

# Review of the Dinematchthyini (Teleostei, Bythitidae) of the Indo-west Pacific. Part II. *Dermatopsis*, *Dermatopsoides* and *Dipulus* with description of six new species

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## ABSTRACT

An ongoing revision of the dinematchthyine fishes (Ophidiiformes, Bythitidae, Bromphycinae) of the Indo-west Pacific based on ca. 5000 specimens will be published in several parts. Part II includes 363 identified specimens in the genera *Dermatopsis* Ogilby, 1896 (*D. greenfieldi* n. sp. from Fiji, *D. hoesei* n. sp. from south-eastern Australia, *D. joergennielsen* n. sp. from New Zealand and *D. macrodon* Ogilby, 1896, from south-eastern Australia); *Dermatopsoides* Smith, 1947 (*D. andersoni* n. sp., *D. kasougae* (Smith, 1943) and *D. talboti* Cohen, 1966, from South Africa, and *D. morrisonae* n. sp. from Western Australia), and *Dipulus* Waite, 1905 (*D. caecus* Waite, 1905 and *D. hutchinsi* n. sp. from Western Australia, *D. multiradiatus* (McCulloch and Waite, 1918) from southern Australia, and *D. norfolkanus* Machida, 1993a, from Norfolk Island). *Dermatopsis multiradiatus* McCulloch and Waite, 1918, is reassigned to *Dipulus*. The three genera are distributed along the subtropical shores of South Africa, Australia, northernmost New Zealand and the Norfolk Island and the tropical shores of Fiji. The genera contain mainly fishes adapted to rocky shores as compared to the predominance of other Dinematchthyini found in reef environments. The three genera are indicated to be closely related, sharing characters such as a maxilla not expanded postventrally, the head without scales and lacking an upper preopercular pore. *Dermatopsoides* is further characterized by the lack of an exposed opercular spine (i.e. completely covered by skin), a character unique amongst Indo-west Pacific dinematchthyine genera. The main distinguishing characters of the species contained in these genera are vertebrae and fin ray counts, morphometric characters, head pores and the morphology of otoliths and pseudoclasts.

KEYWORDS: viviparous brotulas, Indo-west Pacific, Australia, South Africa, New Zealand, Norfolk Islands, Fiji, new species.

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## INTRODUCTION

This review of the dinematiichthyine fishes, a tribe within the subfamily Brommophycinae of the viviparous family Bythitidae, is the fourth part since its inception, dealing first with the American Dinematiichthyini (Møller *et al.* 2004a, 2005) and the second on Dinematiichthyini from the Indo-west Pacific (Schwarzhans *et al.* 2005). The ongoing review of the Indo-west Pacific Dinematiichthyini will result in two more publications before the world-wide review of the group is completed.

Prior to this review, the genera *Dermatopsis* (Ogilby, 1896) and *Dermatopsoides* (Smith, 1947), had been subject to a specific review by Cohen (1966), in which he created the new tribe Dermatopsini for the genera *Dermatopsis*, *Dermatopsoides*, *Gnaterichthys* Dawson, 1966 (then undescribed), and possibly *Diaucistrus* Ogilby, 1899. Cohen stated that there “is a group of several genera which are more closely related to each other than to the *Dinematiichthys-Ogilbia* group”. In the diagnosis of his new tribe he listed amongst others “a single pair of hard genital claspers”, “scales probably lacking on head” and “posterior end of maxillary not greatly expanded vertically” (see Cohen 1966: fig. 1). He also discussed at length the possible relationship of the then monospecific genus *Dipulus* Waite, 1905, with this group, but concluded that “a proper assessment of its relationships requires further study”. In our present concept, Cohen’s Dermatopsini are not recognized within the limits of the Dinematiichthyini as defined by Cohen and Nielsen (1978). However, the current review supports the close relationship of *Dermatopsis*, *Dermatopsoides* and *Dipulus* and may well warrant their separation into a distinct systematic unit. *Diaucistrus* on the other hand does not have the apomorphic shape of the posterior maxillary shared by the three other genera, and was therefore treated in a separate publication (Schwarzhans *et al.* 2005). The American genus *Gnaterichthys* shares the same type of low maxilla, lack of scales on the head and free opercular spine and seems indeed to be closely related to *Dermatopsis*, *Dermatopsoides* and *Dipulus*. It was revised in a publication dealing with American

genera (Møller *et al.* 2004a), and is not included herein. A phylogenetic analysis and possible subdivision of the Dinematiichthyini will be subject to a special publication following the completion of the ongoing review.

*Dermatopsis* and *Dipulus* were discovered more than 100 years ago (Ogilby 1896; Waite 1905) from the east and south Australian shores and have regularly been collected in high numbers since. *Dermatopsoides* on the other hand was first discovered in the middle of the last century (Smith 1943, 1947) and its species have been caught extremely rarely, despite of the introduction of scuba diving and rotenone, which has greatly aided the collection of these cryptic fishes.

The species of the genus *Dipulus* belong to the longest of all Dinematiichthyini and may reach up to almost 200 mm in length; those of the genera *Dermatopsis* and *Dermatopsoides* are smaller, often mature at sizes of 30–50 mm. Dinematiichthyine fishes live in shallow tropical to subtropical waters, hidden in holes and crevices of coral reefs, algae beds and rocky shores. Different reefal and non-reefal environments can be dominated by different groups of the Dinematiichthyini. The species of the three genera reviewed here, however, generally occur in non-reefal environments and are typical for the subtropical rocky shores of South Africa, Australia and northern New Zealand. Only a few species are found in reef-related habitats along the tropical shores of Australia and Fiji. While the geographical distribution of most dinematiichthyine species is already very restricted, those of the genera *Dermatopsis*, *Dermatopsoides* and *Dipulus* exhibit a particularly narrow distribution pattern in some cases, for instance a species endemic to tiny Norfolk Island and a small area at the northern tip of New Zealand or at the south-westernmost area of Western Australia. These narrow distributions might be related to the exceptionally low fecundity in these genera, where no more than four embryos have been found in gravid females.

*Dipulus* was considered a monotypic genus until Machida (1993a) described a second endemic species from Norfolk Island. *Dermatopsis* was known from two

species along the temperate shores of Australia, of which one, *Dermatopsis multiradiatus*, is here assigned to the genus *Dipulus*. With this, a single described species of *Dermatopsis* (*D. macrodon*) remains known from the subtropical shores of south-eastern Australia, chiefly south of the Great Barrier Reef. Now there are three more new species of *Dermatopsis* described herein, one sympatric with *D. macrodon*, a second endemic to northern New Zealand and a third from Fiji. *Dermatopsoides* was previously regarded as geographically restricted to South Africa (two described and one new species), but is now also recorded from the south-western tip of Western Australia with one new species.

The species reviewed here show a higher degree of variation in their general appearance, morphometric measurements and meristic counts than most other dinematichthyines and are mostly slender in body form. Their live coloration, where known, tends to be uniform, the prevailing colours being red, yellow, orange and brown, but there are also species in *Dermatopsis* and *Dermatopsoides* with well-marked dark dorsal and anal fins. Also, head pores and otolith morphology were found to be useful at generic and specific levels. On the other hand, pseudoclaspers, which form a prime character for specific diagnosis in many other groups, for instance the genus *Diancistrus* (see Schwarzhans *et al.* 2005), are morphologically less diversified in this group of genera. Species can be identified reliably without study of pseudoclaspers. Therefore, we have in two cases described new species without males being available, because of sufficient other diagnostic characters.

Information on otoliths of dinematichthyine fishes have also been published on occasions by Nolf (1980) and Schwarzhans (1981). Those assigned to *Dermatopsis* obviously were based on ill-defined specimens probably of the genus *Monothrix*. As a result of this and an even earlier mention by Stinton (1977), fossil otolith-based records had been identified as *Dermatopsis* from areas remote to the restricted recent distribution of the genus, i.e., from Europe, which are clearly invalid (though they may represent some fossil dinematichthyine genera).

Due to the large amount of material with many new taxa we have decided to deal with the dinematichthyine fishes of the Indo-west Pacific in four parts: in the outstanding two parts we will revise the genera *Beaglichthys*, *Brosmolus*, *Monothrix* and include several new genera and finally revise the most common genus *Dinematichthys* sensu lato.

