7	49.3	54.9
Pectoral-fin length	25.2	22.3	27.4	22.8
Pelvic-fin length	21.8	17.3	15.8	22.7
Body depth (at origin of anal fin)	25.2	21.0	22.9	19.5
Body depth (at origin of second dorsal fin)	44.3	35.2	41.7	39.1
Maximum body width	38.9	30.6	31.5	19.2
Eye (horizontal diameter)	9.1	7.5	7.1	9.9
Snout length	10.3	9.5	9.1	6.1
Interorbital width	15.0	11.6	15.2	4.9
Maxillary length	15.5	15.2	7.6	12.7
Illicium length	20.9	21.6	26.4	15.6
Esca length	11.3	17.8	3.0	1.7
Length of second dorsal-fin spine	28.9	18.8	32.5	26.1
Length of third dorsal-fin spine	14.7	18.2	42.2	16.5
Interdorsal distance*	27.4	27.1	15.2	27.9
Length of longest second dorsal-fin ray	19.4	21.8	35.1	19.2
Caudal peduncle length	3.6	5.1	7.6	8.9
Caudal peduncle depth	13.7	10.5	10.2	10.2
Caudal-fin length	38.7	32.5	40.1	32.5
Interpelvic distance	16.1	8.9	13.7	8.5
Pre-illicial distance	3.6	0.0	5.6	1.5

*Distance from the base of the third dorsal-fin spine to the origin of the second dorsal fin.

Description. D1 2 (2, n=1); D2 15 (16); A 7 (8); Pc 7 (7); Pv i, 4 (I, 4); C 1 (1) + 6 (6) + 2 (2) = 9 (9); Vt 9 (10) + 11 (12) = 20 (22).

Body tadpole-shaped, moderately short (paratype slightly more elongate); bulbous, weakly compressed anteriorly, suboval in cross section; tail compressed; upper anterior profile strongly convex, not abruptly elevated, upper eye well below dorsal margin; suboval when viewed anteriorly; nape very prominently humped (less so in paratype); anterior ventral profile strongly convex (or weakly convex); abdomen not

globose; caudal peduncle short, length 3.6 (5.1)% SL. Head length 55 (53)% SL; snout short, 5.4 (5.5) times in head; eye small, 6.1 (7.0) times in head length; gill opening small, aperture slightly smaller than pupil, located directly above and behind insertion of pectoral fin. Nostrils greatly enlarged (less so in paratype), extending from near upper jaw to level of mid-eye; nasal openings often enlarged, protruding slightly; posterior opening posterodorsal to anterior opening, separated slightly from orbit; openings well separated from each other. Mouth small, terminal, slightly protractile; upper jaw oblique, 3.6 (3.5) in head; lips fleshy, not papillose; angle of jaw partly recessing into groove, situated below anterior margin of eye. Teeth caniniform, recurved, relatively large in holotype; mouth not dissected but teeth apparently in 1–2 rows in lower jaw, in a single row in upper jaw; condition of tongue and vomer not examined.

FIGURE 17. *Pezichthys eltanini* **sp. nov.**, lateral view of LACM 11516–1, holotype, 30.0 mm SL, preserved.

Skin rather thick, covered with small, bifid, spinulose scales; no separate wart-like patches of skin; very small dermal flap present on mid-upper arm of pectoral-fin (absent in paratype); no other obvious dermal flaps on body, distal parts of dorsal-fin spines with very short filaments. Body scales close-set, distributed over entire body; arranged irregularly, or in variably defined, vertical or oblique rows; scale bases embedded slightly, not with raised mound of thickened skin. Spinules mainly upright (slightly more prostrate on belly), very short, well exposed, bifurcating near skin surface; apical spines uniform in size, connected apically by low integument when undamaged, often directed slightly posteriorly; spiny scales around rim of eye; scale bases stellate, their diameter greatly exceeding spinule length; spinules usually arising from near middle of scale base. First dorsal fin almost entirely covered with small spinulose scales; basal half of second dorsal fin deeply embedded in thick fleshy skin, fin almost entirely covered with spiny scales; spinules covering bases of anal, caudal, and pelvic fins; arm of pectoral fin and base of rayed portion spinulose; fin membranes covered with spiny scales often becoming naked distally. Illicium covered with thin skin and scattering of minute spinulose scales (naked in paratype). Scales of acoustico-lateralis system bicuspid; much larger and distinct from main spinules (less obvious in paratype).

Illicium terminal on snout, stout, 2.6 (2.4) times in head, 1.4 (0.9) times in length of first ray of first dorsal fin; apex of esca extending to middle of eye (hind margin in paratype) when illicium depressed; partly recessible into groove on left side of first dorsal fin; esca greatly enlarged, bulbous, 1.8 (1.2) times in length of illicium; esca with multiple, long filamentous branches; illicial base weakly bulbous. First dorsal fin small, firm, not greatly erectile; second dorsal-fin spine almost confluent with base of illicium, longer than third spine; fin membrane thick, greatly expanded basally around each spine, its posterior medial extension short, membrane inserted above pelvic-fin base; anterior rays of both fins strongly recurved; first dorsal-fin base 2.5

(2.1) times in second dorsal-fin base. Second dorsal-fin low, outer membrane weakly incised, notched slightly at about a third of its length, anterior and penultimate posterior rays longest; insertion slightly forward of anal-fin insertion (well forward in paratype); rays simple; fin base elongate, 62 (63)% SL; longest ray of second dorsal fin 1.5 (0.9) times in longest dorsal-fin spine; basal membrane thick, concealing all but apices of fin rays anteriorly, covering basal half of posterior rays. Anal fin moderate in size, rays thickened, moderately incised; penultimate posterior rays longest; anal-fin base covered in fleshy skin, 2.5 (1.9) times in second dorsal-fin base. Pectoral fin weakly arm-like, radials moderately elongate, extending well beyond gill opening; fin rays thickened, digitiform, membranes incised, tips flexible, flattened slightly. Pelvic fin moderate in size; rays thickened, digitiform, incised; anterior spine short, embedded and indistinct; fin located on ventral surface, directed ventrolaterally, base aligned horizontally; interpelvic space moderate, almost flat. Caudal fin slender, almost truncate or broadly rounded; length 2.8 (3.1) times caudal peduncle depth.

Coloration. In preservative: Uniformly pale yellow on the body and fins; evidence of slightly darker markings on the esca, dorsal-fin filaments, upper distal membranes of pectoral and pelvic fins, and the hind membranes of the second dorsal and anal fins; eye blackish. Paratype uniformly white, no evidence of markings.

Size. To at least 36.1 mm SL (ca. 48 mm TL). Size of newly hatched young and egg capsule diameter unknown.

Distribution. Demersal in Tasmanian waters, the holotype was collected from ca. 40 km East of Bruny Island (43° 26'S, 147° 52'E), southeastern Tasmania in about 135 m (as 73–75 fathoms). The paratype was questionably from off Temma (41° 14'S, 144° 06'E), northwestern Tasmania, at 520 m depth, but may have been collected off eastern Tasmania (see below).

Etymology. Named in honour of the Polar Research Vessel FRV *Eltanin*, which was used between 1962 and 1979 to survey Antarctic waters and nearby temperate seas. A deepwater handfish, it is known only from the mid continental shelf, and possibly the upper continental slope, off Tasmania. Proposed vernacular name: Eltanin Handfish.

Comparisons. Within the genus *Pezichthys*, *P. eltanini* shares with *P. compressus* a very large esca (a third or more vs. less than a quarter of illicial length) and scales with stellate (rather than subcircular) bases. It differs from similar sized individuals of *P. compressus* in having: a larger eye (horizontal diameter 7.5–9.1 vs. 6.4–6.6% SL), a longer second dorsal-fin rays (length of longest ray 19–22 vs. 16–18% SL), and a more slender tail (depth at origin of second dorsal fin 35–44 vs. 47–48% SL). It also differs in the following ratios: head length 6.1–7.0 vs. 8.1–8.3 times eye diameter, and illicium length 1.2–1.8 vs. 2.7–2.8 times esca length.

Pezichthys eltanini also differs from *P. amplispinus* in having: a shorter pelvic fin (length 17–22 vs. 23–27% SL), caudal peduncle (length 3.6–5.1 vs. 6.8–11% SL), second dorsal-fin spine (length 19–29 vs. 32–36% SL), and third dorsal-fin spine (length 15–18 vs. 19–26% SL); a longer first dorsal-fin base (25–30 vs. 18–20% SL), maxilla (length 15–16 vs. 12–14% SL), illicium (length 21–22 vs. 16–20% SL), and esca (length 11–18 vs. 3–4% SL); a broader interorbital (width 12–15 vs. 8–11% SL); and a proportionally larger esca (length 54–82 vs. 19–21% of illicium length). It also differs in the following ratios: head length 3.5–3.6 vs. 3.6–4.5 times upper jaw length, length of second dorsal-fin spine 0.9–1.4 vs. 1.7–2.2 times illicium length, illicium length 1.2–1.8 vs. 4.7–5.3 times esca length, length of second dorsal-fin base 2.1–2.5 vs. 2.9–3.4 times first dorsal-fin base, caudal fin length 2.8–3.1 vs. 3.4–4.6 times caudal peduncle depth.

Remarks. There are uncertainties about the collection data for the paratype of this species. The registration details for this specimen (NMV A 4282) were recorded as station 45, FRV *Soela* voyage 5/84, on October 19th, 1984. This station is from the continental slope off the west coast of Tasmania in 520–560 m depth; deeper than any other handfish collected and significantly deeper than the holotype which was collected from the continental shelf off Tasmania's east coast in ~135 m. However, no handfish were recorded on the original catch composition sheet but three specimens, which were listed from station 168 (closer to the collection locality of the holotype), were the only specimens listed from the voyage. Two of these specimens are referred to elsewhere in this manuscript; the third has not been located. It is possible that this paratype is the third missing specimen but this cannot be verified.

***Pezichthys macropinnis* sp. nov.**
Figs 2, 4, 14, 18; Tables 4, 7–10

Holotype. CSIRO H 5317–02, 20.5 mm SL, ca. 300 km south-west of Ceduna, Great Australian Bight, South Australia, 33° 16'S, 130° 37'E, 145 m, May 2000.

Diagnosis. Member of the genus *Pezichthys* with a combination of the following characters: esca small, 12% of illicium length (including esca); illicium very elongate and slender, without dermal spinules, its length about 26% SL, 1.9 times in head length; head length about 5.4 times snout length; snout long, length 9% SL; eye 6.9 times in head length; body robust, maximum width about 32% SL; interorbit broad, width about 15% SL; scales with subcircular bases, monospinulate or with prominent, strongly diverging bifurcate spinules (except for those closely associated with pores of the acoustico-lateralis system); spinules variable in length over body; dorsal-fin elements mostly lacking spinules, membranes of fins naked; first dorsal-fin base about 18% SL; second dorsal-fin rays 15, fin base 63% SL; fin rays very elongate, longest ray of second dorsal fin about 35% SL; length of second dorsal-fin spine 0.9 times length of longest ray of second dorsal fin; anal-fin rays 8; body pale with a network of reddish streaks.

Description. D1 2; D2 15; A 8; Pc 7; Pv i, 4; C 9 (two middle rays branched apically, others simple); Vt 9 + 12 = 21.

Body short, moderately compressed; upper anterior profile weakly convex to first dorsal-fin origin, almost upright; not deeply notched behind eye; top of eye well below top of head; oval when viewed anteriorly; nape humped slightly; anterior ventral profile weakly convex, almost straight between pelvic fins; abdomen barely expanded; caudal peduncle moderately elongate, length 7.6% SL. Head length 49% SL; snout short, 5.4 times in head; eye of moderate size, 6.9 times in head length; gill opening small, aperture much smaller than pupil, located immediately above and behind insertion of pectoral fin; nostrils very small, openings obscure. Mouth small, terminal, slightly protractile; upper jaw slightly oblique, 6.5 in head; lips not fleshy; angle of jaw partly recessing into groove, situated below middle of eye. Teeth minute, villiform, apparently in narrow broad bands in both jaws; mouth not dissected to expose vomer and tongue.

Skin thin, not corrugated, covered with mainly bifid, spinulose scales; no separate wart-like patches of skin; no obvious dermal flap on mid-arm of pectoral-fin; dermal flaps absent on body and other fins. Body scales dense, close-set, not imbricate or arranged in defined rows; distributed over entire body; mostly absent from fin rays and membranes (a few spiny scales near bases of leading rays of both dorsal fins); small, naked patch surrounding gill opening; scale bases large (to about a third of pupil diameter), embedded, but not within a prominent mound of thickened skin. Spinules relatively tall, well exposed, usually bifurcate; semi-erect, usually directed posteriorly; divergent (length of spines of each spinule subequal to or slightly longer than the distance between their tips), bifurcating just above skin surface; tips not connected by integument when undamaged; on belly smaller and less erect than those above; spiny scales present around rim of orbit. Illicium base and main stem naked, not covered with a sheath-like membrane. Scales of acoustico-lateralis system bicuspid, not obviously distinguishable from main spinules; widely separated and arranged in barely discernable rows; most pronounced near mouth, otherwise indistinct on head and body.

Illicium subterminal on snout, close to upper jaw, its insertion not confluent with origin of first dorsal fin; very long and slender, 1.9 times in head, 1.2 times in length of second dorsal-fin spine; apex of esca behind hind margin of eye when illicium depressed; partly recessible into a groove beside first dorsal fin; esca minute, very narrow, length 9 times in length of illicium, fleshy without filamentous branches; illicial base not bulbous. First dorsal fin short-based; spines very elongate, second dorsal-fin spine separated slightly from base of illicium, much shorter than third spine; fin membrane moderately well developed near fin bases, absent and probably damaged distally; posterior extension of membrane very short, terminating above base of pelvic fin; anterior elements of both fins not or weakly recurved; first dorsal-fin base 3.5 times in second dorsal-fin base. Second dorsal fin very tall (damaged so extent of incision indeterminate), anterior rays longest; rays simple, very fine, their tips not recurved, often damaged; fin base very elongate, 63% SL; longest ray of second dorsal fin 0.9 of longest dorsal-fin spine; bases of rays barely embedded. Anal fin very

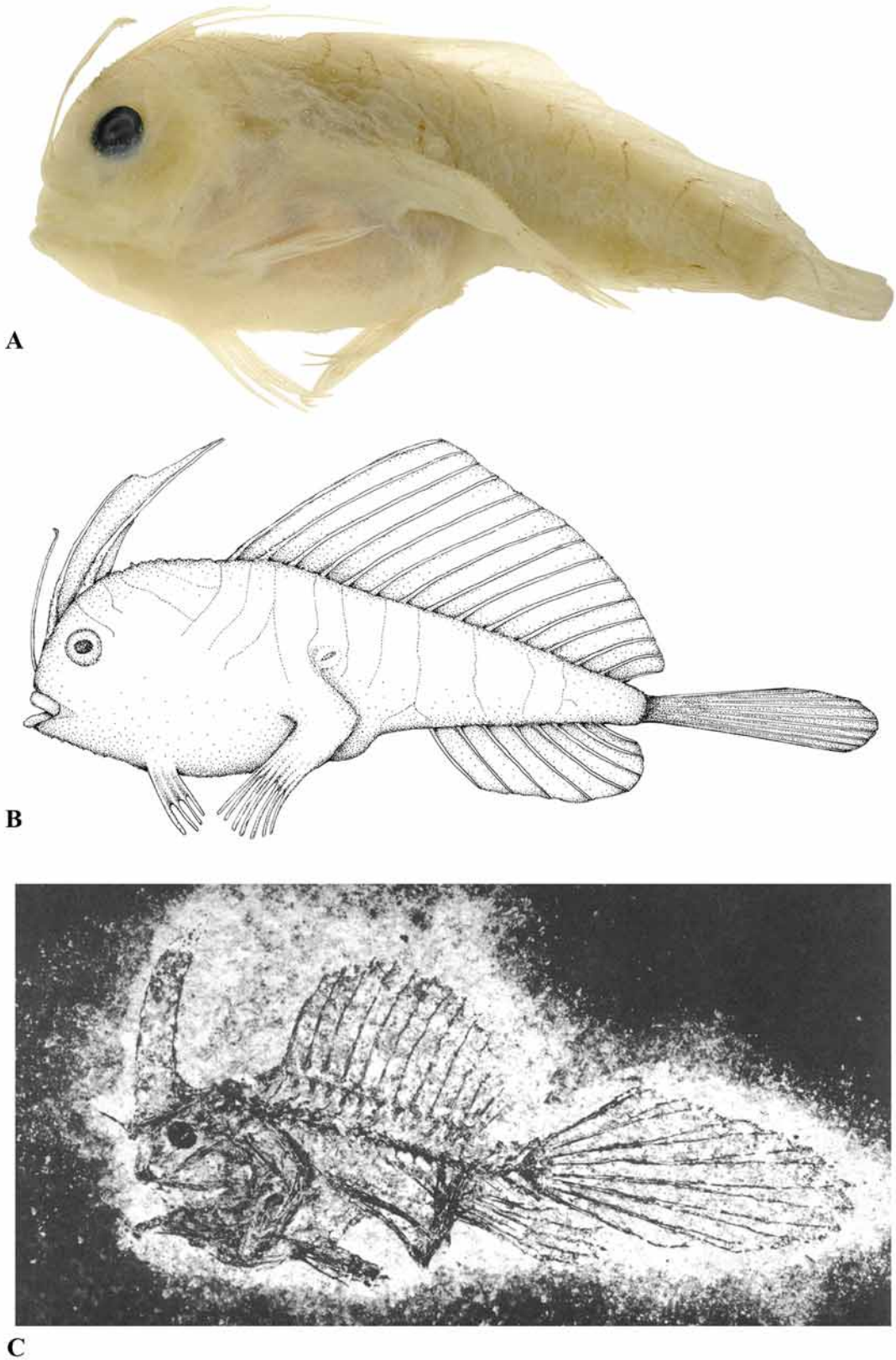


FIGURE 18. *Pezichthys macropinnis* **sp. nov.**, lateral view of: A. CSIRO H 5317–02, holotype, 20.5 mm SL, preserved specimen (image reversed); B. illustration of holotype (by S. Barnes); and C. *Histionotophorus bassanii* BMNH P 19060, Middle Eocene, Monte Bolca, Italy, reproduced from Rosen & Patterson 1969.

tall with moderately elongate base, rays delicate, not fleshy, tips not strongly recurved; penultimate posterior rays longest; anal-fin base 2.6 times in second dorsal-fin base. Pectoral fin weakly arm-like, radials elongate, extending well beyond gill opening; fin rays between filamentous and digitiform, slender, membranes not deeply incised. Pelvic fin relative long; rays filamentous, slender, not deeply incised; anterior spine very short, not deeply embedded; fin located on ventral surface, directed ventrally; interpelvic space almost flat, broad, width 14% SL. Caudal fin very elongate, slender; length 4 times caudal peduncle depth.