## MATERIAL AND METHODS

Examination of ca. 5000 specimens of Indo-west Pacific Dinematichthyini yielded 363 specimens which could be identified to the genera treated herein. Also included are specimens viewed and identified in the collections of AMS, NMNZ and USNM but not borrowed

for detailed investigations. These are listed as additional specimens and are not referred to as type specimens for any of the new species.

The material described herein belongs to the following institutions: AMS (Australian Museum, Sydney); CAS (California Academy of Sciences, San Francisco); CSIRO (Commonwealth Scientific and Industrial Research Organisation, Hobart); NMNZ (Museum of New Zealand Te Papa Tongarewa, Wellington); ROM (Royal Ontario Museum, Toronto); SAIAB (South African Institute for Aquatic Biodiversity, formerly RUSI, JLB Smith Institute of Ichthyology, Grahamstown) (both acronyms used here); SAM (South African Museum, Cape Town); SAMA (South Australian Museum, Adelaide); SMNS (Staatliches Museum für Naturkunde, Stuttgart); WAM (Western Australian Museum, Perth); and ZMUC (Zoological Museum, University of Copenhagen).

For methodology used in analysing dinematichthyine fishes, reference is made to Møller *et al.* (2004a) and Schwarzhans *et al.* (2005). Abbreviations used in meristic counts are: D/V = anterior dorsal fin ray above vertebra number; D/A = anterior anal fin ray below dorsal fin ray number; V/A = anterior anal fin ray below vertebrae number.

The ecology of most of the species is poorly known. From available station data we have gathered some information about habitat and depth range, but we have very little data about behaviour, live coloration and feeding. A number of females were examined for reproductive data, e.g., number and size of embryos.

The distribution maps were created using Microsoft Encarta 2001 digital world atlas.

## COMPARATIVE MATERIAL

**Indo-West Pacific Dinematichthyini.** See Schwarzhans *et al.* (2005).

**American Dinematichthyini.** See Møller *et al.* (2004a) and Møller *et al.* (2005).

**Brosmophycinae and Bythitinae.** See Møller *et al.* (2004b).

## SYSTEMATICS

### Tribe Dinematichthyini Cohen and Nilsen, 1978

(Family Bythitidae Gill, 1861;

subfamily Brosmophycinae Gill, 1862)

**Diagnosis.** Male copulatory organ with penis and 1–2 (rarely 3) pairs of pseudoclaspers in cavity of ventral body wall covered by fleshy hood. First anal fin pterygiophore slightly to strongly clongate. Head pore system generally unreduced, 6 mandibular, 2–4 preopercular, 5–7 infraorbital and 3–4 supraorbital pores, including supraorbital pore above opercular spine. Posteriormost supraorbital head-pore tubular.

**Key to the species of the *Dermatopsis*,  
*Dermatopsoides* and *Dipulus***  
(see also Tables 1–3)

- 1a. Maxilla not vertically expanded postventrally; head without scales; upper preopercular pore absent; 1 pair of (outer) pseudoelaspers; otolith with separate colliculi ..... 2
- 1b. Maxilla vertically expanded postventrally; head with scales patches, at least on cheek, but commonly also on operculum above and (rarely) below opercular spine; upper preopercular pore present or absent; 2 (rarely 1) pairs of pseudoelaspers; otolith with fused or separate colliculi ..... other Indo-west Pacific genera of *Dinematichthyini* (see Schwarzzhans *et al.* 2005)
- 2a. Opercular spine covered by skin, not exposed; lower lip smooth (except with skin folds in *Dermatopsoides morrisonae* n. sp.) ..... (*Dermatopsoides*) 3
- 2b. Opercular spine free, exposed; lower lip with skin folds ..... 6
- 3a. Total number of vertebrae 46–47; dorsal fin rays 93–100; anal fin rays 70–71; single pair of pseudoelaspers straight ..... *Dermatopsoides kasougae*
- 3b. Total number of vertebrae 37–44; dorsal fin rays 60–86; anal fin rays 40–59; single pair of pseudoelaspers bent (not known for *Dermatopsoides morrisonae* n. sp.) ..... 4
- 4a. Lower preopercular pores 3; dorsal and anal fins dark; lower lip with skin folds ..... *Dermatopsoides morrisonae* n. sp.
- 4b. Lower preopercular pores 1 or 2; dorsal and anal fins light, fully translucent; lower lip smooth ..... 5
- 5a. Precaudal vertebrae 11–12, total number of vertebrae 37–40; dorsal fin rays 60–67; anal fin rays 40–45; lower preopercular pores 2; pectoral fin length 12.3–12.7 % SL ..... *Dermatopsoides talboti*
- 5b. Precaudal vertebrae 13, total number of vertebrae 43–44; dorsal fin rays 80–86; anal fin rays 51–59; lower preopercular pores 1; pectoral fin length 9.5–9.9 % SL ..... *Dermatopsoides andersoni* n. sp.
- 6a. Precaudal vertebrae 11–14; dorsal fin rays 64–85; penis without hook near tip ..... (*Dermatopsis*) 7
- 6b. Precaudal vertebrae 13–25; dorsal fin rays 86–191; penis with hook near tip ..... (*Dipulus*) 10
- 7a. Posterior infraorbital pores 3; pseudoelaspers spiny, half the length of penis, total number of vertebrae 44–46 ..... *Dermatopsis joergenielsenii* n. sp.
- 7b. Posterior infraorbital pores 2; pseudoelaspers curved, longer than penis (not known for *Dermatopsis greenfieldi* n. sp.); total number of vertebrae 39–45 ..... 8
- 8a. Scales on body absent; posterior nostril and posterior mandibular pores almost as large as eye; lower preopercular pore not tubular, as large or larger than eye; pseudoelasper broad, expanded, paddle-like; otolith length to height ratio 1.9–2.0 ..... *Dermatopsis hoesei* n. sp.
- 8b. Scales on body present; posterior nostril and posterior mandibular pores 1/3 to 1/4 the size of eye; lower preopercular pore tubular, 1/3 the size of eye; pseudoelasper narrow, with or without fleshy appendix anteriorly (not known for *Dermatopsis greenfieldi* n. sp.); otolith length to height ratio 2.1–2.4 ..... 9
- 9a. Precaudal vertebrae 12–14; dorsal fin rays 69–82; vertical fins with dark pigmentation; supraorbital pore behind eye (in most cases); otolith length to height ratio 2.2–2.4; otolith with sharp postdorsal angle ..... *Dermatopsis macrodon*
- 9b. Precaudal vertebrae 11–12; dorsal fin rays 64–70; vertical fins entirely translucent; no supraorbital pore behind eye; otolith length to height ratio 2.1–2.2; otolith with weak postdorsal angle ..... *Dermatopsis greenfieldi* n. sp.
- 10a. Total vertebrae 79–87; dorsal fin rays 161–191; anal fin rays 109–124; D/A 58–75; V/A 27–28; lower preopercular pores 2; pseudoelaspers with broadly expanded flaps anteriorly and posteriorly, narrow base and pointed, outwardly curved tip ..... *Dipulus caecus*
- 10b. Total vertebrae 45–57; dorsal fin rays 86–112; anal fin rays 56–73; D/A 36–51; V/A 17–26; lower preopercular pores 3; pseudoelaspers bent like a hockey stick, narrow or broadened but without expanded flaps ..... 11
- 11a. Body without scales; total vertebrae 45–49; dorsal fin rays 86–104; opercular spine straight or bent downward; posterior infraorbital pores 2; pseudoelaspers strongly expanded at curvature; otolith with sharp postdorsal angle ..... *Dipulus norfolkanni*
- 11b. Body scaled, total vertebrae 52–57; dorsal fin rays 97–112; opercular spine bent upwards; posterior infraorbital pores 3; pseudoelaspers not expanded at curvature; otolith with broad or without postdorsal angle ..... 12
- 12a. Horizontal scales rows above anal fin origin 8–12; precaudal vertebrae 19–22; anal fin rays 57–64; V/A 23–26; 1st and 2nd lower preopercular pores tubular; otolith length to height ratio 2.3–2.4, with wide sulcus and no postdorsal angle ..... *Dipulus multiradiatus*
- 12b. Horizontal scales rows above anal fin origin 6–7; precaudal vertebrae 16–17; anal fin rays 66–73; V/A 19–20; lower preopercular pores not tubular; otolith length to height ratio 2.1–2.2, with narrow sulcus and obtuse, broad postdorsal angle ..... *Dipulus hntchinsi* n. sp.