Coloration. In preservative: White with linear markings on the body; markings reddish, irregular, very fine, concentrated on upper half, becoming more diffuse ventrally. Fins translucent. Eye blackish.

Size. Known only from the holotype, 20.5 mm SL (ca. 29 mm TL). Size of newly hatched young and egg capsule diameter unknown.

Distribution. Demersal, off Ceduna, Great Australian Bight, South Australia (33° 16'S, 130° 37'E), recorded from 145 m depth.

Etymology. Combination of the Greek *makros* (large) and the Latin *pinna* (fin) in reference to its tall dorsal and anal fins. Proposed vernacular name: Longfin Handfish.

Comparisons. The unique holotype of this species, which appears to be a juvenile (20.5 mm SL), differs markedly from all other known handfishes. The fine, dark, linear body markings and extremely long illicium (and fin rays and spines), are not found in any other extant brachionichthyid. Despite its smaller size and possibility of some atypical allometric changes, *P. macropinnis* differs from its congeners in having: a longer pectoral fin (length 27 vs. 19–24% SL in *P. compressus*, and 22–25% SL in *P. eltanini*), illicium (length 26 vs. 16–20% SL in *P. amplispinus*, 19–23% SL in *P. compressus*, and 21–22% SL in *P. eltanini*), third dorsal-fin spine (length 42 vs. 19–26% SL in *P. amplispinus*, 16–19% SL in *P. compressus*, and 15–18% SL in *P. eltanini*), and second dorsal-fin rays (length of longest ray 35 vs. 17–25% SL in *P. amplispinus*, 16–18% SL in *P. compressus*, and 19–22% SL in *P. eltanini*); a shorter pelvic-fin (length 16 vs. 23–27% SL in *P. amplispinus*, 23–23% SL in *P. compressus*, and 17–22% SL in *P. eltanini*), maxilla (length 7.6% SL vs. 12–14% SL in *P. amplispinus*, 15–16% SL in *P. compressus*, and 15–16% SL in *P. eltanini*), and interdorsal distance (distance between bases of third dorsal-fin spine and second dorsal fin 15 vs. 23–28% SL in *P. amplispinus*, 28–30% SL in *P. compressus*, and 27–27% SL in *P. eltanini*); and a relatively shorter esca (length 12% of illicium length vs. 19–21% in *P. amplispinus*, 35–36% in *P. compressus*, and 54–82% in *P. eltanini*).

In addition to these characters, *P. macropinnis* appears to be distinguishable from *P. amplispinus* in having: longer distance from snout to second dorsal-fin origin (distance 43 vs. 35–42% SL) and pre-illicial distance (5.6 vs. 0.2–1.4% SL); a wider interorbit (width 15 vs. 8.1–11% SL); a relatively longer illicium (54 vs. 33–39% of head length). It also differs in the following ratios: illicium length 8.7 vs. 4.7–5.3 times esca length, and longest dorsal-fin spine 0.9 vs. 1.4–1.9 times length of longest ray of second dorsal fin.

Pezichthys macropinnis appears to be distinguishable from *P. compressus* in having: a broader interorbit (width 15 vs. 12–13% SL); longer caudal fin (length 40 vs. 33–37% SL) and second dorsal-fin spine (length 33 vs. 24–26% SL); and shorter first dorsal-fin base (length 18 vs. 26–28% SL) and esca (length 3.0 vs. 6.8–8.0% SL). It also differs in the following ratios: head length 6.5 vs. 3.4–3.6 times upper jaw length, illicium length 8.7 vs. 2.7–2.9 times esca length, longest dorsal-fin spine 0.9 vs. 1.5 times longest ray of second dorsal fin, and caudal-fin length 4.0 vs. 2.8–3.3 times caudal peduncle depth.

In addition to the above characters, *P. macropinnis* can be distinguished from *P. eltanini* by: a longer caudal peduncle (length 7.6 vs. 3.6–5.1% SL); a relatively larger illicium (length 53 vs. 38–41% of head length); shorter first dorsal-fin base (length 18 vs. 25–30% SL), head (length 49 vs. 53–55% SL), and esca (length 3.0 vs. 11–18% SL). It also differs in the following ratios: head length 6.5 vs. 3.5–3.6 times upper jaw length, and illicium length 8.7 vs. 1.2–1.8 times esca length.

Remarks. The fossil brachionichthyid, *Histionotophorus bassanii* (BMNH P 19060), figured by Rosen & Patterson (1969), is similar in general morphology to the juvenile *P. macropinnis*. Both species have very long fins but differ markedly in most meristic characters. Early juveniles of *Brachionichthys australis*, *B. hirsutus* and *Thymichthys verrucosus*, the only handfishes for which small juveniles are known, closely resemble their

adults in body shape. Whitley (1949) made similar observations for *B. australis* (as *B. hirsutus*). Hence, it is likely that the adult of *P. macropinnis* is also a long-finned form, probably closely resembling the holotype. It has a small esca (about 11% of illicial length) and scales with subcircular (rather than stellate) bases, placing it in a subgroup of *Pezichthys* along with *P. amplispinus* and *P. nigrocilium.*

***Pezichthys nigrocilium* sp. nov.**
Figs 2, 4, 14, 19; Tables 4, 7–10

Holotype. CSIRO H 6154–01, 40.8 mm SL, Pieman Canyon, west of Granville Harbour, western Tasmania, 41° 48'S, 144° 34'E, 176 m, 13 May 2004.

Diagnosis. Member of the genus *Pezichthys* with a combination of the following characters: esca small, 11% of illicium length (including esca); illicium short, very slender, without dermal spinules, its length about 16% SL, 3.5 times in head length; head length about 9 times snout length; snout short, length 6% SL; eye large, 5.6 times in head length; body narrow, maximum width 19% SL; interorbital width narrow, about 5% SL; scale bases subcircular with prominent, strongly divergent, bifurcate spinules (except for those closely-associated with pores of the acoustico-lateralis system); spinules variable in length over body; dorsal-fin elements covered with spinules, outer fin membranes naked; first dorsal-fin base short, length 15% SL; second dorsal-fin rays 15, fin base about 57% SL; length of second dorsal-fin spine 1.4 times length of longest ray of second dorsal fin; anal-fin rays 8; body mainly pale pink with prominent eyelash-like marking radiating from eye; caudal fin plain, without fine spots.

FIGURE 19. *Pezichthys nigrocilium* **sp. nov.**, lateral view of CSIRO H 6154–01, holotype, 40.8 mm SL.

Description. D1 2; D2 15; A 8; Pc 7; Pv i, 4; C 1 + 4 + 4 = 9; Vt 9 + 12 = 21.

Body moderately short, strongly compressed; upper anterior profile almost straight to first dorsal-fin origin, directed posterodorsally, not truncate; not deeply notched behind eye; top of eye close to dorsal margin of head; narrowly oval when viewed anteriorly; nape humped slightly; anterior ventral profile almost straight, slightly concave between pelvic fins; abdomen slightly expanded; caudal peduncle elongate, length 8.9% SL. Head length 55% SL; snout very short, about 9 times in head; eye large, 5.6 times in head length; gill opening small, aperture subequal in size to pupil, located well above and slightly behind insertion of pectoral fin; nostrils very small, openings obscure. Mouth small, terminal, slightly protractile; upper jaw strongly oblique,

4.3 in head; lips fleshy, upper jaw connected laterally to lower jaw by fleshy fold; angle of jaw partly recessing into groove, situated below anterior third of eye. Teeth minute, villiform, in narrow bands in both jaws; mouth not dissected to expose vomer and tongue.

Skin rather thin, not corrugated, covered with mainly bifid, spinulose scales; no separate wart-like patches of skin; no obvious dermal flap on mid-arm of pectoral-fin; dermal flaps absent on body and other fins. Body scales close-set (usually almost touching), not imbricate or arranged in defined rows; distributed over entire body and on rays of dorsal, pectoral and caudal fins; absent on fin membranes, except at bases of dorsal fins; large, naked, vertically oval patch surrounding gill opening, its height about two-thirds of eye diameter; scale bases large (to about a third of pupil diameter), embedded, but not within a prominent mound of thickened skin. Spinules short, well exposed, monospinulate and bifurcate, originating near centres of scales; mainly upright to directed slightly posteriorly; narrowly divergent (length of spines of each spinule usually longer than the distance between their tips), bifurcating above skin surface; tips not connected by integument when undamaged; on belly smaller and less upright than those above; spiny scales present on anterior orbital membrane. Spiny scales on first dorsal fin concentrated on anterior edge of leading spine, posterior edge of third spine and along their lateral edges; in second dorsal fin, spinules concentrated on leading ray and lateral surface of subsequent rays; in caudal fin, along dorsal margin of uppermost ray and along lateral edges of most other rays, absent from ventral edge of lowermost ray; in pectoral fin, restricted to basal halves of rays on their dorsal edges; feeble or absent on anal and pelvic fins. Illicium base and main stem naked, not obviously covered with sheath-like membrane. Scales of acoustico-lateralis system bicuspid, not obviously demarcated from main spinules; scales widely separated and arranged in barely discernable rows; pronounced near mouth, otherwise indistinct on head and body.

Illicium subterminal on snout; well separated from upper jaw, its insertion not confluent with origin of first dorsal fin; short, very slender, 3.5 times in head, 1.7 times in length of second dorsal-fin spine; apex of esca above middle of eye when illicium depressed; not recessible into a groove beside first dorsal fin; esca very small (its length about 9 times in length of illicium), not bulbous, narrow, fleshy, without filamentous branches; illicial base not bulbous. First dorsal fin short-based; second dorsal-fin spine well separated from base of illicium, much longer than third spine; fin membrane thick, expanded around each spine, posterior extension short, membrane terminating forward of origin of pelvic fin; anterior elements of both fins strongly recurved; first dorsal-fin base 3.8 times in second dorsal-fin base. Second dorsal fin low, moderately incised, anterior and penultimate posterior rays longest; rays simple, very fine, their tips very strongly recurved; fin base moderately elongate, 57% SL; longest ray of second dorsal fin 1.4 times in longest dorsal-fin spine; bases of rays embedded slightly, basal fifth of their length covered with flesh and skin. Anal fin tall with short base, rays not fleshy, moderately incised, tips strongly recurved; penultimate posterior rays longest; anal-fin base 2.7 times in second dorsal-fin base. Pectoral fin weakly arm-like, radials moderately elongate, extending slightly beyond gill opening; fin rays digitiform, slender, membranes deeply incised, increasingly so posteriorly, tips flexible, flattened slightly (often recurved distally). Pelvic fin short; rays digitiform, slender, deeply incised; anterior spine short, embedded and indistinct; fin located on ventral surface, usually directed ventrally, base aligned horizontally; interpelvic space almost flat, broad, width 8.5% SL. Caudal fin narrow, almost truncate, middle pair of rays shorter than two adjacent pairs; length 3.2 times caudal peduncle depth.

Coloration. Frozen: Body almost uniformly pale pinkish above, white below; dark markings confined to areas around eye, beneath soft dorsal fin, and on caudal peduncle, caudal-fin base, illicium base, second dorsal-fin spine, and outer pectoral and caudal fins. Dark eyebrow-like markings originating from eyes; markings not bilaterally symmetrical; consisting of two short, dark, vertical streaks above each pupil; a divergent, V-shaped marking originating at posterior margin of left eye (a single horizontal streak at right eye); a broader and longer posteroventrally directed streak at posteroventral margin of left pupil, paired posteroventral streaks on right pupil. Three weak dark saddles beneath dorsal fin; first as parallel vertical streaks (resembling supraorbital marking); posterior markings and those on upper caudal peduncle less well defined; dark, well-defined, vertical streak at base of caudal fin. Illicium translucent with dusky esca and dark blotch at its anterior base. Anterior margin of leading ray of first dorsal fin dark, second ray distinctly paler;

base of second ray and leading membrane silvery white. Second dorsal fin mostly translucent, anterior and posterior tips silvery; two fine dark marks distally near middle of fin. Pelvic and anal fins translucent. Eye silvery white, pupil black.

Size. Known only from the holotype, 40.8 mm SL (ca. 54 mm TL). Size of newly hatched young and egg capsule diameter unknown.

Distribution. Demersal, Pieman Canyon, off Granville Harbour, western Tasmania, 41° 48'S, 144° 34'E, at 176 m depth.

Etymology. Epithet based on the Latin *niger* (black) and *cilium* (eyelash) in allusion to a dark, eyelash-like markings above each orbit. Proposed vernacular name: Eyelash Handfish.

Comparisons. The distinctive 'eye-lash like' markings around the eye are unique to this species. Of members of the genus *Pezichthys*, *P. nigrocilium* is most similar to *P. amplispinus* and *P. macropinnis.* These species have a small esca (less than a quarter of illicial length) and scales with subcircular (rather than stellate) bases. The holotype of *P. nigrocilium* appears to differ from these and other *Pezichthys* in the following ratios: illicium length 28 vs. 33–39% of head length in *P. amplispinus*, 36–42% in *P. compressus*, 38–41% in *P. eltanini*, and 54% in *P. macropinnis*).

Pezichthys nigrocilium differs from *P. amplispinus*, *P. compressus*, and *P. macropinnis* in having: a larger eye (horizontal diameter 9.9 vs. 7.0–8.5% SL in *P. amplispinus*, 6.4–6.6% in *P. compressus*, and 7.1% in *P. macropinnis*); shorter first dorsal-fin base (length 15 vs. 18–20% in *P. amplispinus*, 26–28% in *P. compressus*, and 18% in *P. macropinnis*), anal-fin base (length 21 vs. 25–28% SL in *P. amplispinus*, 27–30% in *P. compressus*, and 24% in *P. macropinnis*), snout (length 6.1 vs. 8.4–10% SL in *P. amplispinus*, 9.6–10% in *P. compressus*, and 9.1% in *P. macropinnis*), and esca (length 1.7 vs. 3.1–4.2% SL in *P. amplispinus*, 6.8–8.0% in *P. compressus*, and 3.0% in *P. macropinnis*); and a narrower body (maximum width 19 vs. 30–38% SL in *P. amplispinus*, 25–32% in *P. compressus*, and 32% in *P. macropinnis*) and interorbital (width 4.9 vs. 8.1–11% SL in *P. amplispinus*, 12–13% SL in *P. compressus*, and 15% SL in *P. macropinnis*).

In addition to the above characters, *P. nigrocilium* differs from *P. amplispinus* in having: a more slender tail (depth at anal-fin origin 20 vs. 23–26% SL); a narrower interpelvic space (distance 8.5 vs. 11–16% SL); first dorsal fin with shorter second (length 26 vs. 32–36% SL) and third spines (17 vs. 19–26% SL); and a relatively shorter esca (length 11 vs. 19–21% of illicium length). It also differs in the following ratios: head length 9.0 vs. 4.9–6.2 times snout length, and illicium length 9.1 vs. 4.7–5.3 times esca length.

Pezichthys nigrocilium differs from *P. compressus* in additional characters: a taller second dorsal fin (longest ray 19 vs. 16–18% SL); more elongate caudal peduncle (length 8.9 vs. 3.5–5.9% SL); shorter maxilla (length 13 vs. 15–16% SL) and illicium (length 16 vs. 19–23% SL); a narrower inter-pelvic space (distance 8.5 vs. 10–12% SL); a shorter pre-illicium length (distance 1.5 vs. 3.6–5.8% SL); a more slender body (depth at anal-fin origin 20 vs. 25–26% SL, depth at origin of second dorsal fin 39 vs. 47–48% SL); and a relatively shorter esca (length 11 vs. 35–36% of illicium length). It also differs in the following ratios: head length 9.0 vs. 5.2–5.4 times snout length, 3.5 vs. 2.4–2.8 times illicium length, 5.6 vs. 8.1–8.3 times eye diameter; illicium length 9.1 vs. 2.7–2.8 times esca length.