*Dermatopsis* Ogilby, 1896

(Tables 1–3)

*Dermatopsis* Ogilby, 1896: 138 (type species *D. macrodon* Ogilby, 1896, by monotypy; see Eshmeyer 1998).

*Dermatopsis*. – Cohen 1966: 186; Cohen and Nielsen 1978: 56; Paxton *et al.* 1989: 316; Nielsen *et al.* 1999: 126.

**Diagnosis.** Anterior nostril immediately above upper lip; head without scales; tip of opercular spine free, exposed; maxilla not vertically expanded postventrally, ventral knob well anterior to rear corner; lower lip with skin folds; male copulatory organ with one pair of mostly large, but not very variable pseudoelaspers (probably representing the outer pseudoelasper in terminology of Møller *et al.* 2004a); penis without hook near tip; sulcus

of otolith with separated ostium and cauda marked by strong indentation at ventral margin of sulcus, its colliculi separated; anterior anal fin ray pterygiophore elongate; lower preopercular pores 2, often joined in single opening and then counted as 1; upper preopercular pore absent; posterior infraorbital pores 2 or 3; precaudal vertebrae variable between 11 and 14, body size not exceeding 75 mm SL.

**Comparison.** *Dermatopsis* appears to be closely related to *Dermatopsoides* and *Dipulus*, which are readily distinguished from the other Indo-west Pacific genera so far described by the absence of scales on the head, the maxilla not vertically expanded postventrally and the presence of skin folds on the lower lip (except lip smooth in most species of *Dermatopsoides*, see also key above).

**Table 1.** Frequency distribution of fin ray counts of the species in the genera *Dermatopsis*, *Dermatopsoides* and *Dipulus*.

	dorsal fin rays																											
	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–99	100–104	105–109	110–114	115–119	120–124	125–129	130–134	135–139	140–144	145–149	150–154	155–159	160–164	165–169	170–174	175–179	180–184	185–189	190–191	
<i>Dermatopsis</i>																												
<i>greenfieldi</i> n. sp.	1	5	1																									
<i>hoesei</i> n. sp.		10	39	4																								
<i>joergenielsenii</i> n. sp.				11	9	1																						
<i>macrodon</i>	2	8	16	2																								
<i>Dermatopsis</i> sp.			1																									
<i>Dermatopsoides</i>																												
<i>andersoni</i> n. sp.				2	1																							
<i>kasougae</i>						1	–	1																				
<i>morrisonae</i> n. sp.			1	1																								
<i>talboti</i>	3	2																										
<i>Dipulus</i>																												
<i>caecus</i>																				1	2	5	2	1	1	1		
<i>hutchinsi</i> n. sp.								1	3	1																		
<i>multiradiatus</i>							16	32	21	3																		
<i>norfolkianus</i>				4	7	3																						
	anal fin rays																											
	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89	90–94	95–99	100–104	105–109	110–114	115–119	120–124											
<i>Dermatopsis</i>																												
<i>greenfieldi</i> n. sp.	2	5																										
<i>hoesei</i> n. sp.		33	20																									
<i>joergenielsenii</i> n. sp.			7	14																								
<i>macrodon</i>		6	18	4																								
<i>Dermatopsis</i> sp.		1																										
<i>Dermatopsoides</i>																												
<i>andersoni</i> n. sp.			2	1																								
<i>kasougae</i>							2																					
<i>morrisonae</i> n. sp.			2																									
<i>talboti</i>	3	1																										
<i>Dipulus</i>																												
<i>caecus</i>														1	3	4	6											
<i>hutchinsi</i> n. sp.						4	2																					
<i>multiradiatus</i>				22	50																							
<i>norfolkianus</i>				8	7																							

Within this group of three genera, *Dermatopsis* differs from *Dermatopsoides* in the free opercular spine (vs not exposed, covered by skin) and from *Dipulus* in the number of precaudal vertebrae (11–14 vs 13–25), dorsal fin rays (64–85 vs 86–191) and the penis without a hook near the tip (vs with hook).

**Distribution.** *Dermatopsis* was recognized as a valid genus by Cohen (1966) and Cohen and Nielsen (1978) as well as by Nielsen *et al.* (1999), containing two species found along the subtropical shores of Australia: *Dermatopsis macrodon* from south-eastern Australia, and *D. multiradiatus* from southern and south-western Australia. The latter is, following our revision, hereinafter placed in the genus *Dipulus*.

Three new species of *Dermatopsis* are being described below, one each from south-eastern Australia (New South Wales), the northern island of New Zealand and Fiji. One specimen is recorded in open nomenclature from

the southern part of the Great Barrier Reef, Queensland. South-eastern Australia, south of the Great Barrier Reef, now harbours two sympatric species of the genus. References of *D. macrodon* in past literature therefore are likely to represent both species, particularly since the new species described in the following seems to be generally more common.

***Dermatopsis greenfieldi* n. sp.**

(Figs 1–2, 6; Tables 1–4)

**Material examined.** (7 specimens, 29–50 mm SL). HOLOTYPE – CAS 224403, female, 47 mm SL, Nananui-i-Cake, Fiji, 17°20.006'S, 178°16.374'E, coral reef with dead and living corals, 1–4.5 m, D.W. Greenfield, K. Longenecker, R. Langston and party, 14 March 1982. PARATYPES – CAS 224404, female, 42 mm SL, same data as holotype; CAS 224405, 3 females, 28–49 mm SL, Northern division, Fiji, reef about 25 yards off rocky shore, coral and sand, 16°26.701'S, 179°56.261'W, 1–2

**Table 2.** Frequency distribution of vertebral counts of the species in the genera *Dermatopsis*, *Dermatopsoides* and *Dipulus*.

	precaudal vertebrae															
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
<i>Dermatopsis</i>																
<i>greenfieldi</i> n. sp		2	3													
<i>hoesei</i> n. sp		10	31	12	2											
<i>joergenielseni</i> n. sp				6	15											
<i>macrodon</i>			4	19	5											
<i>Dermatopsis</i> sp.				1												
<i>Dermatopsoides</i>																
<i>andersoni</i> n. sp				3												
<i>kasongae</i>					2											
<i>morrisonae</i> n. sp.				1	1											
<i>talboti</i>		2	4													
<i>Dipulus</i>																
<i>caecus</i>													3	3	7	1
<i>hutchinsi</i> n. sp							3	3								
<i>multiradiatus</i>										37	26	7	1			
<i>norfolkianus</i>					6	6	4									

	total vertebrae										
	35–39	40–44	45–49	50–54	55–59	60–64	65–69	70–74	75–79	80–84	85–89
<i>Dermatopsis</i>											
<i>greenfieldi</i> n. sp	4	1									
<i>hoesei</i> n. sp		54									
<i>joergenielseni</i> n. sp		7	14								
<i>macrodon</i>		27	1								
<i>Dermatopsis</i> sp.		1									
<i>Dermatopsoides</i>											
<i>andersoni</i> n. sp		3									
<i>kasongae</i>			2								
<i>morrisonae</i> n. sp			2								
<i>talboti</i>	3	3									
<i>Dipulus</i>											
<i>caecus</i>									1	4	8
<i>hutchinsi</i> n. sp				2	4						
<i>multiradiatus</i>				51	21						
<i>norfolkianus</i>			16								

**Table 3.** Comparison of selected otolith, morphometric and pseudoclasper characters of the species in the genera *Dermatopsis*, *Dermatopsoides* and *Dipulus*.

	pseudoclasper	penis	scales	otolith length to height							ostial colliculum length to caudal colliculum length ratio																		
				broadly expanded	paddle-like expanded	long curved stick	short spiny	with hook	without hook	on body	1.9	2.0	2.1	2.2	2.3	2.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7
<i>Dermatopsis</i>																													
<i>greenfieldi</i> n. sp.				x				x	x									x	x										
<i>hoesei</i> n. sp.	x			x				x	x																x				
<i>joergenielseni</i> n. sp.			x	x	x			x																	x	x	x		
<i>maerodon</i>		x		x	x			x	x	x							x	x	x	x	x								
<i>Dermatopsis</i> sp.				x				x						x															
<i>Dermatopsoides</i>																													
<i>andersoni</i> n. sp.			x	x				x											x										
<i>kasougae</i>			x	x	x																								
<i>morrisonae</i> n. sp.								x																					
<i>talboti</i>			x	x																									
<i>Dipulus</i>																													
<i>caecus</i>	x			x				x	x	x				x	x														
<i>hutehinsi</i> n. sp.		x		x	x			x	x					x	x	x													
<i>multiradiatus</i>		x		x	x					x	x						x	x											
<i>norfolkanus</i>	x			x				x	x															x	x	x			

m, D.W. Greenfield, K. Longenecker, R. Langston and party, 20 May 2003; CAS 222570, female, 44 mm SL, Viti Levu, Carybdis reef, of Rakiraki, Fiji, steep wall, coral pavement and sand, 17°11.566'S, 177°59.195'E, 8–10 m, D.W. Greenfield, K. Longenecker, R. Langston and party, 5 March 2002; ROM 40404, female, 53 mm SL, Cagilai Island, Viti Levu, Fiji, P. Ryan and G. Brodie, 15 Oct. 1982.

**Diagnosis.** Vertebrae 11–12 + 27–29 = 39–41, dorsal fin rays 64–70, anal fin rays 44–49; scales present on body; eye 1.8–2.6 % SL, sharp spine on ventral maxilla positioned behind rear tip of eye; otolith with pointed posterior tip and weak postdorsal angle, otolith elongate, length to height ratio 2.1–2.2, sulcus with separated eolliculi.

**Description.** The principal meristic and morphometric characters are shown in Table 4. Body slender, up to 50 mm SL. Head without scales. Horizontal diameter of scales on body about 0.8 % SL, in 12 horizontal rows. Maxillary not expanded posteriorly, with sharp ventral spine positioned

behind rear tip of eye. Anterior nostril on tip of snout. Posterior nostril, about 1/4 the size of eye.

**Head sensory pores** (Fig. 2A–B). Supraorbital pores 2. Infraorbital pores 5 (3 anterior and 2 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 1 lower, no upper. All pores small, about 1/2 the size of posterior nostril, except for lower preopercular pore about size of posterior nostril.

**Dentition** (of holotype). Premaxilla with 5 rows of small teeth anteriorly, merging into two rows posteriorly. Anteriormost teeth in inner row up to 1/4 diameter of pupil. Vomer horseshoe-shaped, with one row of 14 small teeth up to 1/5 diameter of pupil. Palatine teeth in a single row with 7 small teeth up to 1/5 diameter of pupil. Dentary with 4 outer rows of granular teeth and 1 inner row of larger teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about 1/3 of pupil diameter.

**Otolith** (Fig. 2C–D). Elongate, length to height ratio 2.1–2.2 (29–50 mm SL); otolith length to sulcus length

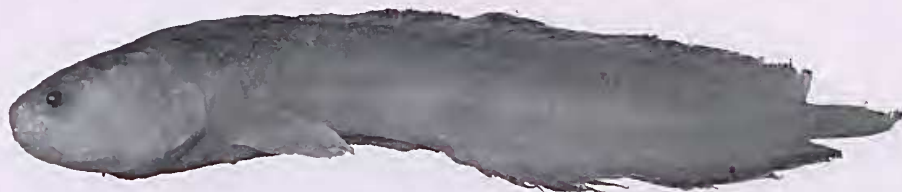


Fig. 1. *Dermatopsis greenfieldi* n. sp., CAS 224403, holotype, female, 47 mm SL.

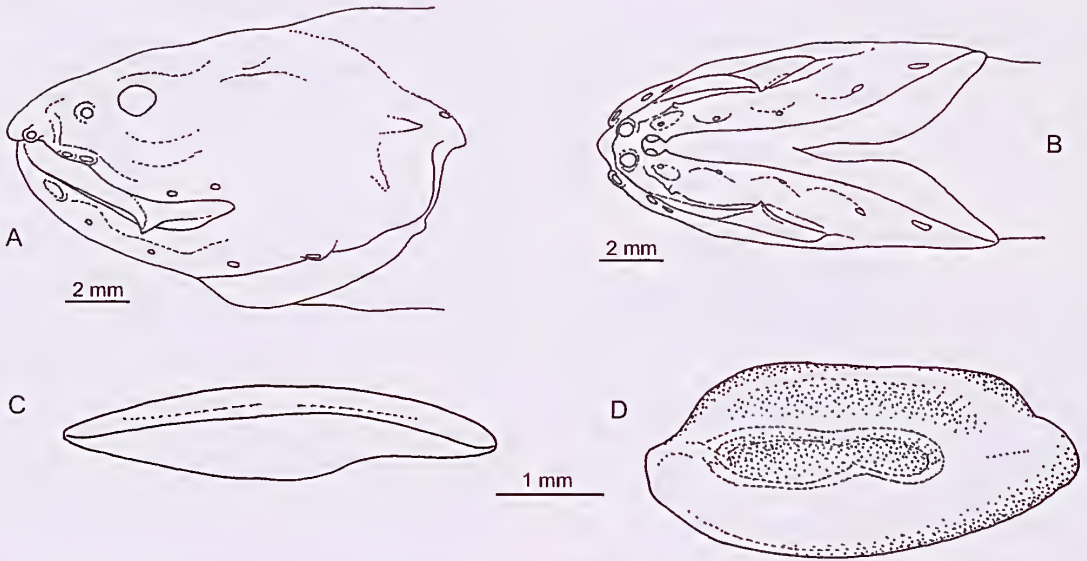


Fig. 2. *Dermatopsis greenfieldi* n. sp. A, lateral view of head, CAS 224403, holotype, female, 47 mm SL; B, ventral view of head, holotype; C, ventral view of right otolith, CAS 222598, paratype, female, 42 mm SL; D, median view of right otolith, CAS 222598, paratype, female, 42 mm SL.

Table 4. Meristic and morphometric characters of *Dermatopsis greenfieldi* n. sp.

	Holotype CAS 224403	Holotype + 6 paratypes Mean (range)	n
Standard length in mm	47	43.1 (29–50)	7
<b>Meristic characters</b>			
Dorsal fin rays	69	67.3 (64–70)	7
Anal fin rays	49	46.1 (44–49)	7
Pectoral fin rays	19	20.3 (19–22)	7
Preecaudal vertebrae	11	11.6(11–12)	7
Caudal vertebrae	28	28.0 (27–29)	7
Total vertebrae	39	39.7 (39–41)	7
Rakers on anterior gill arch	17	16.0 (14–19)	6
Pseudobranchial filaments	0	0.7(0–2)	7
D/V	5	6.1 (5–7)	7
D/A	27	24.1 (21–27)	7
V/A	15	15.3 (15–16)	7
<b>Morphometric characters in % of SL</b>			
Head length	24.6	25.2 (23.8–27.5)	7
Head width	11.5	11.9 (11.0–13.1)	7
Head height	16.6	16.3 (14.8–17.4)	7
Snout length	6.0	6.0(5.8–6.2)	6
Upper jaw length	13.7	13.4 (12.1–14.0)	7
Diameter of pigmented eye	1.9	2.1 (1.8–2.6)	7
Diameter of pupil	1.2	1.3(1.1–1.8)	6
Interorbital width	4.9	4.9 (4.4–5.4)	6
Postorbital length	17.7	18.0 (17.2–18.5)	6
Preal length	51.8	52.2 (50.6–55.4)	7
Predorsal length	30.5	32.1 (30.4–35.9)	7
Body depth at origin of anal fin	13.3	14.0 (12.5–15.9)	7
Pectoral fin length	15.3	15.0 (13.9–15.6)	7
Pectoral fin base height	6.0	6.4(5.9–7.1)	7
Ventral fin length	16.3	17.1 (15.6–18.9)	7
Base ventral fin – anal fin origin	36.2	34.5 (28.2–39.3)	7



ratio 1.8; sulcus divided into ostium and cauda, marked by indentation of the ventral sulcus margin, colliculi also divided; length of ostial colliculum to length of caudal colliculum ratio 1.8–1.9; anterior and posterior tips of otolith pointed, each with small concavity dorsally, weak postdorsal angle; inner face with weak ventral furrow close to ventral rim and broad, well defined dorsal depression.