In addition to the above characters, *P. nigrocilium* differs from *P. eltanini* in the following: a longer caudal peduncle (length 8.9 vs. 3.6–5.1% SL); a shorter first dorsal-fin base (length 15 vs. 25–30% SL), second dorsal-fin base (length 57 vs. 62–63% SL), snout (length 6.1 vs. 9.5–10% SL), maxilla (length 13 vs. 15–16% SL), illicium (length 16 vs. 21–22% SL), and esca (length 1.7 vs. 11–18% SL); a narrower body (maximum body width 19 vs. 31–39% SL) and interorbit (width 4.9 vs. 12–15% SL); and a relatively shorter esca (length 11 vs. 54–82% of illicium length). It also differs in the following ratios: head length 9.0 vs. 5.4–5.5 times snout length, 3.5 vs. 2.4–2.6 times illicium length; illicium length 9.1 vs. 1.2–1.8 times esca length.

Pezichthys nigrocilium and *P. macropinnis*, although known only from the holotypes, differ markedly in body form and coloration. *Pezichthys nigrocilium* appears to have a longer head (length 55 vs. 49% SL), pelvic-fin (length 23 vs. 16% SL), and maxilla (length 13 vs. 7.6% SL); a longer interdorsal space (distance between bases of third dorsal-fin spine and second dorsal fin 28 vs. 15% SL); a shorter second dorsal-fin base (length 57 vs. 63% SL); and much shorter pectoral-fin (length 23 vs. 27% SL), illicium (length 16 vs. 26%

SL), second dorsal-fin spine (length 26 vs. 33% SL), third dorsal-fin spine (length 17 vs. 42% SL), longest second dorsal-fin ray (19 vs. 35% SL), and caudal fin (length 33 vs. 40% SL).

Remarks. The single known specimen of this species was captured on the outer continental shelf off western Tasmania using a benthic sled deployed from the FRV *Southern Surveyor*. Its absence in fish collections is probably a function of inappropriate sampling rather than genuine rarity. Nevertheless, the extent of its range needs to be established.

Sympterichthys Gill

Sympterichthys Gill, 1878: 221. Type species. *Lophius laevis* Lacepède, 1804 (= *Chironectes unipennis* Cuvier, 1817) by original designation.

Definition. *Sympterichthys* is unique among brachionichthyids in having the following combination of features: body relatively deep, depth 37–47% SL at second dorsal-fin origin; head strongly compressed in cross section and elongate, length 46–55% SL; caudal peduncle short, 2–6% SL; illicium slender, short to moderate in length (2.1–3.0 in head length), usually 2–3 times length of esca when present; skin surface rough, almost completely covered with spiny scales but lacking wart-like protuberances and dermal appendages; scale bases embedded, irregular in shape; spinules simple and/or bifurcate, adpressed, directed posteriorly, originating at posterior margin of scale base, partly embedded, their tips protruding slightly above skin surface; sensory scales not strongly demarcated; body plain or weakly marbled, without a strong or vivid colour pattern; pectoral-fin rays 7–9; anal-fin rays 7–9; vertebrae 21–22.

Species. Presently contains two valid nominal species: *Sympterichthys moultoni* **sp. nov.**, and *S. unipennis* (Cuvier, 1817).

Remarks. The most obvious characters defining *Sympterichthys* are the strongly compressed head and body, a simple colour pattern, rough skin with a dense coverage of bifurcate scales and no dermal appendages. Another new genus *Thymichthys* is similar but its two currently recognised species are largely covered with smooth warty skin (spiny scales are sometimes present but sparse and usually almost fully embedded), the head and body are more robust (almost subtriangular in cross section), dermal flaps and filaments are distributed over the body and fins, and the coloration is bright or strongly patterned. These groups have either monospinulate or bicuspid scales with adpressed spinules originating at the posterior margin of their bases (rather than medially). Both species of *Thymichthys* have been included in *Sympterichthys* by past authors (e.g. Paxton *et al.*, 2006).

Key to species of *Sympterichthys*

Illicium with dermal spinules on its basal half; scale bases rudimentary, irregular, with long bifurcate spinules; length of second dorsal-fin spine 0.8–0.9 times length of longest ray of second dorsal fin; 15–16 second dorsal-fin rays, 7–8 anal-fin rays, 7–8 pectoral-fin rays..... *Sympterichthys moultoni* **sp. nov.**

Illicium without dermal spinules; scale bases variable in shape, dendritic to narrowly thallate, with long unicuspid or bifurcate spinules; length of second dorsal-fin spine about 1.3 times length of longest ray of second dorsal fin; 17 second dorsal-fin rays, 9 anal-fin rays, 9 pectoral-fin rays (based on holotype)..... *Sympterichthys unipennis* (Cuvier)

Sympterichthys moultoni sp. nov.

Figs 2, 4, 6, 20, 21; Tables 5, 7–10

Holotype: CSIRO H 3773–03, 45.1 mm SL, east of Cape Howe, New South Wales, 37° 25'S, 150° 16'E, 161–184 m, 1 Sep. 1994.

Paratypes: 3 specimens (30–39 mm SL): CSIRO H 3792–02, 29.5 mm SL, south-east of Lakes Entrance, eastern Bass Strait, Victoria, 38° 36'S, 148° 32'E, 125 m, 27, Aug. 1994; CSIRO H 4461–01, 39.3 mm SL, south of Gabo Island, Victoria, 37° 45'S, 150° 03'E, 133–136 m, 7 Dec. 1996; NMV A 29407–001, 36.1 mm SL, south-east of Lakes Entrance, eastern Bass Strait, Victoria, 38° 58'S, 148° 33'E, 211 m, 5 Mar. 1984.

Additional material: H 6815–01, 38.9 mm SL, south-east of Cape Barren Island, Bass Strait, Tasmania, 40° 33'S, 148° 49'E, 105–150 m, 13 May 2003.

Diagnosis. Member of the genus *Sympterichthys* with a combination of the following characters: esca large, size variable, about 56% of illicium length; illicium thick, fleshy, with some dermal spinules on basal half, length 16–21% SL, 2.1–3 times in head length; esca similar thickness to rest of structure; body entirely covered with close-set, non-imbricate scales; scale bases rudimentary, margins irregular, with long bifurcate spinules (except for those closely associated with pores of the acoustico-lateralis system); spinules mainly adpressed, originating from posterior region of scale base, apical spines moderately divergent; second dorsal-fin rays 15–16, fin base 61–66% SL; length of second dorsal-fin spine 0.8–0.9 times length of longest ray of second dorsal fin; 7–8 anal-fin rays; 7–8 pectoral-fin rays; upper body uniformly pale pink; membranes between distal portions of rays of dorsal, caudal and pelvic fins dark.

Description. D1 2 (2, n= 3 paratypes); D2 15 (15–16); A 7 (7–8); Pc 8 (7–8); Pv i, 4 (i, 4); C 1 (1) + 6 (6) + 2 (2) = 9 (9); Vt 10 (9–10) + 11 (11–12) = 21 (21).

Body short to moderately elongate, moderate to strongly compressed; upper anterior profile strongly convex, upright before second dorsal fin; upper margin of eye well below dorsal margin of head, at level of illicial base; head almost oval when viewed anteriorly; nape humped very slightly; anterior ventral profile strongly convex; abdomen expanded slightly; caudal peduncle short, length 6.2 (4.2–5.2)% SL. Head length 50 (45–55)% SL; snout variable in length, 4.8 (5.6–6.6) times in head; eye very small, lateral, somewhat embedded, 7.4 (7.4–9.6) times in head length; gill opening small, aperture subequal to pupil, located posterodorsal to insertion of pectoral fin; nostrils small, distinct, surrounded with spinules in holotype; posterior opening almost dorsal to anterior opening, separated slightly from orbit. Mouth very small, narrow, terminal to slightly inferior, weakly protractile; upper jaw oblique, 3.4 (2.8–3.5) in head; lips fleshy; angle of jaw deeply recessed into groove, situated below middle of eye; tongue narrowly rounded apically. Teeth (in paratype CSIRO H 4461–01) elongate, caniniform, similar in shape in both jaws and few in number; in single row along inner margin of maxilla, in 1–2 rows in lower jaw; vomer apparently edentate (mouth not dissected).

Skin very thick, uniformly covered with small-based, spinulose scales with elongate bifid apical spines; no separate wart-like patches of skin; no obvious dermal flap present on mid-arm of pectoral-fin; dermal flaps absent from body. Body scales close-set, distributed over entire body and over basal half of dorsal and anal fins; spinules on body more or less equidistant from each other, aligned in ill-defined diagonal rows or irregularly; scale bases deeply embedded, not within raised mound of thickened skin. Spinules elongate, mostly embedded, bifurcating within skin, only tips of apical spines exposed; apical spines strongly divergent, not connected by integument, mainly adpressed, orientation variable but frequently posteroventral; those on belly not significantly smaller than those above; scale bases variable in shape, plate-like, with strongly irregular margins, their width subequal to or smaller than spinule length; scale base extremities blunt; spinules arising obliquely from posterior margin of scale base. Basal halves of both dorsal fins (including membranes), anal fin, pelvic fin, and pectoral fin (including all of arm) covered with spinulose scales; distal halves of these fins naked, no scales arranged in series along lateral margins of fin rays; spinulose scales confined to base of caudal fin, holotype with 2 more posteriorly placed sensory scales, otherwise fin naked. Illicium base weakly spinulose, main stem with a few scales on basal half; skin covering stem thick, forming a wide, pouch-like covering around much thinner ossified ray. Scales of acoustico-lateralis system bicuspid, horseshoe-shaped, well demarcated from main body spinules; spine apices overlain with narrow or broad, lobe-like integument; sensory scales variably separated, arranged in obvious series on head and along tail, spinulose scales largely absent from areas connecting these scales.

TABLE 5. Morphometric data for the holotype (CSIRO H 3773–03) and paratypes of *Sympterichthys moultoni* **sp. nov.**, and the holotype (MNHN A 4630) of *S. unipennis* **sp. nov.** Standard and total lengths are recorded in mm, other values expressed as percentages of standard length.

	S. moultoni					*S. unipennis*
	Holotype	Paratypes (n=3)				Holotype
		Mean	Min	Max	S.D.	
Standard length (mm)	45.1	34.9	29.5	39.3	5.0	43.8
Total length (mm)	61.3	43.9	39.6	48.3	6.2	57.6
First dorsal-fin base length	19.7	21.9	20.7	22.8	1.0	18.2
Second dorsal-fin base length	65.7	63.5	61.0	65.3	2.2	63.8
Distance from snout to second dorsal-fin origin	36.1	36.8	35.9	37.3	0.8	36.1
Anal-fin base length	30.9	30.5	29.1	32.5	1.8	35.9
Distance from snout to anal-fin origin	62.7	66.3	64.5	68.1	1.8	66.9
Head length	50.0	50.6	45.5	55.4	5.0	49.1
Pectoral-fin length	25.0	23.1	21.4	24.9	2.5	23.3
Pelvic-fin length	23.7	21.6	20.0	23.2	2.3	16.9
Body depth (at origin of anal fin)	23.3	22.3	21.0	23.9	1.5	19.5
Body depth (at origin of second dorsal fin)	44.8	42.9	40.7	46.8	3.4	36.9
Maximum body width	29.2	23.8	19.4	27.5	4.1	12.8
Eye (horizontal diameter)	6.8	6.1	5.8	6.5	0.4	5.3
Snout length	10.5	8.4	7.7	9.5	0.9	7.0
Interorbital width	9.6	11.9	9.6	13.2	2.0	8.2
Maxillary length	14.9	15.7	14.6	16.3	1.0	13.7
Illicium length	16.4	20.9	20.6	21.2	0.4	18.5
Esca length	-	11.7	11.5	11.8	0.2	-
Length of second dorsal-fin spine	19.7	20.3	17.4	23.1	4.0	23.6
Length of third dorsal-fin spine	15.2	15.7	14.8	16.6	1.3	22.1
Interdorsal distance*	24.3	25.9	24.3	27.6	2.3	25.3
Length of longest second dorsal-fin ray	21.0	24.3	23.0	25.5	1.8	18.7
Caudal peduncle length	6.2	4.8	4.2	5.2	0.5	1.9
Caudal peduncle depth	9.1	10.8	9.8	11.8	1.0	9.6
Caudal-fin length	36.0	34.0	33.9	34.2	0.2	31.7
Interpelvic distance	9.6	8.2	6.7	9.7	2.1	7.5
Pre-illicial distance	4.8	5.0	4.5	5.7	0.6	5.5

*Distance from the base of the third dorsal-fin spine to the origin of the second dorsal fin.

Illicium terminal on snout, asparagus-shaped; slender, relatively short, 3.0 (2.1–2.7) times in head, 1.2 (0.8–1.1) times in length of second dorsal-fin spine; apex of esca just short of base of third dorsal-fin spine when fin depressed; partly retractable into shallow groove on either side of first dorsal fin; esca moderately enlarged, finely filamentous, about 3 times in length of illicium, emanating from a equally broad, tubular stem; illicial base not bulbous. First dorsal fin reduced, short-based; spines close together, second dorsal-fin spine almost confluent with base of illicium, slightly longer than third spine; fin membrane thickened, fleshy, expanded almost to apex of each spine (third spine visible distally); posterior extension of membrane very short, terminating forward or below apex of erect third spine; anterior elements of both fins weakly recurved; first dorsal-fin base 3.3 (2.7–3.1) times in second dorsal-fin base. Second dorsal fin low, barely incised,

anterior and penultimate posterior rays longest; rays simple; fin base elongate, 66 (61–65) % SL; longest ray of second dorsal fin 0.9 (0.8–0.9) times in longest dorsal-fin spine; basal membrane relatively thick, concealing bases of all fin rays, covering about two-thirds of anterior fin rays and about half of posterior rays. Anal fin short, base fleshy, margin weakly incised; penultimate posterior rays longest; anal-fin base 1.8 (1.9–2.2) times in second dorsal-fin base. Pectoral fin short, weakly arm-like, elbow extending well beyond gill opening; fin rays digitiform, slender, membranes deeply incised, not increasingly so posteriorly, tips flexible, filamentous. Pelvic fin short, narrow-based; rays slender, deeply incised; anterior spine short, embedded and indistinct; fin located on ventral surface, directed ventrally, base aligned horizontally; interpelvic space narrow, usually convex. Caudal fin small, narrowly rounded; length 3.9 (2.9–3.5) times caudal peduncle depth.

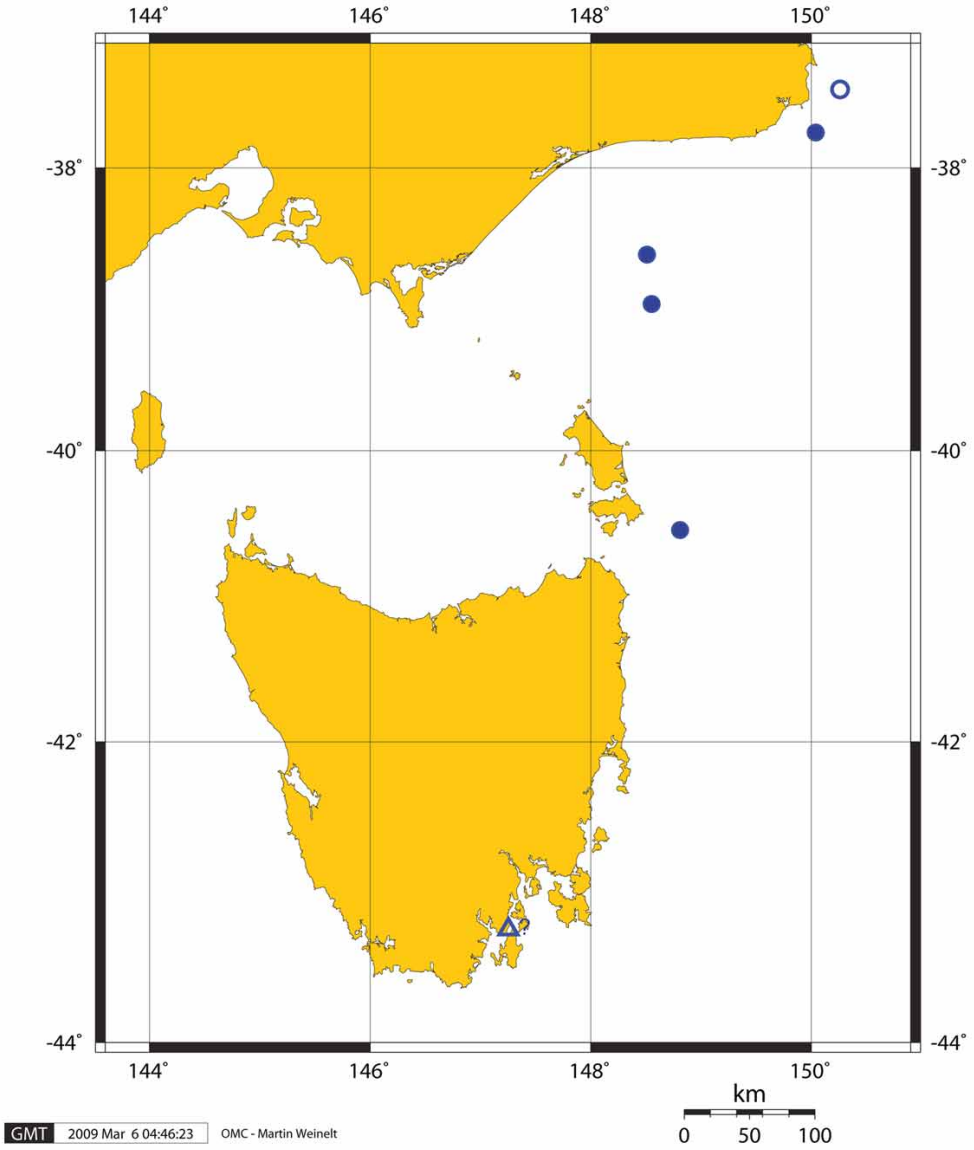


FIGURE 20. A. Collection localities for *Sympterichthys moultoni* **sp. nov.**, holotype (○) and paratypes (●); and B. likely type locality of *S. unipennis* (△), southeastern Tasmania. Locations are approximate and may represent multiple records.