**Axial skeleton** (of holotype). First neural spine half the length of second. Neural spine of vertebrae 2–4 elongate and 5–8 depressed. Parapophyses present from vertebrae 6 to 10. Pleural ribs on vertebrae 3–8. First anal fin pterygiophore elongate, but not reaching tip of last precaudal parapophysis.

**Male copulatory organ.** So far only female specimens known.

**Coloration.** Live colour unknown. Uniformly light brown when preserved.

**Comparison.** *Dermatopsis greenfieldi* is easily distinguished from *D. macrodon* and *D. joergenielseni* n. sp. by the low number of vertebrae (39–41 vs 40–45 and 44–46), low number of dorsal fin rays (64–70 vs 69–82 and 76–85) and the low number of anal fin rays (44–49 vs 47–56 and 51–58). From *D. joergenielseni* n. sp. it further differs in larger eye (1.8–2.6 vs 1.1–1.7 % SL), the predorsal length (30.4–35.9 vs 25.1–30.0 % SL) and in the otolith length to height ratio (2.1–2.2 vs 2.0); from *D. macrodon* it differs in addition in the absence of a supraorbital pore behind the eye (vs usually present) and translucent vertical fins (vs dark at base). *Dermatopsis greenfieldi* differs from *D. hoesei* n. sp. in the presence of body scales (vs absent), smaller pores, small posterior nostril (1/4 of eye size vs 1/2 of eye size), larger eye (1.8–2.6 vs 1.4–1.9 % of SL) and the otolith length to height ratio (2.1–2.2 vs 1.9–2.0).

**Distribution** (Fig. 6). *Dermatopsis greenfieldi* is known exclusively from the Fiji Islands.

**Ecology.** Lives in coral reef habitats in depths from 1 to 10 m.

**Etymology.** Named in honour of David W. Greenfield, Moss Landing Marine Laboratories, USA, in recognition for his great contributions to coral reef ichthyology.

#### *Dermatopsis hoesei* n. sp.

(Figs 3–6; Tables 1–3, 5)

*Dermatopsis macrodon* (in part). – Whitley 1935: 239, fig. 8; Cohen 1966: fig. 2A.

**Material examined.** (57 specimens, 25–48 mm SL). HOLOTYPE – AMS I.28732-022, male, 35 mm SL,

Bitangabee Bay southern headland, New South Wales, 37°13'S, 150°00'E, 0–1.5 m, M. Beshaw, S. Reader, M. Ricketts and J. Leis, 6 April 1989. PARATYPES – AMS I.15330-037, 3 males, 31–34 mm SL, 7 females, 29–45 mm SL, Jervis Bay, Chinaman Beach, New South Wales, 35°01'S, 150°46'E, 3 m, M. Cameron, H. and J. Paxton, 3 Jan. 1969; AMS I.15892-022, male, 27 mm SL, female, 38 mm SL, Narrabeen near Sydney, New South Wales, 33°45'S, 151°19'E, 1 m, 25 July 1970; AMS I.15912-046, 6 males, 30–39 mm SL, 5 females, 31–35 mm SL, Jervis Bay, Cabbage Tree Point, New South Wales, 35°01'S, 150°46'E, 0–5 m, 17 Oct. 1970; AMS I.17343-017, male, 44 mm SL, Newcastle area, Seal Rocks, New South Wales, 32°28'S, 152°32'E, 1 m, 11 May 1973; AMS I.20095-049, 1 male, 36 mm SL, 5 females, 27–48 mm SL, and ZMUC P771554-55, male, 38 mm SL, female 41.5 mm SL, Arrawarra Headland, New South Wales, 30°04'S, 153°12'E, 0–1 m, J. Paxton and D. Hocse, 4 May 1977; AMS I.28732-025, 6 males, 27–36 mm SL, 2 females, 34–37 mm SL, same data as for holotype; AMS I.28738-025, 3 males, 27–30 mm SL, 4 females, 30–35 mm SL, Bittangabee Bay, off rocks below camping area, New South Wales, 37°13'S, 150°00'E, 0–4 m, M. McGrouther and party, 8 April 1989; SMNS 14762, male, 34 mm SL, 2 females, 27–43 mm SL, Red Head, 20 km NE of Ulladulla, New South Wales, 35°13'S, 150°32'E, 0–3 m, R. Fricke and T. Trnski, 12 May 1993; WAM P.27112-005, 3 males, 32–40 mm SL, Shelley Point, Summerland Bay, New South Wales, 29°32'S, 153°21'E, J.B. Hutchins, 9 Feb. 1981; WAM P.28844-022, 2 males, 25–29 mm SL, Port Hacking, New South Wales, 34°04'S, 151°07'E, 14 Nov. 1974.

**Diagnosis.** Vertebrae 11–14 + 27–31 = 40–43, dorsal fin rays 67–77, anal fin rays 46–53; no scales on head and body; posterior nostril large, about half size of eye; lower preopercular pore large, about size of posterior nostril or larger; weak spine on maxilla positioned behind rear tip of eye; single pair of pseudoclaspers curved, expanded and paddle-like, longer than penis, without fleshy appendices; and otolith with pointed posterior tip and concavity above and massive postdorsal angle, otolith length to height ratio 1.9–2.0, sulcus with divided colliculi

**Description.** The principal meristic and morphometric characters are shown in Table 5. Body slender, up to 48 mm SL, mature at about 30 to 35 mm SL. Head and body without scales. Maxillary not expanded posteriorly, with weak spine positioned behind rear tip of eye. Anterior

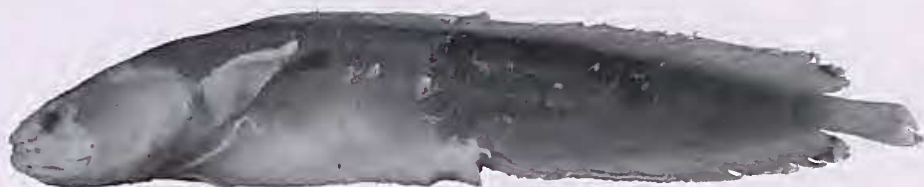
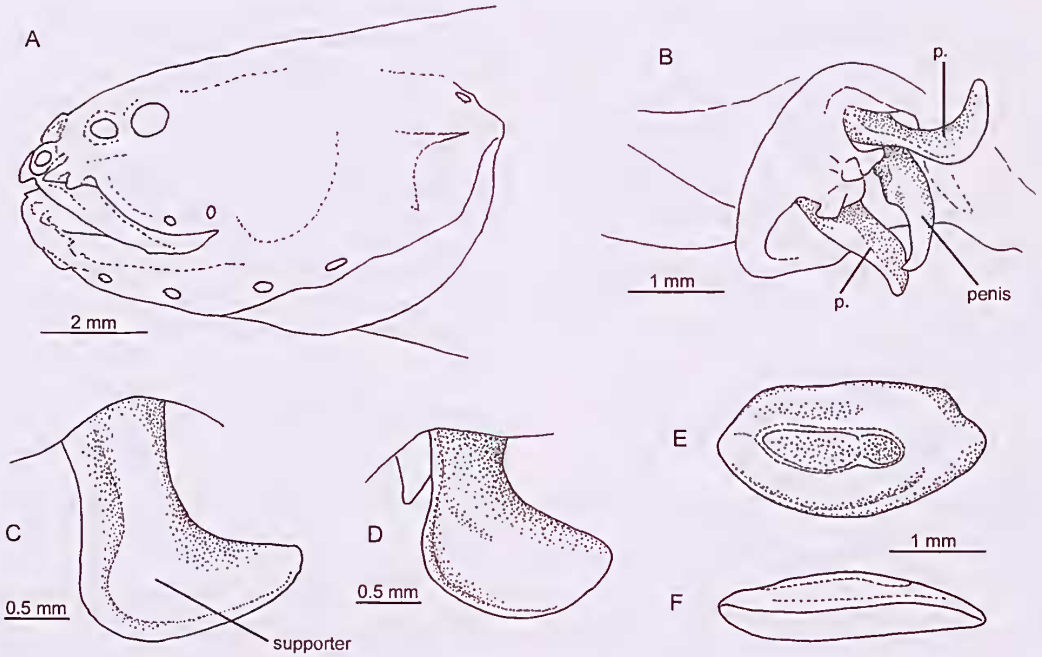


Fig. 3. *Dermatopsis hoesei* n. sp., AMS I.28732-022, holotype, male, 35 mm SL.