Coloration. In life: Body uniform pale pinkish (becoming white in preservative), no evidence of spots or other markings on any of the types. In holotype, fins pale; fin membranes on distal half of caudal and pectoral fins dark, other membranes translucent.

In preserved paratypes: darker brownish areas more extensive; membranes of first dorsal fin, pelvic and pectoral fins, anterior part of second dorsal fin, and posterior parts of second dorsal and anal fins pigmented; smallest specimen (CSIRO H 3792–02) with more uniformly pigmented caudal fins.

Size. Probably a small species, to at least 45.1 mm SL (ca. 61 mm TL).

Distribution. Known from outer continental shelf of eastern Australia from Cape Howe, New South Wales (37° 25'S, 150° 16'E), to eastern Bass Strait, Victoria (38° 58'S, 148° 33'E) in 125–211 m, possibly shallower. An additional specimen collected off Cape Barren Island (Tasmania) was taken in 105–150 m.

FIGURE 21. *Sympterichthys moultoni* **sp. nov.**, lateral view of CSIRO H 3773–03, holotype, 45.1 mm SL.

Etymology. Named in honour of the efforts of Peter Moulton, a fisheries biologist with the former Victorian Institute of Marine Science (now the Marine and Freshwater Resources Institute), whose interest in temperate Australian fishes led to the collection of the first specimen of this species, as well as many specimens of hitherto poorly known handfishes. Proposed vernacular name: Moulton's Handfish.

Comparisons. *Sympterichthys moultoni* superficially resembles *P. compressus* in body shape and in having a uniform pale pink coloration (fading to white in preservation). However, these species differ markedly in squamation and characters defining the genera. *Sympterichthys moultoni* is covered in prostrate, bifid spinules originating at the posterior end of plate-like, scale bases (rather than erect bifid spinules located centrally on stellate scales), and it has a thick illicial sheath (its thickness similar to the esca rather than having a very slender illicium without an obvious sheath), and almost smooth fin rays (rather than being densely covered with spinules).

Sympterichthys moultoni (ca. 30–45 mm SL) differs from the only known specimen of its congener *S. unipennis* (44 mm SL) in more than 60% of morphometric characters and ratios evaluated. These include having: a deeper (depth at anal-fin origin 21–24 vs. 20% SL; depth at second dorsal-fin origin 41–47 vs. 37% SL) and wider body (maximum width 19–29 vs. 13% SL, although the *S. unipennis* holotype may have been flattened slightly during preservation); a longer pelvic-fin (length 20–24 vs. 17% SL), snout (length 7.7–11 vs. 7.0% SL), maxilla (length 15–16 vs. 14% SL), longest ray of second dorsal-fin (length 21–26 vs. 19% SL), caudal peduncle (length 4.2–6.2 vs. 1.9% SL), and caudal fin (length 34–36 vs. 32% SL); a wider interorbit (width 9.6–13 vs. 8.2% SL); and a shorter anal-fin base (length 29–33 vs. 36% SL), and second dorsal-fin rays (length 15–17 vs. 22% SL). It also differs in a number of ratios, including: length of longest dorsal-fin spine 0.8–0.9 vs. 1.3 times length of longest ray of second dorsal fin, and length of second dorsal-fin base 1.9–2.2 vs. 1.8 times length of anal-fin base.

Remarks. All five known specimens of *Sympterichthys moultoni* have been collected since the 1980s using benthic sled or demersal trawl, in about 100–200 m. Like all handfishes occurring off southeastern

Australia, populations of this species may have been impacted by commercial fishing in the region. Little is known of its life history or preferred habitat.

An additional specimen (CSIRO H 6815–01), which was collected recently by D. Maynard off Cape Barren Island (Bass Strait), was tentatively identified as *Sympterichthys moultoni*. It was excluded from the type series as it differs markedly in the following morphometric ratios: a deeper tail (depth at anal-fin origin 26 vs. 21–24 % SL); wider body (maximum body width 31 vs. 19–29 % SL); a longer pre-second dorsal-fin distance (length 38 vs. 36–37 % SL), anal-fin base (length 35 vs. 29–33 % SL), pectoral-fin (length 26 vs. 21–25 % SL), third dorsal-fin spine (length 22 vs. 15–17 % SL) and caudal fin (length 50 vs. 34–36 % SL); a larger eye (horizontal diameter 8.6 vs. 5.8–6.8 % SL); a longer interdorsal space (distance between bases of third dorsal-fin spine and second dorsal fin 31 vs. 24–28 % SL); a more slender body anteriorly (depth at origin of second dorsal fin 39 vs. 41–47 % SL); and a shorter caudal peduncle (length 2.9 vs. 4.2–6.2 % SL) and pre-illicial distance (length 3.8 vs. 4.5–5.7 % SL). It also differs in the following ratios: head length 3.1 vs. 2.2–3.1 times illicium length, length of second dorsal-fin spine 1.3 vs. 0.8–1.2 times illicium length, caudal-fin length 4.7 vs. 2.9–3.9 times caudal-peduncle depth, head length 6.0 vs. 7.4–9.6 times eye length and illicium length 32 vs. 33–47% of head length. Otherwise, this specimen is superficially similar to *S. moultoni*, but without additional material we cannot determine if differences in morphometric characters reflect intraspecific or interspecific variation.

***Sympterichthys unipennis* (Cuvier)**

Figs 4, 20, 22; Tables 5, 7–10

Lophius laevis Lacepède, 1804: 202, 210, pl. 55 (4) [original description, junior homonym of *Lophius laevis* Latrielle, 1804]; holotype MNHN A 4630; probably Tasmania (as Australian seas).
Chironectes unipennis Cuvier, 1817: 435 [replacement name for *Lophius laevis* Lacepède, preoccupied].
Chironectes unipinnis Cuvier, 1817: pl.18 (3) [misspelling of *Chironectes unipennis* in plate].
Chironectes laevis (non Latrielle). Valenciennes, 1837: 434 [new combination].
Brachionichthys laevis (non Latrielle). Günther, 1861: 182 [new combination].
Sympterichthys laevis (non Latrielle). Gill, 1878: 221 [new combination].
Sympterichthys unipennis. Whitley, 1949: 403 [new combination].
Brachionichthys unipennis. Pietsch, 1985: 95 [new combination].
Sympertichthys laevis (non Latrielle). Paxton *et al.*, 1989: 276 [misspelling of *Sympterichthys laevis*].

Holotype. MNHN A 4630, 43.8 mm SL, Australian seas, voyage de Péron 1800–1804, no other data.

Diagnosis. Member of the genus *Sympterichthys* with a combination of the following characters: esca minute, as a simple filament (possibly damaged); illicium thick based, thin distally, without dermal spinules, length about 18% SL, 2.7 times in head length; body entirely covered with close-set, embedded, non-imbricate, spiny scales; scale bases variable in shape, dendritic to narrowly thallate, with long unicuspid or bifurcate spinules (except for those closely associated with pores of the acoustico-lateralis system); spinules adpressed, posteriorly directed, originating from posterior region of scale base, apical spines moderately divergent; second dorsal-fin rays 17, fin base 64% SL; length of second dorsal-fin spine 1.3 times length of longest ray of second dorsal fin; 9 anal-fin rays; 9 pectoral-fin rays; fresh coloration unknown, pale in preservative with darker markings on first dorsal fin and membranes of pectoral, pelvic and caudal fins.

Description. D1 2; D2 17; A 9; Pc 9; Pv i, 4; C 1 + 7 + 1 = 9; Vt 9 + 13 = 22.

Body moderately elongate, very strongly compressed, narrowly expanded anteriorly, tail moderately elongate; upper anterior profile convex (pre-illicial snout almost vertical, slightly concave), only slightly elevated before eyes with a prominent supraocular and postocular shelf and deep notch above posterior aspect of eye; upper margin of eye close to dorsal margin of head; nape not humped, not elevated before second dorsal fin; head narrowly oval when viewed anteriorly; anterior ventral profile strongly convex, abdomen bulging; caudal peduncle very short, almost absent, 1.9% SL. Head length 49% SL; snout very short, 7.0 in head; eye 9.2 times in head length; gill opening aperture small, tubiform, subequal to size of pupil, located

slightly above and behind insertion of pectoral fin. Nostrils minute and obscure. Mouth small, terminal, moderately protractile; upper jaw slightly oblique, of moderate size, 3.6 in head; upper lip narrow, slightly fleshy; lower lip continuous, connected at symphysis, covered with a fleshy fold laterally that narrows towards junction with upper jaw; jaw angle partly retracting into a thick, vertical skin fold (beneath anterior margin of eye); tongue well developed, rounded. Teeth in upper jaw moderately elongate, caniniform, in about 2 rows; single band of strongly recurved, longer canines in lower jaw; vomer not examined in holotype.

Skin thick, moveable, smooth or wrinkled slightly (not flabby); fully covered with small, spiny scales; scales reasonably closely set, non-imbricated, irregularly spaced, not in defined rows, distributed over entire body, more or less uniform in size; chin and snout tip naked; spinules distributed over rays and membranes of dorsal and anal fins, densest near fin bases; spinules also present on basal half of pectoral, pelvic and caudal fin; fins otherwise naked; illicium naked; scales of acoustico-lateralis system widely separated and indistinct, suboval with short apical spinules, central pore usually not obvious; scale bases embedded, distal apices emergent as low, unicuspid or bicuspid spinules; spinule tips very slender, exposed distally but strongly adpressed, not concealed within wart-like mounds of skin; scale bases very variable in shape, somewhat dendritic or narrowly thallate with 1–4 anterior root-like projections, each about subequal in length to spinule tips; spinules usually recurved upwards, directed posterolaterally (posterodorsally or posteroventrally near dorsal and ventral margins respectively); no enlarged membranous flaps present on arm-like base of pectoral-fin; no cutaneous flaps on body.

Illicium terminal, originating at about level of mid-eye, separated by eye diameter from snout tip, pre-illicial distance 5.5% SL; not elongate, 2.7 in head, 1.3 in length of second dorsal-fin spine, not retractable into a shallow groove beside first dorsal fin; apex possibly damaged, terminating in a minute, curled filament, without an obvious esca, reaching well beyond base of third dorsal-fin spine when depressed; basal third of illicium broad, covered with thick, smooth skin; almost filamentous distally with smooth membrane.

First dorsal fin moderately elevated; second dorsal-fin spine recurved slightly, origin connected to the base of illicium at about a fifth its length, distinctly longer than third spine; membrane of fin plunging toward dorsal surface above pelvic-fin base, then continuing to second dorsal fin as a prominent fleshy ridge; first dorsal-fin base 3.5 in second dorsal-fin base. Second dorsal-fin base moderately elongate, 64% SL, membrane thickest basally, barely concealing ray bases, rays relatively low, simple, those on anterior half barely shorter than those posteriorly. Anal fin moderately elongate, first and last rays shortest, other rays similar in length; longest ray of second dorsal fin 1.3 in longest dorsal-fin spine; anal-fin base 1.8 in second dorsal-fin base. Pectoral-fin base thickened and moderately elongate, extending to about an eye diameter behind gill opening; fin rays slender; fin membranes deeply incised, increasingly so posteriorly; ray tips finger like, flexible, slightly flattened, curved distally. Pelvic-fin moderate to short, located on ventral surface, base almost orientated horizontally; rays slender, rather deeply incised; spine short, embedded and indistinct; interpelvic space flattened, relatively narrow, 7.5% SL. Caudal fin moderately elongate, length 3.3 times caudal peduncle depth; posterior margin damaged, probably emarginate or rounded, weakly incised.

Coloration. In preservative: Body uniformly yellowish white, evidence of darker reddish-brown areas below and above eyes, and on membranes of pectoral, pelvic and caudal fins; apices of first dorsal fin and anterior rays of second dorsal fin reddish brown; no evidence of vertical dark markings through base and posterior margin of caudal fin; membranes of dorsal and caudal fins translucent; eye bluish black. Its coloration after almost two decades in preservative was described by Cuvier (1817) as reddish brown mottled with darker brown.

Size. Known only from the holotype, probably a small species, about 44 mm SL (ca. 58 mm TL).

Distribution. Known only from the holotype and collection data were given as 'Australian seas' with no other information. The specimen was obtained by French zoologist François Péron during an expeditionary voyage to Australia in the early 19th century commissioned by Napoleon Bonaparte and led by Captain Nicolas Baudin (1800–04). During 1802, fish surveys were made in D'Entrecasteaux Channel, southeastern Tasmania. The captain's journal (see Cornell, 1974, p 310) refers to a little fish 'which is unusual in that its

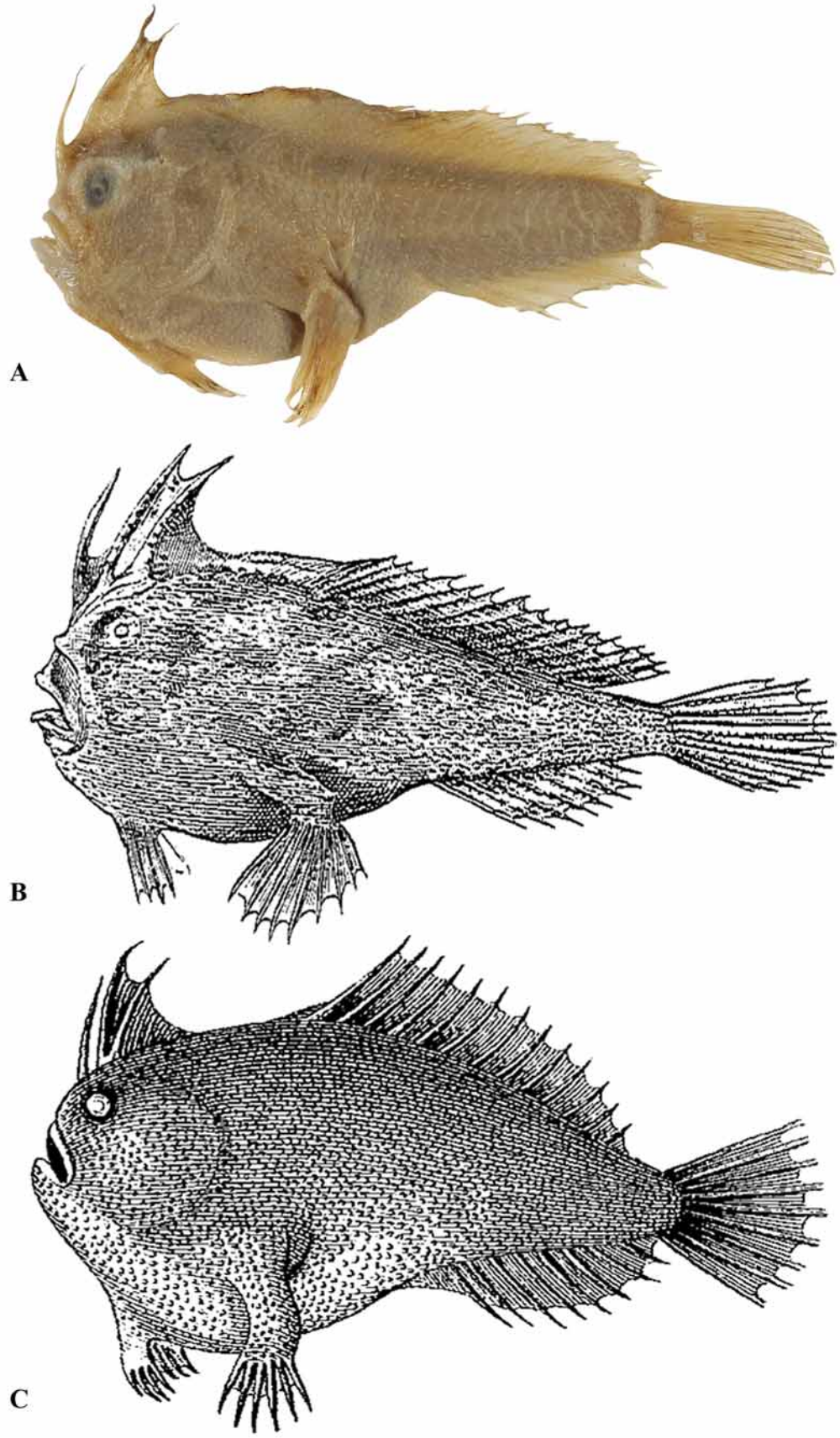


FIGURE 22. *Sympterichthys unipennis*, lateral view of MNHN A 4630, holotype, 43.8 mm SL: A. preserved specimen; B. illustration figured as *Chironectes unipennis* (reproduced from Cuvier 1817); and C. illustration figured as le *Lophie lisse* (reproduced from Lacepède 1804, image reversed).

foremost fins are exactly like hands'. However, *Brachionichthys hirsutus* (as *Lophius hirsutus*) was also taken on the same expedition, and we cannot be certain whether Baudin was referring to one or both of these species. Interestingly, both species are illustrated on plate 55 (Lacepède, 1804) together with one other fish, *Urolophus cruciatus* (as *Raja cruciata*), which is the most abundant batoid in the D'Entrecasteaux Channel.