**Fig. 4.** *Dermatopsis hoesei* n. sp. **A**, lateral view of head, WAM P.27112-005, paratype, male, 40 mm SL; **B**, inclined lateral view of male copulatory organ, WAM P.27112-005, paratype, 40 mm SL; **C**, view of left pseudo-clasper from outside, AMS 1.28732-002, holotype, 35 mm SL; **D**, view of left pseudo-clasper from outside, WAM P.27112-005, paratype, 40 mm SL; **E**, median view of right otolith, SMNS 14762, paratype, female, 43 mm SL; **F**, ventral view of right otolith, SMNS 14762, paratype, female, 43 mm SL.

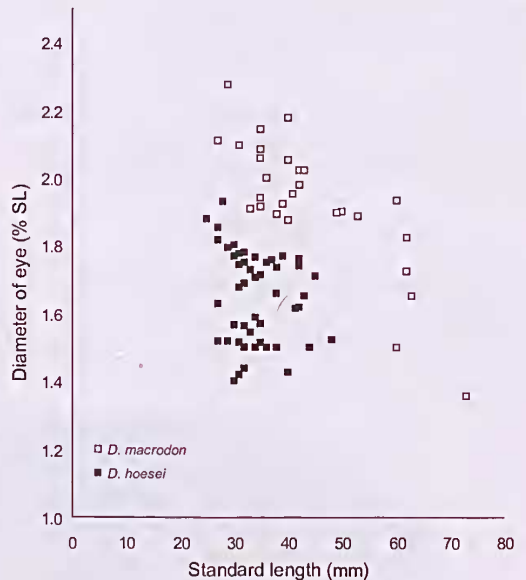
nostril at tip of snout. Posterior nostril very large, about 1/2 the size of eye.

**Head sensory pores** (Fig. 4A). Supraorbital pores 2 (rarely 3). Infraorbital pores 5 (3 anterior and 2 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 1 lower (joined 2 pores), no upper preopercular pore. All pores large, posterior mandibular pores about size of posterior nostril, lower preopercular pore even larger in some specimens.

**Dentition** (of holotype). Premaxilla with 3 rows of small teeth anteriorly, merging into 2 rows posteriorly. Anteriormost teeth in inner row up to 1/4 diameter of pupil. Vomer horseshoe-shaped, with 1 row of 7 large teeth up to 3/4 diameter of pupil. Palatine teeth in single row with 5 large teeth up to 1/2 diameter of pupil. Dentary with 2 outer rows of granular teeth and 1 inner row of larger teeth anteriorly, merging into 1 row of large teeth posteriorly, up to about size of pupil diameter.

**Otolith** (Fig. 4E-F). Moderately elongate, length to height ratio 1.9–2.0 (34–43 mm SL); otolith length to sulcus length ratio 1.8; sulcus divided into ostium and cauda, marked by indentation of the ventral sulcus margin, colliculi also divided; length of ostial colliculum to length of caudal colliculum ratio 2.5; anterior tip of otolith rounded without concavity dorsally, posterior tip pointed, with concavity dorsally and with massive postdorsal angle; inner face with well marked ventral furrow close to ventral rim and narrow, not well defined dorsal depression.

**Axial skeleton** (of holotype). First neural spine half the length of second. Neural spine of vertebrae 2–3 elongate and 4–7 depressed. Parapophyses present from vertebrae 6 to 12. Pleural ribs on vertebrae 3–11. First



**Fig. 5.** Eye diameter in relation to standard length in *Dermatopsis hoesei* n. sp. and *Dermatopsis macrodon*.

Table 5. Meristic and morphometric characters of *Dermatopsis hoesei* n. sp.

	Holotype	Holotype + 56 paratypes	n
	AMS I.28732-022	Mean (range)	
Standard length in mm	35	34.0 (25–48)	55*
Meristic characters			
Dorsal fin rays	73	71.6 (67–77)	53
Anal fin rays	50	49.2 (46–53)	53
Pectoral fin rays	19	19.7 (17–22)	32
Precaudal vertebrae	12	12.1(11–14)	55
Caudal vertebrae	29	29.0 (27–31)	54
Total vertebrae	41	41.1 (40–43)	54
Rakers on anterior gill arch	–	8.7 (5–10)	10
Pseudobranchial filaments	–	0.4(0–1)	10
D/V	6	5.9 (5–7)	54
D/A	28	26.9 (23–30)	54
V/A	17	16.7 (15–18)	54
<b>Morphometric characters in % of SL</b>			
Head length	23.2	24.2 (21.9–26.5)	41
Head width	11.2	11.1 (8.8–15.0)	31
Head height	14.2	14.6 (12.8–16.4)	31
Snout length	5.7	5.8 (4.4–6.5)	31
Upper jaw length	11.7	11.6 (10.2–13.3)	34
Diameter of pigmented eye	1.5	1.7 (1.4–1.9)	55
Diameter of pupil	1.3	1.2(0.8–1.6)	38
Interorbital width	4.5	5.1 (4.0–6.0)	30
Postorbital length	16.5	17.1 (15.7–18.7)	30
Precanal length	54.6	52.6 (46.7–55.7)	33
Predorsal length	30.3	30.2 (27.2–33.4)	32
Body depth at origin of anal fin	11.1	13.2 (11.0–16.0)	35
Pectoral fin length	13.9	14.3 (12.7–17.7)	27
Pectoral fin base height	6.2	6.0(4.6–7.1)	28
Ventral fin length	17.5	17.1 (13.3–20.5)	39
Base ventral fin – anal fin origin	37.9	35.5 (29.2–40.1)	32

\* Two specimens with broken tail not included.

anal fin pterygiophore clongate, almost reaching tip of last precaudal parapophysis.

**Male copulatory organ** (Fig. 4B–D). A single pair of pseudoclaspers, expanded paddle-like, underpinned by similarly expanded supporter, longer than penis, without fleshy appendices. Isthmus between pseudoclaspers wide, fleshy. Penis tapering with broad base, curved.

**Coloration.** Live colour unknown. Uniformly light brown when preserved.

**Comparison.** *Dermatopsis hoesei* is sympatric with *D. macrodon* and is best recognised by its lack of scales on body (vs present), large pores (vs small), the curved expanded paddle-like pseudoclaspers (vs with narrow supporter and with broad fleshy appendix anteriorly), the usual lack of a supraorbital pore behind the eye (vs present in most), the longer pectoral fin (12.7–17.7 vs 9.8–14.3 % SL), the pale, translucent vertical fins (vs dark at base) and the more compressed otolith (length to height ratio 1.9–2.0 vs 2.2–2.4). Also the eye is larger than in *D. macrodon* (Fig. 5), and the specimens of *D. hoesei* do not seem to grow to the same size (up to 48 mm SL vs up to 73 mm SL) as do *D. macrodon*. The number of vertebrae tends to be lower compared to *D. macrodon*

and *D. joergenielseni* n. sp. (40–43 vs 40–45 and 44–46 respectively), likewise the number of dorsal fin rays (67–77 vs 69–82 and 76–85) and anal fin rays (46–53 vs 47–56 and 51–58). With *D. greenfieldi* it shares the low number of vertebrae and fin rays, but is easily distinguished by the weak spine at the ventral maxilla (vs sharp), the otolith proportions (length to height ratio 1.9–2.0 vs 2.1–2.2 and strong postdorsal angle vs weak) and the size of the head pores (Fig. 4A vs Fig. 2A).

**Remarks.** *Dermatopsis hoesei* has previously been included in *D. macrodon* (see Cohen 1966). For further discussion see *D. macrodon*.

In any event, female specimens, and even more so the juveniles of the two species *D. hoesei* and *D. macrodon* cannot always be reliably distinguished. We have left 37 specimens belonging to one or the other species, all less than 30 mm SL (mostly less than 25 mm SL), in open nomenclature (see *D. macrodon* for more discussion).

**Distribution** (Fig. 6). *Dermatopsis hoesei* is distributed along the rocky shores of south-eastern Australia, south of the Great Barrier Reef, chiefly along the shores of New South Wales between the latitudes 29°S and 37°S.

**Ecology.** Lives along rocky shores at shallow depths from 0 to 4 m. A 42 mm SL female (AMS 15330-037), contains 3 embryos, 11–16 mm SL. They are pale except for some weak pigmentation on top of head.