Etymology. Epithet based on a combination of the Latin *unus* (one) and *penna* (wing), presumably in allusion to its wing-like first dorsal fin. Proposed vernacular name: Smooth Handfish (Yearsley *et al*., 2006).

Comparisons. *Sympterichthys unipennis* differs from *S. moultoni* in several morphometric characters, including having: more slender tail (depth at anal-fin origin 20 vs. 21–24% SL, at second dorsal-fin origin 37 vs. 41–47% SL); a narrower body (maximum width 13 vs. 19–29 % SL, although the *S. unipennis* holotype has possibly been flattened laterally); and a longer anal-fin base (length 36 vs. 29–33% SL), second dorsal-fin spine (length 24 vs. 17–23% SL), and third dorsal-fin spine (length 22 vs. 15–17% SL). It also has more fin elements (second dorsal-fin rays 17 vs. 15–16; anal-fin rays 9 vs. 7–8; and pectoral-fin rays 9 vs. 7–8).

Remarks. The holotype and only known specimen of *Sympterichthys unipennis* is in reasonably good condition considering its long preservation period (ca. 200 years). It appears to have undergone minor shrinkage (the supraorbital bones are protruding slightly and the skin is slightly flabby) and its body is strongly compressed indicating that it may have been squashed slightly after capture. Cuvier's (1817) drawing of this specimen closely resembles the current shape of the holotype (see Fig. 22). However, Lacepède's (1804) original drawing portrays a much deeper bodied fish. Even extreme shrinkage could not account for these differences. As was often the case, the 19th C drawings appear to have been stylized somewhat, as the caudal peduncle lengths are clearly inaccurate (i.e. much too long) in both cases. We conclude that its present strongly compressed body form is natural rather than artificial.

The shape of the illicium and esca is an important character in most lophiiform fishes. The illicium of the holotype of *S. unipennis* lacks an esca, and its absence is also evident in both 19th C drawings suggesting that it was either never present or damaged soon after capture. Interestingly, while all other extant handfishes have an esca, this character is relatively poorly developed in its congener, *S. moultoni*.

The nomenclatural history of this species is intriguing. The invalid use of *Lophius laevis* Lacepède, a junior primary homonym of an antennariid, and the validity of its replacement name *Chironectes unipennis* Cuvier, has been discussed succinctly by Pietsch (1985), and Eschmeyer and Fricke (2009). With the erection of his new genus *Sympterichthys*, Gill (1878) designated *S. unipennis* as its type species. One of the authors (PL) initially suspected that this species was distinct from *Thymichthys* (then *Sympterichthys*) *verrucosus* McCulloch & Waite and advised authors of the first Zoological Catalogue of Australia – Fishes (Paxton *et al*., 1989) accordingly. More recently, we suspected that Cuvier's holotype and handfishes referable to *T. verrucosus* could be conspecific. The senior author had initially examined the holotype of *S. unipennis* in Paris (1981) in isolation of the considerable Australian material available of *S. verrucosus*, and later in partial isolation in Australia (kindly couriered to Hobart by G. Duhamel, 2001). However, a thorough examination of all material referable to *Thymichthys verrucosus* indicated that more than a single morph existed in Australian collections, so in December 2008 the holotype of *S. unipennis* was once again couriered to Tasmania (by B. Séret) for a brief re-examination. Based on these comparisons, we concluded that *S. unipennis* is not conspecific with any of the *S. verrucosus* morphs or any other extant species. Despite being one of the first Australian fishes discovered by science, the type of *S. unipennis* remains the only known specimen.

Thymichthys gen. nov.

Type species. *Thymichthys politus* (Richardson, 1844) (by original designation).

Definition. *Thymichthys* is unique among brachionichthyids in having skin variably adorned with wart-like protuberances, strongly demarcated sensory scales and dermal appendages. Its members also differ from other handfishes in the following combination of features: body relatively deep (33–52% SL at second dorsal-fin

origin) and variable in shape, subtriangular to compressed slightly in cross section, elongate, length 46–56% SL; caudal peduncle usually very short, 2–6% (rarely to 9%) SL; illicium robust or slender (1.9–3.4 in head length), usually 2–3 (rarely to 4) times length of esca; skin surface usually smooth to touch, with variably developed, embedded scales; scales usually sparse, with simple and/or bifurcate spinules and irregular bases; spinules usually short, adpressed, directed posteriorly, originating at posterior margin of scale base, their tips fully embedded or barely protruding above skin surface; body brightly coloured or with a strong pattern of blotches, spots and reticulations; pectoral-fin rays 7–10 (mainly 8 or 9); anal-fin rays 6–10 (rarely 6); vertebrae 20–24 (mainly 21–23).

Etymology. Combination of the Greek *thymos* (warty excrescence) and Greek *ichthys* (fish) in allusion to the warty protuberances on the skin of these handfishes.

Species. Presently contains two valid nominal species: *Thymichthys politus* (Richardson, 1844) and *T. verrucosus* (McCulloch & Waite, 1918). Regional forms of *T. verrucosus* differ morphologically and may be separate species.

Remarks. The type species of the genus, *Thymichthys politus*, was wrongly listed by Jordan (1919) as the type of *Brachionichthys* Bleeker 1855 (Eschmeyer & Fricke, 2009). The composition of this group has not been fully resolved and other species, presently assigned to *T. verrucosus*, may exist. A dedicated investigation using additional material and the assistance of molecular methods is needed to resolve these issues.

Key to species of *Thymichthys*

Illicium well separated from upper jaw (pre-illicial distance 3.3–7.9% SL); eye relatively large, 6.9–9.3 times in head length; body without well-developed dermal flaps; length of second dorsal-fin spine 0.7–1 times length of longest ray of second dorsal fin; 9 (rarely 10) pectoral-fin rays; body reddish, bluish or blackish near dorsal tips of pectoral and pelvic fins, and along margins of dorsal, anal and caudal fins ..... *Thymichthys politus* (Richardson)

Illicium adjacent upper jaw (pre-illicial distance 1.2–3.2% SL); eye relatively small, 4.8–7.1 times in head length; body with well-developed dermal flaps; length of second dorsal-fin spine 1.1–1.6 times length of longest ray of second dorsal fin; usually 8 pectoral-fin rays; body brownish with lighter and darker blotches and spots; a prominent blackish bar extending through caudal peduncle onto posterior parts of dorsal and anal fins .... *Thymichthys verrucosus* (McCulloch & Waite)

Thymichthys politus (Richardson), new combination

Figs 1, 2, 5, 23–25; Tables 6–10

Cheironectes politus Richardson, 1844a: 133–134; holotype whereabouts unknown; from Port Arthur, Tasmania [original description].
Chironectes politus: Günther, 1861: 183 [amendment of generic name].
Brachionichthys politus: Johnston, 1883: 121 [new combination].
Sympterichthys politus: Paxton et al., 2006: 648 [new combination].

Neotype. CSIRO H 4118–01, 61.4 mm SL, Actaeon Islands, D'Entrecasteaux Channel, Tasmania, 43° 34'S, 147° 00'E, 5 m, 6 Apr. 1985.

Additional material. 7 specimens (28–90 mm SL): CSIRO H 782–01, 67.3 mm SL, off Forestier Peninsula, Tasmania, 42° 52'S, 147° 57'E, 10–12 m, Jun. 1987; CSIRO H 4114–08, 49.8 mm SL, Tasmania, no other data; CSIRO T 4, 65.9 mm SL, off Forestier Peninsula, Tasmania, ca. 42° 52'S, 147° 57'E, 20 m, 1983; CSIRO T 1997–01, 57.8 mm SL, and CSIRO T 1997–02, 60.2 mm SL, Actaeon Islands, D'Entrecasteaux Channel, Tasmania, ca. 43° 32'S, 147° 00'E, 8 m, 19 Apr. 1980; QVMT 2009:5:2, 90 mm SL, southern Tasmania, no other data; TMH D 928, 28.1 mm SL, off Bridport, Bass Strait, Tasmania, 40° 58'S, 147° 25'E, 15 Oct. 1950.

Diagnosis. Member of the genus *Thymichthys* with a combination of the following characters: esca large, 45–65% (mean 52%) of illicium length (including esca); illicium short, thick and fleshy, without dermal spinules, length 14–17% SL, 3–3.4 times in head length, well separated from upper jaw (pre-illicial length 3.3–7.9% SL); eye of moderate size, 6.9–9.3 times in head; body variably covered with small, close-set flattened warts but lacking well-developed dermal flaps; posterior margins of warts usually with a small, sharp, prostrate spine (mostly embedded with its tip sometimes visible); scales deeply embedded, widely spaced; second dorsal-fin rays 16–17, fin base 63–71 (mean 67)% SL; length of second dorsal-fin spine 0.7–1 times length of longest ray of second dorsal fin; 9–10 anal-fin rays; 9 (rarely 10) pectoral-fin rays; body variable shades of red, usually paler ventrally; often bluish or blackish near dorsal tips of pectoral and pelvic fins, and along margins of dorsal, anal and caudal fins.

Description (data for neotype precedes other material). D1 2 (2, n=7); D2 17 (16–17); A 10 (9–10); Pc 9 (9–10, rarely 10); Pv i, 4 (i, 4); C 1 (0–1, rarely 0) + 6 (6–8, mainly 6) + 2 (1–2, rarely 1) = 9 (9); Vt 9 (8–10, rarely 8) + 14 (12–14, mainly 14) = 23 (22–24, rarely 24).

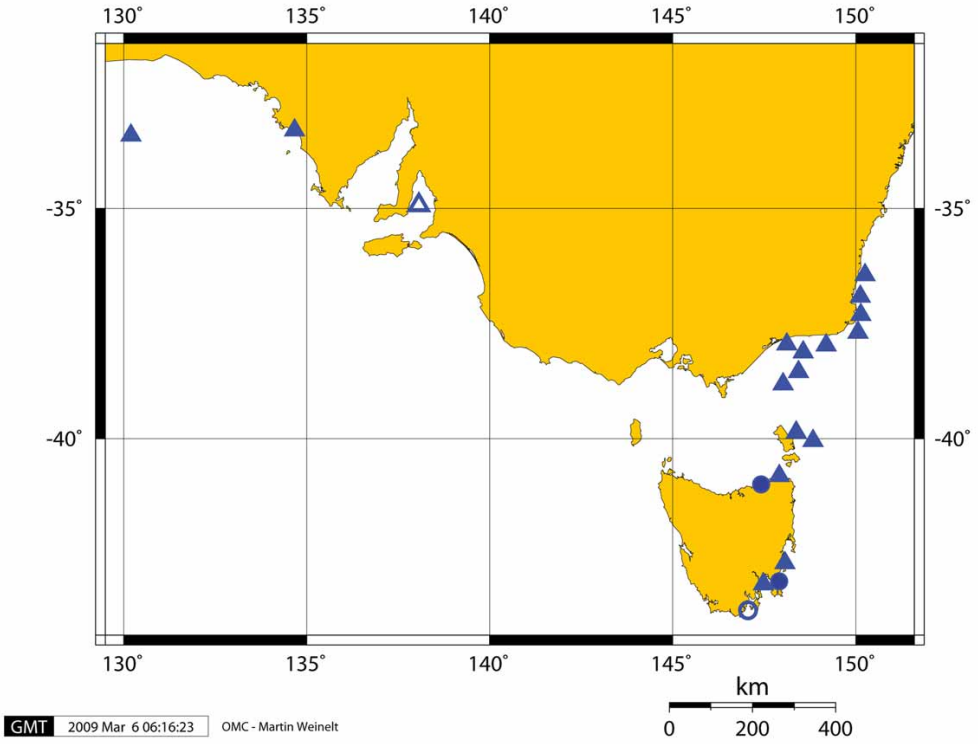


FIGURE 23. Collection localities for: A. *Thymichthys politus*, neotype (○) and additional material (●); B. *T. verrucosus*, holotype (△) and additional material (▲).

Body relatively elongate, moderately compressed; upper anterior margin strongly convex and elevated slightly; profile truncate to weakly convex above mouth (pre-illicial snout almost vertical); margin below first dorsal fin almost straight, usually with a deep notch above posterior aspect of eye; upper margin of eye not close to dorsal margin of head; nape usually humped; profile of head suboval when viewed anteriorly; anterior ventral profile strongly convex, sometimes flattened between pelvic fins; abdomen not expanded; caudal peduncle short, length 4.5 (2.1–5.9)% SL. Head length 46 (48–52)% SL; snout very short, length 6.8 (5.9–6.4) times in head; eye of moderate size, diameter 6.9 (7.3–9.3) times in head length; gill opening small, papilliform, aperture subequal to size of pupil, located slightly above and behind insertion of pectoral fin. Nostril aperture sizes, position and protrusibility variable (often indistinct from surrounding pores of the cephalic sensory system); usually large, well separated (anterior opening slightly closer to upper jaw than to posterior opening); anterior opening usually tubular and fringed distally (sometimes pore-like); posterior

opening usually tubular, located close to orbit at horizontal level of mid eye and posterodorsally to anterior opening. Mouth small to moderate in size, terminal, not protractile; upper jaw oblique, 3.8 (3.7–4.9) in head; lips thin, not fleshy, partly recessible into shallow, circumoral groove and connected slightly forward of or below anterior margin of eye; angle of jaw not retractable into a groove; tongue well developed, rounded apically. Teeth small, villiform, in narrow bands in both jaws; band in lower jaw slightly broader near symphysis than in upper jaw; vomer edentate.

TABLE 6. Morphometric data for the neotype (CSIRO H 4118–01) and four additional specimens of *Thymichthys politus*, and the morphometric data for 20 specimens of *T. verrucosus*. Standard and total lengths are recorded in mm, other values expressed as percentages of standard length.

	T. politus					*T. verrucosus* (all morphs)			
	Neotype	Non-types (n=4)				Non-types (n=20)			
		Mean	Min	Max	S.D.	Mean	Min	Max	S.D.
Standard length (mm)	61.4	62.8	57.8	67.3	4.5	52.9	34.9	67.1	9.1
Total length (mm)	80.1	83.4	74.8	90.4	7.8	73.6	50.3	92.8	12.0
First dorsal-fin base length	22.0	29.1	23.9	31.3	3.5	29.2	22.2	32.5	2.5
Second dorsal-fin base length	71.1	65.9	62.8	68.9	2.5	66.3	60.1	72.5	3.1
Distance from snout to second dorsal-fin origin	31.9	36.2	32.8	39.6	2.9	38.3	34.7	41.7	2.0
Anal-fin base length	37.4	39.4	36.5	42.0	2.3	31.5	28.3	35.7	1.9
Distance from snout to anal-fin origin	62.0	59.5	58.4	60.9	1.1	66.0	59.8	72.3	2.8
Head length	45.9	49.7	48.4	51.8	1.5	51.4	48.8	55.5	1.6
Pectoral-fin length	24.8	25.7	21.9	29.7	3.4	25.5	22.1	28.6	2.0
Pelvic-fin length	21.9	21.9	17.0	24.3	3.3	22.2	18.9	26.2	1.9
Body depth (at origin of anal fin)	22.5	25.1	23.4	26.6	1.4	21.5	18.2	24.5	1.8
Body depth (at origin of second dorsal fin)	34.1	35.4	32.8	37.9	2.2	41.7	34.8	52.1	4.4
Maximum body width	31.2	31.2	28.3	34.4	3.2	29.7	21.3	43.5	6.4
Eye (horizontal diameter)	6.7	5.9	5.6	6.7	0.5	8.7	7.3	10.9	0.9
Snout length	6.7	8.2	7.6	8.8	0.5	9.1	7.0	10.2	0.8
Interorbital width	9.4	10.0	9.0	10.7	0.8	12.5	9.2	16.7	1.9
Maxillary length	12.2	12.0	10.5	13.1	1.1	15.6	14.3	18.0	1.0
Illicium length	13.6	16.1	15.1	17.2	0.8	20.9	15.4	26.6	2.8
Esca length	6.7	8.5	7.2	9.9	1.2	7.7	3.5	14.1	2.7
Length of second dorsal-fin spine	20.2	22.0	19.3	23.5	1.9	30.5	25.4	37.2	3.1
Length of third dorsal-fin spine	19.4	21.5	20.1	23.4	1.5	23.0	19.3	28.7	2.3
Interdorsal distance*	22.1	23.0	22.2	24.8	1.2	25.1	21.4	28.9	1.8
Length of longest second dorsal-fin ray	22.0	24.8	23.1	26.2	1.6	22.9	19.8	27.1	1.9
Caudal peduncle length	4.5	3.9	2.1	5.9	1.6	5.0	3.4	8.7	1.2
Caudal peduncle depth	10.4	11.5	10.5	12.1	0.7	10.3	8.8	11.7	0.7
Caudal-fin length	30.5	32.7	29.4	37.2	3.4	38.3	28.7	45.9	4.3
Interpelvic distance	9.8	11.4	9.0	13.3	2.1	11.4	8.3	13.2	1.2
Pre-illicial distance	5.0	5.7	3.3	7.9	1.9	2.4	1.2	3.2	0.6

*Distance from the base of the third dorsal-fin spine to the origin of the second dorsal fin.