**Etymology.** Named in honour of Doug Hoese, Sydney, AMS, in recognition of his many great contributions to Australian ichthyology.

*Dermatopsis joergenielsenii* n. sp.

(Figs 6–8; Table 6)

*Dermatopsis macrodon*. – Cohen 1966 (in part); Ayling and Cox 1982: 153; Paulin *et al.* 1989: 133; Francis 1993: 158; Schwarzzhans and Grenfell 2002: 19 (fossil otolith record).

**Material examined.** (28 specimens, 25–57 mm SL). HOLOTYPE – NMNZ P.36610, male, 43 mm SL, North Island, Bay of Plenty, south Whale (Motuhora) Island, New Zealand, 37°51'42''S, 176°58'26''E, 8–12 m, 22 April 1999. PARATYPES – NMNZ P.35580, 2 males, 39–44 mm SL, female, 45 mm SL, North Bay, Whale Island, 37°50'03''S, 176°58'34''E, 13–15 m, 3rd East Cape Field Trip, 3 June 1998; NMNZ P.42522, 5 males, 37–51 mm SL, 8 females, 29–54 mm SL, same data as holotype; NMNZ P.36678, 3 males, 31–43 mm SL, 5 females, 35–57 mm SL, juvenile, 25 mm SL, and ZMUC P771549-50, 2 males, 48–52 mm SL, off Homestead Point, White Island, New Zealand North Island, 37°31'46''S, 177°10'41''E, 8–14 m, 23 April 1999.

**Additional identified material.** All New Zealand: NMNZ P.003154, 61 specimens, 21–50 mm SL, 35°13'00''S, 174°14'00''E; NMNZ P.006103, 13 specimens, 64–63 mm SL, 35°10'00''S, 174°20'00''E; NMNZ P.007997, 2 specimens, 24–32 mm SL, 35°00'00''S, 173°47'00''E; NMNZ P.008003, 20 specimens, 25–34 mm SL,

35°00'00''S, 173°47'00''E; NMNZ P.008004, 1 specimen, 33 mm SL, 35°12'00''S, 174°13'00''E; NMNZ P.014190, 1 specimen, 44 mm SL, 35°13'00''S, 174°14'00''E; NMNZ P.015226, 1 specimen, 52 mm SL, 35°00'30''S, 173°45'30''E; NMNZ P.015264, 4 specimens, 34–55 mm SL, 35°23'24''S, 174°22'12''E; NMNZ P.015275, 1 specimen, 37 mm SL, 35°23'12''S, 174°21'06''E; NMNZ P.015483, 1 specimen, 58 mm SL, 36°58'00''S, 176°05'00''E; NMNZ P.018185, 2 specimens, 47–52 mm SL, 37°17'12''S, 176°16'24''E; NMNZ P.028078, 2 specimens, 32–34 mm SL, 35°34'00''S, 174°30'00''E; NMNZ P.028222, 1 specimen, 25 mm SL, 37°32'36''S, 178°12'54''E; NMNZ P.036629, 1 specimen, 54 mm SL, 37°50'03''S, 176°53'27''E; NMNZ P.029815, 1 specimen, 37 mm SL, 37°36'48''S, 177°54'36''E; NMNZ P.035570, 2 specimens, 38–49 mm SL, 37°49'47''S, 176°52'38''E.

**Diagnosis.** Vertebrae 13–14 + 30–32 = 44–46, dorsal fin rays 76–85, anal fin rays 51–58; body scaled; posterior infraorbital pores 3; ventral spine on maxilla positioned behind rear of eye; single pair of pseudoclaspers straight, spiny, short, about half the length of penis, without fleshy appendices; otolith with rounded posterior tip and weak postdorsal angle, otolith length to height ratio 2.0, sulcus with nearly fused colliculi.

**Description.** The principal meristic and morphometric characters are shown in Table 6. Body slender, up to 57 mm SL, mature at about 30 to 35 mm SL. Head without scales, horizontal diameter of scales on body about 0.6 % SL, in about 10 horizontal rows (in holotype). Maxillary not expanded posteriorly, with ventral spine positioned behind rear of eye. Anterior nostril on tip of snout. Posterior nostril large, about 1/3 the size of eye.

**Head sensory pores** (Fig. 8A). Supraorbital pores 2. Infraorbital pores 6 (3 anterior and 3 posterior). Mandibular



Fig. 6. Sample sites of *Dermatopsis greenfieldi* n. sp., *D. hoesei* n. sp., *D. joergenielsenii* n. sp., *D. macrodon*, *Dermatopsis* sp. and *Dermatopsoides morrisonae* n. sp. One symbol may represent several samples.

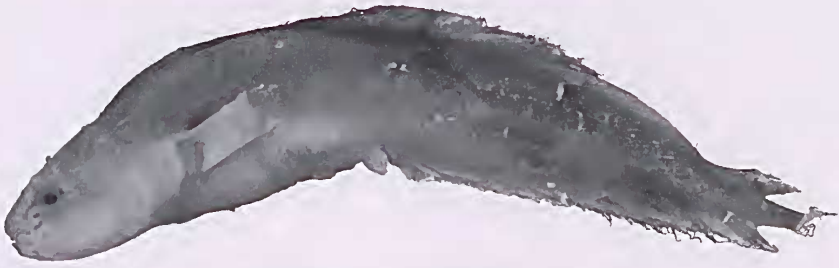


Fig. 7. *Dermatopsis joergenielseni* n. sp., NMNZ P.36610, holotype, male, 43 mm SL.

pores 6 (3 anterior and 3 posterior). Preopercular pores 1 lower, no upper. All pores small, about 1/2 the size of posterior nostril, except for lower preopercular pore about size of posterior nostril.

**Dentition** (of holotype). Premaxilla with 4 rows of small teeth anteriorly, merging into single row posteriorly. Antermost teeth in inner row up to 1/3 diameter of pupil. Vomer horseshoe-shaped, with 1 row of 12 small teeth up to 1/5 diameter of pupil. Palatine teeth in single row with 4 small teeth up to 1/5 diameter of pupil. Dentary with 3 outer rows of granular teeth and 1 inner row of larger teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about 3/4 of pupil diameter.

**Otolith** (Fig. 8D–F). Moderately elongate, length to height ratio 2.0 (43–54 mm SL); otolith length to sulcus length ratio 2.0; sulcus divided into ostium and cauda, marked by indentation of the ventral sulcus margin, but its colliculi fused; length of ostial colliculum to length

of caudal colliculum ratio 2.5–2.7; anterior tip of otolith pointed with small concavity dorsally, posterior tip rounded, with weak or no postdorsal angle; inner face with well marked ventral furrow close to ventral rim bending upwards strongly behind cauda and broad, well defined dorsal depression.

**Axial skeleton** (of holotype). First neural spine half the length of second. Neural spine of vertebrae 2–4 elongate and 4–9 depressed. Parapophyses present from vertebrae 3 to 12. Pleural ribs on vertebrae 2–12. First anal fin pterygiophore elongate, almost reaching tip of last precaudal parapophysis.

**Male copulatory organ** (Fig. 8B–C). A single pair of short, spiny straight pseudoclasps, underpinned by supporter. Isthmus between pseudoclasps wide. Penis thin, curved, about twice the length of pseudoclasps.