Skin usually thick, flabby and corrugated; body covered over most of surface with small, flattened wart-like protuberances or papillose ridges (sometimes altered through preservation, see CSIRO T 4); warts close

set, their posterior margins sometimes with a short, sharp, spine tip protruding (most scales and their associated spines fully embedded in skin); rudimentary dermal flap sometimes present on mid-arm of pectoral fin (rudimentary in neotype), thallate, irregular in shape, much smaller than gill opening when present; dermal filaments poorly represented on ventrolateral surface of body. Fin rays and their associated membranes without evidence of scales or spines; illicium naked, covered with thick, fleshy skin with papillose ridges. Scales of acoustico-lateralis system bicuspid, with small central pore flanked by slender apical spinules; spinules horseshoe-shaped, much longer than spinules of body scales; arranged in well defined series; best defined on head (below lower jaw, and below and above eye) and in a single row extending along mid-upper trunk more or less parallel to dorsal margin.

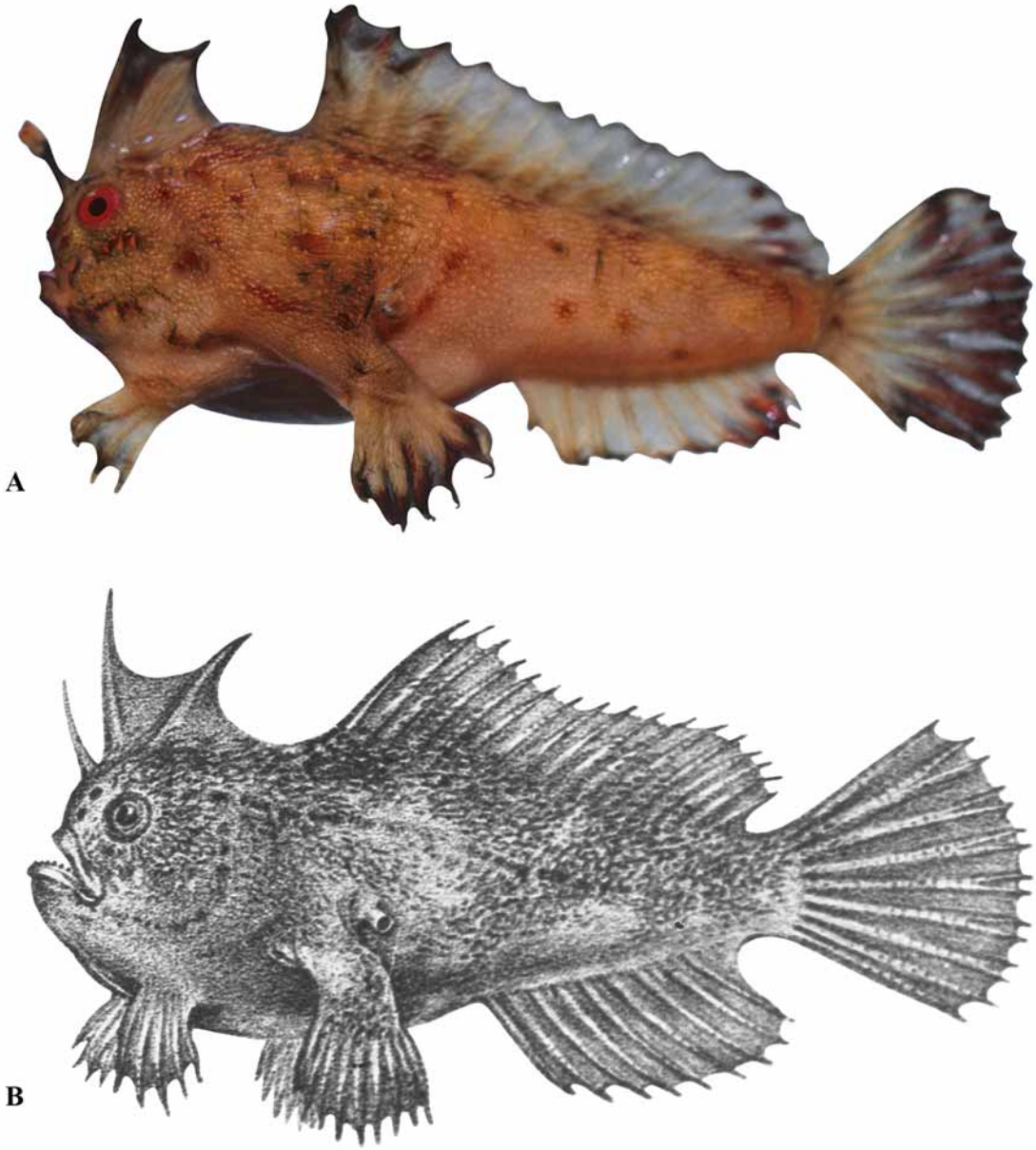


FIGURE 24. *Thymichthys politus*, lateral view of: A. CSIRO H 4118–01, neotype, 61.4mm SL; and B. illustration of holotype (whereabouts unknown), reproduced from Richardson (1844a), courtesy of University of Tasmania Archives (image reversed).

Illicium terminal on snout; well separated from upper jaw, its insertion confluent with origin of first dorsal fin; short and thick, 3.4 (3.0–3.2) times in head, 1.5 (1.1–1.5) times in length of second dorsal-fin spine; when depressed, apex of esca reaching to about base of third dorsal-fin spine; illicium not retractable into obvious

fleshy groove beside first dorsal fin; esca large with short, thallate filaments, 2.0 (1.5–2.2) times in length of illicium; filaments dense, matted; illicial base indistinct, obscured by skin. First dorsal fin not greatly elevated, its base with long posterior membrane; second dorsal-fin spine distinctly recurved, originating at base of illicium, distinctly longer than third spine; posterior membrane terminating above or behind level of insertion of pelvic fin, interdorsal distance short, exceeding snout length; first dorsal-fin base 3.2 (2.0–2.8) times in second dorsal-fin base. Second dorsal fin rays tallest anteriorly; fin margin not indented, decreasing slightly in height posteriorly, anterior rays much taller than penultimate posterior rays; rays simple; fin base elongate, 72 (63–69)% SL; longest ray of second dorsal fin 0.92 (0.74–0.96) times in longest dorsal-fin spine; fin membrane relatively thick, usually fully or partly concealing bases of fin rays. Anal fin moderately tall; penultimate posterior fin rays subequal to those anteriorly; length of anal-fin base 1.9 (1.6–1.8) times in length of second dorsal-fin base. Pectoral fin extended, arm-like, radials elongate, robust; extending posteriorly for almost an eye diameter behind gill opening; fin rays filamentous distally, short, membranes deeply incised, increasingly so posteriorly, tips highly flexible. Pelvic fin short, robust; rays thick and fleshy, rather deeply incised; anterior spine short, embedded and indistinct; fin located on ventral surface, usually directed ventrolaterally; its base aligned horizontally; interpelvic space broad, flat to weakly concave. Caudal fin relatively short, margin narrowly rounded; length 2.9 (2.6–3.2) times caudal peduncle depth.

Coloration. In life: Two primary colour morphs exist but both are dominated by reddish tones. A bright red morph (CSIRO H 782–01, see Fig. 25A) is uniform vivid red (burgundy) over body and fin bases; outer parts of dorsal, caudal, anal, and pectoral fins bluish and white, sharply demarcated from reddish basal part of fins by a black edge; bluish and white areas confined to about half to a third of soft dorsal, anal and pectoral fins, covering most of caudal fin, and as two notches on first dorsal fin; pelvic fin mostly whitish; extremities of pectoral and pelvic fins red tipped; eye reddish pink; illicial stem red, esca pink. A mottled morph, which includes the neotype (CSIRO H 4118–01, see Fig. 24A), is less strikingly coloured: pink with extensive reddish patches and spots, densest over head and upper body; fins translucent pink, rich red with bluish areas, or consistent with body colour.

In preservative: Reddish areas fading to pinkish or white; bluish and black areas become dusky, brownish or black.

Size. To at least 90 mm SL (ca. 136 mm TL); smallest specimen examined 28.1 mm SL. Size of newly hatched young and egg capsule diameter unknown.

Distribution. In widely disjunct populations; collected off the Forestier Peninsula (ca. 42° 50'S, 147° 57'E) and Actaeon Islands, D'Entrecasteaux Channel (ca. 43° 30'S, 147° 03'E), southeastern Tasmania; also a single specimen from Bass Strait, off northern Tasmania (ca. 40° 58'S, 147° 25'E). Occurs demersally inshore at depths of about 1–20 m.

Etymology. Epithet based on *polio*, Latin for polish, in reference to its 'shining reddish brown appearance'. Vernacular name: Red Handfish (Last *et al.*, 2007).

Comparisons. *Thymichthys politus* is the only reddish coloured handfish with a warty skin, a slender body, and a short illicium with a large esca. It is distinguished from its closest relative, *T. verrucosus*, in the comparison section for that species.

Remarks. An imperfect figure (Fig. 1C) of a handfish, presumably of *T. politus*, was published in *Dr Ross's Van Diemen's Land Annual for 1835*. Richardson (1842) referred to this figure and named a reddish handfish collected by amateur naturalist, Mr T. Lempriere near the penal colony of Port Arthur, as *Cheironectes* (incorrect spelling of *Chironectes*) *politus*. Richardson provided brief details of colour and noted the unusual spinous dorsal and pectoral-fin shapes of this specimen. However, a formal description of this handfish was not completed until two years later (Richardson, 1844a, b).

It appears that *T. politus* was not uncommon at Port Arthur (Tasman Peninsula) in the early 1800's. Richardson (1844) quoting Lempriere (from a compiled list of fishes collected) wrote 'its colour is red, with spots, and all that I have seen were of the same size' – inferring that he had seen multiple specimens. However, *T. politus* may have undergone a major population decline at Port Arthur. There has been an active dive business in the area and substantial other independent commercial and recreational diving effort around

Port Arthur and its environs since the 1980s but only two reported local observations of *T. politus* have surfaced (Gowlett-Holmes, pers. comm.).

TABLE 7. Counts of pectoral-fin rays for species of the family Brachionichthyidae. Data for both sides are included where obtainable.

	Number of pectoral-fin rays					
	6	7	8	9	10	n
Brachionichthys australis		63				63
Brachionichthys hirsutus	1	154	1			156
Brachiopsilus dianthus				3	5	8
Brachiopsilus dossenus				6		6
Brachiopsilus ziebelli				22		22
Pezichthys amplispinus		14				14
Pezichthys compressus		4				4
Pezichthys eltanini		4				4
Pezichthys macropinnis		2				2
Pezichthys nigrocilium		2				2
Sympterichthys moultoni		4	4			8
Sympterichthys unipennis				2		2
Thymichthys politus				14	2	16
Thymichthys verrucosus		4	58	6	2	70

The Tasman Peninsula specimens, which were not retained, apparently resembled the mottled colour morph – figured by Edgar *et al.* (1982) based on a specimen collected from the D'Entrecasteaux Channel and conforming to Richardson's (1844a) description of the holotype: 'shining reddish brown, with minute paler marblings or reticulations'. The holotype suffered fin damage in the voyage from Australia to England (Richardson, 1844a) and was subsequently lost (Paxton *et al.*, 1989). Hence, in the absence of other material from Port Arthur, the neotype is based on the mottled morph (rather than the bright red morph) pending a molecular investigation of the conspecificity of these forms.

The collection method used by Lempriere was not discussed by Richardson but it is most likely to have been using a dip net over rock and weed substrates at low tide. A large population of *T. politus*, consisting of hundreds of individuals of the bright red morph, was discovered on an inshore reef at Primrose Sands (Frederick Henry Bay) in the 1990s (Gowlett-Holmes, pers. comm.). Individuals were found near the outer reef edge in 5 m depth but were also common in wading depths near the shore where they could have been easily collected using dip nets. Their habitat on the Primrose Sands reef consisted mainly of stands of the green alga *Caulerpa trifaria* and other mixed algae. More recently, this substrate has been almost totally destroyed by an infestation of the native sea urchin (*Heliocidaris erythrogramma*) and no handfishes have been seen there since.

Most museum specimens of *T. politus*, as well as those observed by divers, have been about 60–70 mm SL. However, a large specimen from an unknown locality off southern Tasmania (QVM T 2009:5:2), was much larger (ca. 90 mm SL). This individual is very elongate and differs from both other forms of *T. politus* in being dark brown and white in preservative.

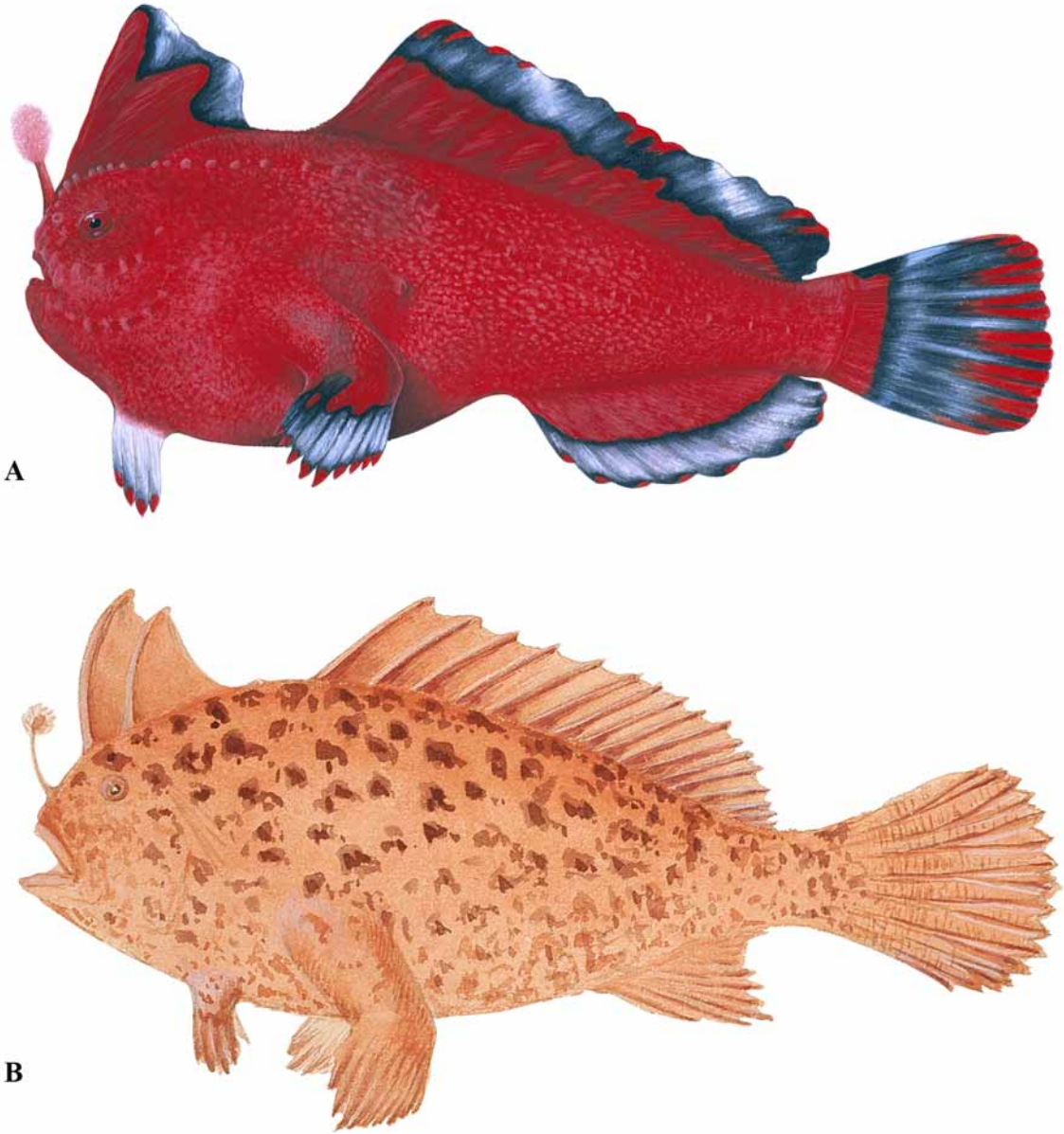


FIGURE 25. *Thymichthys politus* colour morphs: A. composite illustration of the 'bright red' morph by R. Swainston; and B. unpublished painting by Lady Lefroy of a 'red handfish', presumably the mottled morph, presented to R.M. Johnson in the late 19th C. Reproduced courtesy of University of Tasmania Archives.

Thymichthys verrucosus (McCulloch & Waite), new combination

Figs 2, 5, 6, 23, 26, 27; Tables 6–10

Sympterichthys verrucosus McCulloch & Waite, 1918: 76–77, pl. 7 (3) [original description].
Brachionichthys verrucosus: Scott, 1953: 159 [new combination].
Brachionichthys sp. 3: Last, Scott & Talbot, 1983: 253, fig. 22.5.

Holotype. SAMA F 626, ca. 31.5 mm SL (caudal fin broken off near its base), St Vincent Gulf, South Australia, ca. 34° 53'S, 138° 06'E, no other data.

Paratype. SAMA F 627, 28.6 mm SL, same data as holotype.

TABLE 8. Counts of second dorsal-fin rays for species of the family Brachionichthyidae.

	Number of second dorsal-fin rays						
	14	15	16	17	18	19	n
Brachionichthys australis			7	18	6		31
Brachionichthys hirsutus				10	49	8	67
Brachiopsilus dianthus				2	2		4
Brachiopsilus dossenus				3			3
Brachiopsilus ziebelli			1	7	2		10
Pezichthys amplispinus		2	5				7
Pezichthys compressus	1	1					2
Pezichthys eltanini		1	1				2
Pezichthys macropinnis		1					1
Pezichthys nigrocilium		1					1
Sympterichthys moultoni		3	1				4
Sympterichthys unipennis				1			1
Thymichthys politus			3	5			8
Thymichthys verrucosus	2	1	18	14	1		36

TABLE 9. Counts of anal-fin rays for species of the family Brachionichthyidae.

	Number of anal-fin rays						
	6	7	8	9	10	11	n
Brachionichthys australis			2	14	15	1	32
Brachionichthys hirsutus			1	22	44	2	69
Brachiopsilus dianthus				2	2		4
Brachiopsilus dossenus					3		3
Brachiopsilus ziebelli				6	4		10
Pezichthys amplispinus		1	4	2			7
Pezichthys compressus			1	1			2
Pezichthys eltanini		1	1				2
Pezichthys macropinnis			1				1
Pezichthys nigrocilium			1				1
Sympterichthys moultoni		2	2				4
Sympterichthys unipennis				1			1
Thymichthys politus				5	3		8
Thymichthys verrucosus	2	12	15	7			36

TABLE 10. Counts of vertebrae for species of the family Brachionichthyidae.

	Number of trunk vertebrae				Number of caudal vertebrae						Total number of vertebrae							
	8	9	10	11	10	11	12	13	14	15	20	21	22	23	24	25	26	n
Brachionichthys australis		7	5					8	5				3	10				13
Brachionichthys hirsutus		1	6	4				6	7	1			1	2	5	2	1	11
Brachiopsilus dianthus			2	2			1	3					1	1	2			4
Brachiopsilus dossenus		2	1					2	1				1	2				3
Brachiopsilus ziebelli		1	8	1				7	3				1	6	2	1		10
Pezichthys amplispinus		7					7					7						7
Pezichthys compressus			2			2						2						2
Pezichthys eltanini		1	1			1	1				1		1					2
Pezichthys macropinnis		1					1					1						1
Pezichthys nigrocilium		1					1					1						1
Sympterichthys moultoni		2	2			2	2					4						4
Sympterichthys unipennis		1						1					1					1
Thymichthys politus	1	3	4				1	2	5				3	3	2			8
Thymichthys verrucosus		5	24	2	1	11	15	4			2	9	19	1				31

Additional material. 49 specimens (5–67 mm SL): AMS IA 3604, ca. 58 mm SL (damaged), south of Montague Island, New South Wales, ca. 36° S, 150° E, 1928; CSIRO H 796–01, 40.5 mm SL, Ringarooma Bay, Tasmania, 40° 50'S, 147° 49'E, 29–30 m, 21 Jul. 1987; CSIRO H 974–03, 60.5 mm SL, Tasmania, no other data; CSIRO H 3781–01, 63.5 mm SL, north-east of Eden, New South Wales, 36° 58'S, 150° 12'E, 115–117 m, 4 Sep. 1994; CSIRO H 3792–03, 34.9 mm SL, south-east of Lakes Entrance, Bass Strait, Victoria, 38° 36'S, 148° 33'E, 125 m, 27 Aug. 1994; CSIRO H 3792–04, 62.3 mm SL, south-east of Lakes Entrance, Bass Strait, Victoria, 38° 36'S, 148° 33'E, 125 m, 27 Aug. 1994; CSIRO H 3795–01, 49.9 mm SL, south-east of Gabo Island, Victoria, 37° 43'S, 150° 05'E, 136 m, 16 Sep. 1994; CSIRO H 4119–01, 36.4 mm SL, east of Maria Island, Tasmania, 42° 43'S, 148° 24'E, 87–152 m, 5 Nov. 1984; CSIRO H 4267–01, 47.8 mm SL, south of Green Cape, New South Wales, 37° 19'S, 150° 04'E, 82 m, 6 May 1996; CSIRO H 4451–01, 53.1 mm SL, east of Disaster Bay, New South Wales, 37° 18'S, 150° 17'E, 125 m, 7 Dec. 1996; CSIRO H 4452–01, 45.3 mm SL, south-west of Cape Everard, Victoria, 38° 03'S, 149° 07'E, 112–115 m, 25 Nov. 1996; CSIRO H 4453–01, 45.1 mm SL, CSIRO H 4453–02, 44.9 mm SL, CSIRO H 4453–03, 67.1 mm SL, CSIRO H 4453–04, 52.8 mm SL, and CSIRO H 4453–05, 61.0 mm SL, east of Bermagui, New South Wales, 36° 30'S, 150° 18'E, 214–225 m, 1 Dec. 1996; CSIRO H 5311–01, 57.5 mm SL, south-west of Cape Everard, Victoria, 37° 57'S, 149° 16'E, 111–113 m, 24 Apr. 2000; CSIRO T 1, 54.1 mm SL, Frederick Henry Bay, Tasmania, ca. 42° 55'S, 147° 36'E, 1 Jun. 1905; CSIRO T 5, 4 specimens, 48.1–61.6 mm SL, east of Flinders Island, Bass Strait, Tasmania, 40° 00'S, 148° 47'E, 20 m, 13 Apr. 1985; CSIRO T 9, 2 specimens, 34.5–49.8 mm SL, east of Flinders Island, Bass Strait, Tasmania, 40° 00'S, 148° 47'E, 4 Jun. 1905; NMV A 2629, 41.1 mm SL, off Lakes Entrance, Bass Strait, Victoria, 38° 54'S, 147° 55'E, 71 m, 17 Nov. 1981; NMV A 3040, 57.4 mm SL, 22 km south-east of Point Hicks, Victoria, 38° 01'S, 149° 10'E, 115 m, 30 Jun. 1982; NMV A 13022, 2 specimens, 39.7 and 48.7 mm SL, south-east of Merimbula, New South Wales, 36° 53'S, 150° 12'E, 117–119 m, 5 Aug. 1993; NMV A 29405–001, 2 specimens, 51.8–53.7 mm SL, off Marlo, Bass Strait, Victoria, 38°

27'S, 148° 26'E, 226 m, 10 Sep. 1984; NMV A 29408–002, 61.8 mm SL, off Cape Conran, Bass Strait, Victoria, 38° 00'S, 148° 09'E, 118 m, 22 Sep. 1983; NMV A 29409–002, 44.7 mm SL, off Marlo, Bass Strait, Victoria, 38° 33'S, 148° 24'E, 218–221 m, 6 Jun. 1984; NMV A 29409–003, 51.0 mm SL, off Marlo, Bass Strait, Victoria, 38° 33'S, 148° 24'E, 218 m, 6 Jun. 1984; NMV A 29413–001, 60.7 mm SL, off Lakes Entrance, Bass Strait, Victoria, 38° 10'S, 148° 32'E, 76 m, 7 Jun. 1982; NMV A 29414–001, 54.3 mm SL, off Lakes Entrance, Bass Strait, Victoria, 38° 51'S, 148° 8'E, 78 m, 10 Sep. 1983; NMV A 3040, 57.0 mm SL, off Cape Conran, Bass Strait, Victoria, 38° 02'S, 149° 10'E, 114 m, 30 Jun. 1982; NMV A 4268, 3 specimens, 5.4–16.9 mm SL, east of Maria Island, Tasmania, 42° 37'S, 148° 13'E, 100 m, 23 Apr. 1985; SAMA F 668, 3 specimens, 29.9–41.5 mm SL, east of Glenelg, Gulf St Vincent, South Australia, 34° 34'S, 138° 19'E, no other data; SAMA F 4750, 52.5 mm SL, Venus Bay, western Eyre Peninsula, South Australia, ca. 33° 12'S, 134° 40'E, Aug. 1983; SAMA F 10458, 57.0 mm SL, and SAMA F 10459, 54.8 mm SL, Venus Bay, western Eyre Peninsula, South Australia, ca. 33° 12'S, 134° 40'E, 37–55m, Jul. 1982; SAMA F 11927, 40.3 mm SL, off Wilson Bluff, Great Australian Bight, South Australia, 33° 20'S, 130° 12'E, 196 m, 3 Aug. 1981; SAMA F 11928, 59.4 mm SL, Venus Bay, western Eyre Peninsula, South Australia, ca. 33° 12'S, 134° 40'E, 32–45 m, 1 Jun. 1982; SAMA F 11929, 53.7 mm SL, Venus Bay, western Eyre Peninsula, South Australia, 33° 12'S, 134° 40'E, 1 Aug. 1982; TMH D 928, 28.1 mm SL, off Bridport, Bass Strait, Tasmania, ca. 40° 57'S, 147° 26'E, 15 Oct. 1950.

Diagnosis. Member of the genus *Thymichthys* with a combination of the following characters: esca variable in size, length 23–57% (mean 37%) of illicium length (including esca); illicium short to moderately elongate, not thick and fleshy, without dermal spinules, length 15–27% SL, 1.9–3.4 times in head length, its base adjacent upper jaw (pre-illicial length 1.2–3.2% SL); eye small, diameter 4.8–7.1 times in head length; body usually densely covered with prominent, close-set, globular or fleshy warts; skin with small, widely spaced, embedded, spiny scales and variably developed dermal flaps; spinules unicuspid or bicuspid, prostrate, their tips embedded or barely visible); second dorsal-fin rays 14–18 (mainly 16–17), fin base length 60–73 (mean 66)% SL; length of second dorsal-fin spine 1.1–1.6 times length of longest ray of second dorsal fin; 6–9 anal-fin rays; usually 8 pectoral-fin rays; body brownish with lighter and darker blotches and spots; presence of blackish bar on caudal peduncle and caudal-fin base that extends onto hind parts of dorsal and anal fins.

Description. Based on tasselled form (types damaged); morphometric data based on tasselled form, data for eastern form in parentheses (see also remarks below); meristic data for types given first followed by data for other material.

D1 holotype 2, paratype 2 (2, n=34); D2 14, 14 (15–18, rarely 15 or 18); A 6, 6 (7–9, rarely 9); Pc damaged, possibly 7–8 (7–10, usually 8); Pv i 4, i 4 (i 4); C damaged, 1 (1) + damaged, 7? (6–7, rarely 7) + damaged, 1? (1–2, rarely 1) = 9, 9 (9); Vt 10, 9 (9–11, mainly 10) + 10, 11 (11–13, rarely 13) = 20, 20 (21–23, rarely 23).

Body relatively short, usually robust anteriorly; upper anterior margin strongly convex and elevated; profile truncate to weakly convex above mouth (pre-illicial snout almost vertical); margin below first dorsal fin almost straight, with a broad supraocular shelf, usually with a notch above posterior eye; upper eye well separated from dorsal margin; nape variably humped; profile subtriangular to compressed slightly when viewed anteriorly; anterior ventral profile convex, more flattened between pelvic fins; abdomen little to slightly expanded; caudal peduncle short, length 3.5–5.1 (3.4–8.7)% SL. Head length 49–53 (49–56)% SL; snout short, length 5.1–6.1 (5.1–7.1) times in head; eye small, diameter 4.8–6.1 (4.9–7.1) times in head length; gill opening large, tubiform, aperture slightly smaller than eye; prominent, protruding from head; skin smooth and distinct from warty skin adjacent; located above insertion of pectoral fin. Nostrils small, obscure, usually indistinct from surrounding pores of the cephalic sensory system; apertures small, well separated (anterior opening about half way between upper jaw and posterior opening); anterior opening usually short, tubular and fringed distally; posterior opening short, tubular (pore-like), located well away from orbit, near horizontal level of ventral aspect of eye and dorsally or posterodorsally to anterior opening. Mouth variable, small to moderate in size, terminal, not protractile; upper jaw slightly oblique, 3.2–3.6 (2.8–3.6) in head; lips

narrow, fleshy, partly recessed into well-developed, circumoral groove; angle of jaw retracting into groove below anterior half of eye; tongue well developed, rounded apically. Teeth small, villiform, in narrow bands in both jaws; band in lower jaw broader near symphysis than in upper jaw (mouth not dissected).

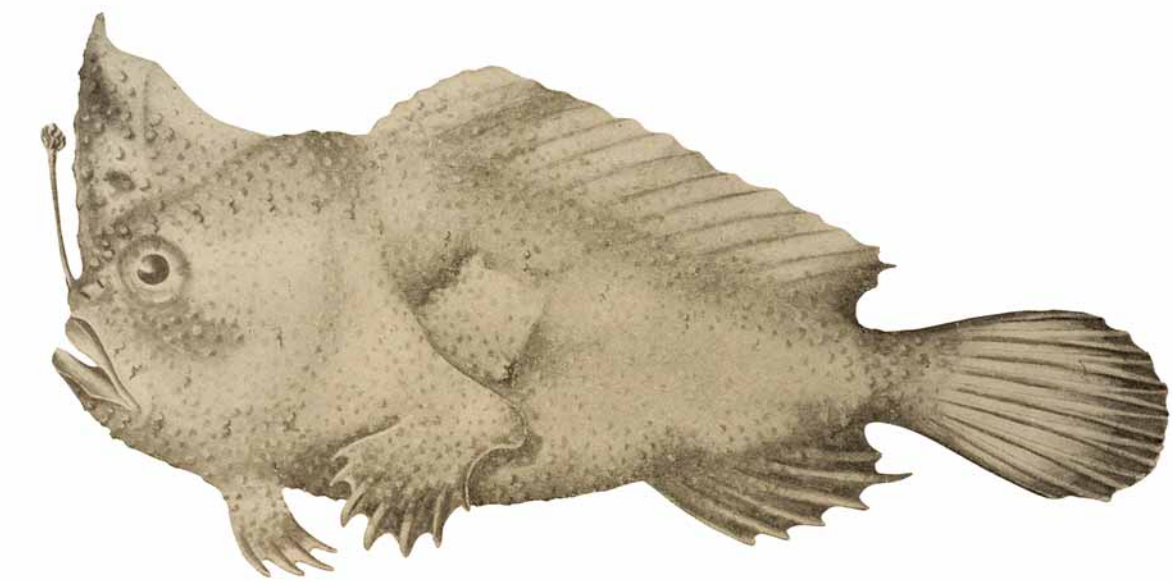


FIGURE 26. *Thymichthys verrucosus*, lateral view of SAMA F 626, holotype, 31.5 mm SL, from McCulloch and Waite, 1918 (image reversed). Reproduced courtesy of University of Tasmania Archives – demonstrates strong Moiré effect.

Skin thick, flabby, very corrugated; body densely covered over most of surface with small to large (possibly smaller or indistinct in some specimens due to preservation), wart-like protuberances; warts very close set, globular apically in best preserved material; rarely terminating posteriorly in a protruding spinule. Body scales variably developed, sparse, usually densest on head, patchy and widely separated on tail, absent ventrally on belly; their bases variable in shape, deeply embedded; narrow monospinulate or bicuspid with very short, barely emergent tips; spinules originating at posterior margin of scale base, tips directed obliquely, posteriorly on tail, often more dorsally on head. Small to large dermal flap usually present on mid-arm of pectoral fin; flap thallate, irregular in shape, simple or complex, subequal in size to gill opening in some specimens; dermal filaments present over most of head and body, their length and shape variable. Fin spines and rays and their associated membranes without visible spines (sometimes sparse, minute, embedded as evident from radiographs), instead covered with small warts and dermal filaments (densest basally); fin membranes thick, fleshy; illicium naked, covered with thick, almost smooth, fleshy skin. Scales of acousticolateralis system bicuspid, with small, oval central pore flanked by slender apical spinules; spinules almost U-shaped, much longer than spinules of body scales; arranged in well defined series; most pronounced on head (below lower jaw, below and above eye, and on operculum and nape) and as a single row extending along mid-upper trunk more or less parallel to dorsal margin to caudal-fin base.

Illicium terminal on snout; its base adjacent upper jaw and almost confluent with origin of first dorsal fin; moderately elongate, length 1.9–2.6 (2.1–3.4) times in head length, 1.2–1.5 (1.2–1.7) times in length of second dorsal-fin spine; apex of depressed esca reaching to slightly behind base of third dorsal-fin spine; illicium retractable into a narrow, fleshy groove beside first dorsal fin (groove usually present only on one side of head, no obvious preference for either side); esca of moderate size, with short, slender or narrowly thallate filaments, its length 1.9–3.1 (1.7–4.4) times in length of illicium; filaments dense, almost straight to twisted slightly; illicial base distinct, expanded slightly but not obscured by skin. First dorsal fin not greatly elevated, its base long; second dorsal-fin spine almost straight to recurved slightly, originating adjacent base of illicium, slightly longer than third spine; membrane of fin terminating above or slightly behind pelvic-fin base; first dorsal-fin base 2.1–2.3 (2.1–2.9) times in second dorsal-fin base. Second dorsal fin rays not elevated

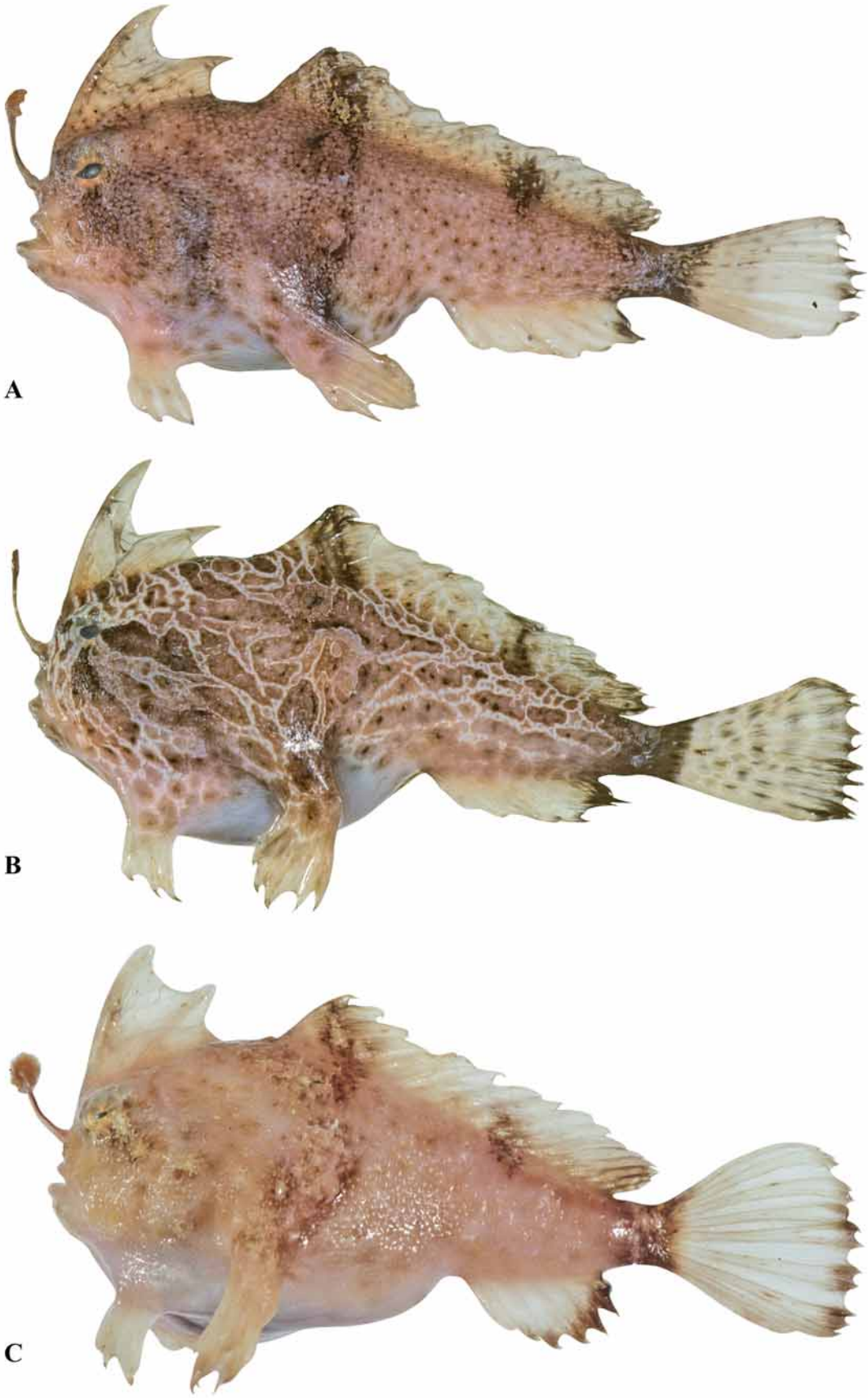


FIGURE 27. Variation in coloration in *Thymichthys verrucosus*: A. CSIRO H 4453–03, 67.1 mm SL, 'spotted' morph; B. CSIRO H 4453–04, 52.8 mm SL, 'network' morph; and C. CSIRO H 5311–01, 57.5 mm SL, 'plain' morph.

anteriorly; fin margin not indented, almost straight to weakly convex, barely decreasing in height posteriorly, last few posterior rays smallest; rays simple; fin base elongate, 67–73 (60–73)% SL; longest ray of second dorsal fin 1.2–1.5 (1.1–1.6) times in longest dorsal-fin spine; fin membrane relatively thick, partly concealing bases of fin rays. Anal-fin moderately tall, penultimate posterior rays subequal to those anteriorly; length of anal-fin base 2.0–2.3 (1.9–2.3) times in second dorsal-fin base. Pectoral fin strongly arm-like, radials elongate, robust, extending posteriorly for up to an eye diameter behind gill opening; fin rays weakly filamentous distally, short, membranes deeply incised, slightly more so posteriorly, tips flexible. Pelvic fin well developed, robust; rays thick and fleshy, rather deeply incised; anterior spine short, embedded and indistinct; fin located on ventral surface, directed ventrolaterally or posteroventrally, base aligned horizontally; interpelvic space broad, flat to weakly concave. Caudal fin moderately elongate, narrowly rounded to emarginate; length 2.8–4.3 (3.0–4.8) times caudal peduncle depth.

Coloration. McCulloch and Waite (1918) describe the alcohol preserved holotype as 'brownish with lighter and darker areas; a large whitish blotch above the gill opening and another above the anterior dorsal rays; indefinite dark markings on the head below the eye, on the anterior portion of the back, and covering the abdomen; first dorsal with a dark basal spot, and a larger one on its upper third; an oblique dark marking covers the base of the tail, the posterior dorsal rays, and all the anal fin; distal portions of the caudal and pectoral fins blackish.' The holotype and paratype, which are now uniformly dark brown and appear to have been dehydrated at some stage (shrunken and brittle), are not useful for describing its colour. However, material examined indicated that this species is highly variable in coloration but there are some consistent features that were noted above. These include: body brownish with lighter and darker blotches and/or spots and the presence of a blackish bar on the caudal peduncle and caudal-fin base extending onto the hind parts of dorsal and anal fins (persistent in old preserved material). Also, the outer margins of the pectoral and caudal fins are often blackish, and the entire outer half of the anal fin is black in some specimens. Some specimens have small brownish black spots on the fins and ventral head (e.g. CSIRO H 4453–03, Fig. 27A), and are covered dorsally with a distinct network pattern (e.g. CSIRO H 4453–04, Fig. 27B), or a more simple pattern of dark markings (e.g. CSIRO H 5311–01, Fig. 27C). Fresh coloration: light and dark areas and markings more obvious than in preserved material.

Size. Attains at least 67 mm SL and ca. 93 mm TL. The holotype, which is damaged with the caudal fin separated at the peduncle, is now about 31.5 mm SL and 40 mm TL (including the tail fragment). The paratype is intact and is 28.6 mm SL and about 37 mm TL. Both specimens are strongly dehydrated and much shorter than the manuscript lengths of 45 mm and 41 mm (presumed TL but not stated in McCulloch and Waite's manuscript) respectively. Several specimens are gravid, including the paratype; other gravid females ranged from 40.5–60.5 mm SL (n=12). Egg capsule diameter ranged from ca. 1.6–3.2 mm and the eggs are slightly smaller, 1.5–2 mm diameter.

Distribution. The type material was collected in St Vincent Gulf, South Australia (ca. 34° 53'S, 138° 06'E). Comparative material was collected off Wilson Bluff, central Great Australian Bight (33° 20'S, 130° 12'E), eastward to off Bermagui in southern New South Wales, and southward through Bass Strait to Frederick Henry Bay, southeastern Tasmania (ca. 42° 55'S, 147° 36'E); depth to about 230 m.

Etymology. The epithet is presumably based on the Latin *verrucosus* (full of warts) with reference to the obvious warty nature of its skin. Initially referred to in the vernacular as the Warty Handfish (Whitley, 1949) and retained as such as the Australian Standard Name (Yearsley *et al.*, 2006).

Comparisons. *Thymichthys verrucosus* differs from its congener, *T. politus*, in some meristic values, coloration, morphology of the skin and illicium, and in several morphometric features. The morphs of *Thymichthys verrucosus* have a relatively longer (15–27% vs. 14–17% SL in *T. politus*) and more slender illicium with a proportionally smaller esca; the illicium is also located closer to the upper jaw (pre-illicial distance 1.2–3.2 vs. 3.3–7.9% SL). These species differ in colour with *T. verrucosus* being primarily brownish on the body with lighter and darker blotches and spots, and has a blackish bar on the caudal peduncle and caudal-fin base that extends onto the hind parts of dorsal and anal fins. In *T. politus* the body is reddish or pinkish and there is no equivalent dark band near the caudal base. *Thymichthys verrucosus* has more

prominent, wart-like structures on the skin (usually globular rather than flattened) and dermal flaps, particularly those on the arm of pectoral fin, nape and sides of tail, are much better developed (dermal flaps usually rudimentary or absent in *T. politus*).

The morphs of *Thymichthys verrucosus* also have a more robust body with larger proportions around the head than *T. politus*: eye diameter 7.3–11 vs. 5.6–6.7% SL; and maxillary length 14–18 vs. 11–13% SL. Other differences include: length of second dorsal fin spine 25–37 vs. 19–24% SL in *T. politus*; anal-fin base (28–36 vs. 37–42% SL); length of longest dorsal-fin spine 1.1–1.6 vs. 0.7–1.0 times length of longest ray of second dorsal fin. *Thymichthys verrucosus* has fewer anal-fin (usually 7–8 vs. 9–10) and typically fewer pectoral-fin rays (usually 8 vs. 9–10).

Remarks. *Thymichthys verrucosus* is represented in collections (n=51) by at least four morphs and may represent an unresolved species complex. These forms all have warty skin, a brownish mottled colour pattern with a blackish bar through the posterior tail and caudal fin which is unique to *T. verrucosus*. However, meristic ranges were atypically broad for these specimens, and there appear to be differences in body shape, skin morphology, colour, illicium shape, and size at maturity. The holotype and paratype differ from all other material in having unusually low second dorsal (14 in both types vs. 15–18 rays, only one of 35 specimens had 15 rays), anal (6 in both types vs. 7–9 rays) and vertebral (20 in both types vs. 21–23 rays) counts. The paratype, a gravid female, was only 28.6 mm SL which was much smaller than the next smallest female with an obvious egg mass (CSIRO H 796–01, 40.5 mm SL). Otherwise, an illustration of the holotype resembles specimens of the tasselled form (on which the description above is based) in having prominent warty skin and very well-developed dermal flaps and filaments; both types are now badly desiccated and very fragile, so coloration and details of skin texture could not be determined. However, the above characters are clearly evident from McCulloch and Waite's original description and drawing. Ranges of these forms overlap but there is no evidence to suggest they are sympatric; the ornate tasselled form occurs from the Great Australian Bight (off South Australia), through Bass Strait, to Tasmania, whereas both types were collected in Gulf St Vincent (South Australia). Given the poor state of preservation of types it was not possible to obtain useful morphometric data for comparison; consequently, we were unable to obtain additional characters to shed light on their taxonomic status.

The other two morphs are included mainly in material collected further east: a bulbous headed, slightly compressed form distributed from the Great Australian Bight to Lakes Entrance, eastern Victoria, and a compressed, non-bulbous headed form found off eastern Victoria and southern New South Wales. There are minor differences between these forms in coloration, esca size, wartiness of the skin, spinule exposure and density, thickness of fin membranes, abdomen extension, and tail depth and elongation. Some of these variations may be linked to general variability in body shape of soft-bodied fishes and others to artefacts of preservation. However, some of these differences seem to be consistent within regions providing evidence of either population or species structure. The forms have been combined in this study pending the collection of more material (particularly from the type locality), and a comprehensive molecular study. The Barcode of Life Project for fishes (FISHBOL), using the CO1 gene, has successfully discriminated several species of handfishes (Last *et al.*, 2007; Holmes, unpublished data) and should shed light on their relationships.

Biogeography

Nelson (2006) gives a distribution of the family as southern Australia, primarily Tasmania, in depths to 60 m. The present study extends the known range of the group to include western Australia (west to about Middini Beach in the Great Australian Bight, ca. 127° 31′E) to eastern Australia (north to Stradbroke Island, southern Queensland, ca. 27° 35′E). This broad distribution rests on the basis of a single species, *Brachionichthys australis*. Apart from *Thymichthys verrucosus*, which may be a species complex, all other species are micro-endemics. Of the 14 recognised species, 7 (*Brachionichthys hirsutus*, *Brachiopsilus dianthus*, *Brachiopsilus ziebelli*, *Pezichthys eltanini*, *Pezichthys nigrocilium*, *Thymichthys politus* and possibly *Sympterichthys*

unipennis) appear to be confined to Tasmanian waters, and another 4 species (*Brachiopsilus dossenus*, *Pezichthys amplispinus*, *Pezichthys compressus* and *Sympterichthys moultoni*) are confined to southeastern Australia (between southeastern Tasmania and southern New South Wales). Two genera, *Brachiopsilus* and *Sympterichthys*, are probably represented only in eastern Bass Strait and off Tasmania. A juvenile specimen of *Pezichthys macropinnis* (from the Great Australian Bight) is the only handfish known solely from west of Bass Strait.

Handfishes occur mainly on the continental shelf and some such as *Brachionichthys hirsutus*, *Brachiopsilus dianthus*, *Brachiopsilus ziebelli* and *Thymichthys politus*, are known from or mainly live shallower than 40 m. The deepest record is of *Pezichthys eltanini* which was captured at a depth of 520 m. Other species are confined to the continental shelf, although *Brachionichthys australis*, *Brachiopsilus dossenus*, *Pezichthys compressus*, *Sympterichthys moultoni* and *Thymichthys verrucosus*, extend slightly deeper onto the upper continental slope just beyond the shelf break (to ca. 230 m).

Some of the best known inshore species have very small geographic ranges. *Brachionichthys hirsutus* is now confined the environs of the Derwent Estuary, and *Brachiopsilus ziebelli* and *Thymichthys politus* occur in small, widely disjunct populations (a few km^2). Offshore species, *Pezichthys amplispinus* and *Pezichthys compressus*, have been collected on the outer continental shelf within relatively small areas (ca. 200–1000 km^2).

The contemporary distribution of handfishes is somewhat difficult to explain given that a fossil of *Histionotophorus bassanii* (de Zigno), considered to be a brachionichthyid by Rosen & Patterson (1969), was taken from the Monte Bolca sediments, Italy (Eocene). Pietsch (1981), based on data extracted from the few then known species, thought that this genus should be synonymised with *Brachionichthys*. De Zigno's fish shares important similarities with modern brachionichthyids, including a dorsal fin with 3 well-developed cephalic spines with a distinct membrane between the last two spines, no epural, an oblique mouth, elongate caudal-fin rays and two elongate pectoral-fin radials, but its placement in *Brachionichthys* as defined herein is probably inappropriate. *Histionotophorus bassanii* has unusually long fins and exhibits important differences from extant handfishes in fin counts based on values obtained from three specimens by Eastman (1904): soft dorsal-fin rays 13 (14–19 in modern brachionichthyids), pelvic-fin rays presumably 6 (5 as 1 spine, 4 rays) and caudal-fin rays 8 (9, very rarely 10). A figure of this species (BMNH P 19060) and an illustration of the caudal skeleton (Rosen & Patterson, 1969), also show 8 caudal-fin rays (upper 7 branched, lowermost simple) whereas modern handfishes typically have 9 rays (with mainly 6 branched rays and 3 simple rays; the lowermost pair are simple). Eastman (1904) seems to have transposed values for the pectoral (given as P. 6, but drawn as 7 in composite reconstruction) and pelvic fins (given as V. 7, but drawn as 6). *Pezichthys macropinnis*, which is based on a juvenile, has unusually long fins and lower fin rays counts than most of its confamilials. It also has 7 pectoral-fin rays and 21 vertebral centra (vs. 22 in *Histionotophorus*, 18 of de Zigno confirmed by Eastman to be incorrect). However, the skin is reported by Eastman to be naked (rough and spiny in *Pezichthys*).

Eastman (1904) was perplexed that a highly modified fish could appear suddenly in the Eocene and remain essentially unchanged until modern times. Similarly, it is equally perplexing that a group represented in the Palaeogene in present day Italy, could now be confined to southern and eastern Australia. For example, a more derived antennarioid sister group, the antennariids, are represented in all tropical and subtropical seas, except the Mediterranean (Nelson, 2006). Palaeogeographic models do not support an obvious pathway between Australia and the Mediterranean Sea during the Eocene.

Clearly, this distribution is unusual but could have arisen in much the same way as disjunct populations form and local extinctions occur in the modern fauna. Handfishes appear to be very poor dispersers as both young and as adults. They prefer to 'walk' over the substrate rather than swim so remain localised. They lay small clusters of large eggs that are attached to the bottom in bundles. After hatching, the young appear to remain in the general vicinity of the clutch. Hence, their distributions are often patchy with limited mixing of populations. A widespread but patchily distributed and vulnerable ancient fauna (possibly evolving in the late

Cretaceous or early Palaeogene) could have been subjected to broad scale extinction events (possibly in the mid to late Tertiary). A remnant fauna appears to have survived in Australian seas and radiated locally. The temperate Australian fish fauna contains high levels of local endemism, including some endemic families and genera. Some of these taxa, such as *Pseudaphritis* and *Zearaja*, are now thought to be ancient taxa (Balushkin, 1992; Last & Gledhill, 2007) and their persistence in the region may be coincidental with the extant distribution of a highly vulnerable group such as the Brachionichthyidae. In summary, the unique palaeogeography of the Australian region may have provided a faunal refuge when major extinction of these groups took place elsewhere.

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