**Coloration**. Live colour unknown. Uniformly light to medium brown when preserved.

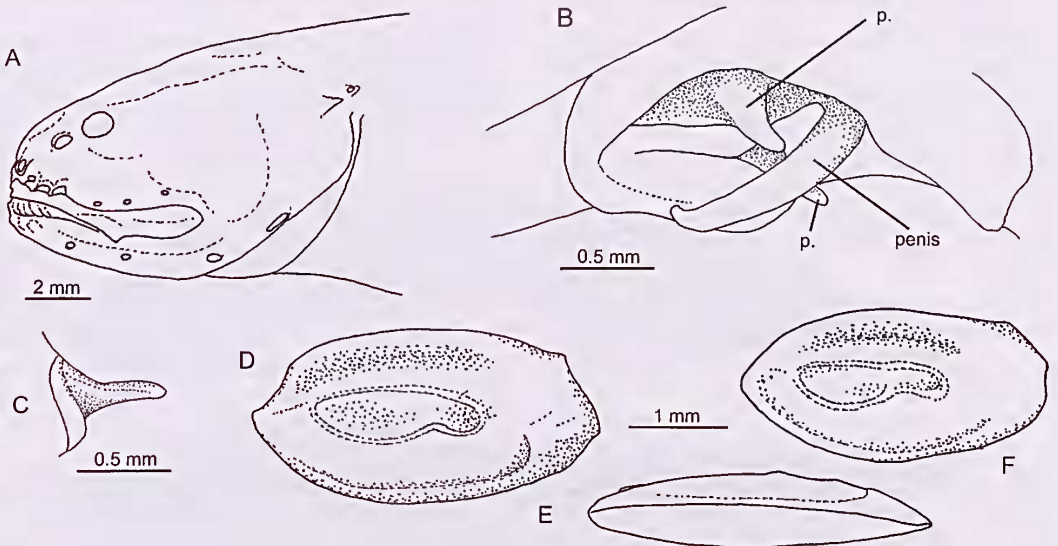


Fig. 8. *Dermatopsis joergenielseni* n. sp. A, lateral view of head, NMNZ P.36678, paratype, female, 48 mm SL; B, inclined lateral view of male copulatory organ, NMNZ P.36610, holotype, 43 mm SL; C, view of left pseudoclasper from inside, NMNZ P.42522, paratype, 40 mm SL; D, ventral view of right otolith, NMNZ P.42522, paratype, female, 54 mm SL; E, median view of right otolith, NMNZ P.42522 paratype, female, 54 mm SL; F, median view of right fossil otolith, Nukumuran stage, Late Pliocene, Ashcott Road, Hawkes Bay, New Zealand.

**Table 6.** Meristic and morphometric characters of *Dermatopsis joergenielsenii* n. sp.

	Holotype NMNZ P.36610	Holotype + 27 paratypes Mean (range)	n
Standard length in mm	43	43.5 (25–57)	28
<b>Meristic characters</b>			
Dorsal fin rays	78	79.3 (76–85)	21
Anal fin rays	56	55.0 (51–58)	21
Pectoral fin rays	20	20.2 (19–21)	14
Precaudal vertebrae	14	13.7(13–14)	21
Caudal vertebrae	30	31.2 (30–32)	21
Total vertebrae	44	45.0 (44–46)	21
Rakers on anterior gill arch	13	13.5 (13–14)	5
Pseudobranchial filaments	0	0	5
D/V	7	6.7 (6–7)	21
D/A	26	27.2 (24–31)	21
V/A	17	16.9 (16–18)	21
<b>Morphometric characters in % of SL</b>			
Head length	22.5	22.0 (18.5–25.1)	20
Head width	9.3	10.8 (8.1–15.0)	14
Head height	13.7	13.6 (12.8–15.8)	15
Snout length	5.7	5.9 (5.1–6.7)	17
Upper jaw length	13.0	12.3 (11.8–13.2)	17
Diameter of pigmented eye	1.5	1.5 (1.1–1.7)	21
Diameter of pupil	1.0	1.0(0.7–1.2)	19
Interorbital width	4.0	4.9 (4.0–5.6)	18
Postorbital length	16.8	15.6 (14.4–17.2)	18
Preanal length	47.5	50.6 (47.1–54.1)	17
Predorsal length	30.0	28.4 (25.1–30.0)	18
Body depth at origin of anal fin	12.6	12.3 (10.4–15.6)	9
Pectoral fin length	16.6	14.1 (11.7–16.6)	9
Pectoral fin base height	5.2	5.5(4.9–6.0)	9
Ventral fin length	16.4	15.5 (12.9–18.3)	17
Base ventral fin – anal fin origin	30.9	33.5 (25.0–40.0)	18

**Comparison.** *Dermatopsis joergenielsenii* is distinguished from the other three species of the genus in the high number of vertebrae 44–46 (vs 39–45) and the presence of 3 posterior infraorbital pores (vs 2). *Dermatopsis joergenielsenii* differs in addition from *D. hoesei* in the presence of body scales (vs absent), short pseudoelaspers (half the length of the penis vs same length as penis), dorsal fin rays (76–85 vs 67–77), anal fin rays (51–58 vs 46–53) and the postdorsal angle of the otolith (no or weak vs strong); from *D. greenfieldi* in the number of precaudal vertebrae (13–14 vs 11–12), the dorsal fin ray count (76–85 vs 64–70), anal fin rays (51–58 vs 44–49) the eye size (1.1–1.7 vs 1.8–2.6 % SL), the predorsal length (25.1–30.0 vs 30.4–35.9 % SL), and the length to height ratio of the otolith (2.0 vs 2.1–2.2). For further distinction from *Dermatopsis macrodon*, see reference to that species.

**Remarks.** *Dermatopsis joergenielsenii* has previously been described and figured by Cohen (1966) and others (e.g. Paulin *et al.* 1989; Paulin and Roberts 1992) as *D. macrodon*. Cohen noticed certain differences, which he felt not to be significant enough to warrant establishing a separate species. Now with further characters (pseudoelaspers and

otoliths) analysed, the distinction of two geographically separated species has become clearly substantiated. It must be remarked that Cohen gave a range of 42 to 45 vertebrae from 16 specimens he investigated from New Zealand while in the 21 specimens x-rayed and counted by us the vertebrae range is between 44 and 46. Cohen's material has not been reviewed, so that this discrepancy remains unanswered at this time. However, the other diagnostic characters, particularly pseudoelaspers, otoliths and pore patterns are stable. Furthermore, part of the lack of differentiation may have been masked by the fact that two sympatric species of *Dermatopsis* are now recognized along the south-eastern Australian coast, which previously were recorded as only one, *D. macrodon* (see species references to *D. macrodon* and *D. hoesei*).

*Dermatopsis joergenielsenii* is the only extant Dinematiichthyini so far also known from the fossil record. An otolith, originally described as *D. macrodon*, was recorded from the Nukumuruan (Late Pliocene, 2.4–2.0 Mya) of Hawkes Bay (Fig. 8F), indicating a fairly long presence of the species in New Zealand waters and that it was more widely (more southerly) distributed in the past.

**Distribution** (Fig. 6). *Dermatopsis joergennielsenii* is distributed along the northernmost shores of North Island, New Zealand 35°00'–37°51'S.

**Ecology.** Lives on rocky shores down to 17 m, most commonly deeper than 5 m.

**Etymology.** Named in honour of Jørgen Nielsen, Copenhagen, ZMUC, in recognition of his many great contributions to the biology and systematics of the Ophidiiformes.

***Dermatopsis macrodon* Ogilby, 1896**

(Figs 5–6, 9–10; Tables 1–3, 7)

*Dermatopsis macrodon* Ogilby, 1896: 140 (type locality: Maroubra near Sydney, New South Wales, Australia).

*Dermatopsis macrodon* (in part). – Ogilby 1897: 86; Whitley 1935: 239, fig. 8; Thinès 1955: 78; Thinès 1969: 157; Cohen 1966: 188; Paxton *et al.* 1989: 316; Kuitert 1993: 61; Gomon *et al.* 1994: 372; Kuitert 2000: 61; Nielsen *et al.* 1999: 126.

**Material examined.** (28 specimens, 27–73 mm SL). Holotype, AMS I.3505, female, 73 mm SL, Maroubra near Sydney, New South Wales, Australia, 33°57'S, 151°16'E, T. Whitelegge, 1896.

**Additional specimens:** AMS IA.5928, 4 females, 31–60 mm SL, Port Jackson, New South Wales, 33°51'S, 151°16'E; AMS IB.6836, 2 females, 36–62 mm SL, Minnie Waters, New South Wales, 29°50'S, 153°18'E; AMS I.15892-012, 3 males, 27–42 mm SL, Narrabeen near Sydney, New South Wales, 33°45'S, 151°19'E; AMS I.15912-040, male, 41 mm SL, female, 42 mm SL, Jervis Bay, Cabbage Tree Point, Australian Capital Territory, 35°01'S, 150°46'E; AMS I.16469-016, male, 43 mm SL, female, 62 mm SL, Minnie Waters, New South Wales, 29°50'S, 153°15'E; AMS I.19901-031, male, 49 mm SL, female, 39 mm SL, Neilsen Park, Sydney, New South Wales, 33°51'S, 151°16'E, Bottle and Glass Rocks;

AMS I.25380-001, 5 males, 29–38 mm SL, female, 40 mm SL, S end of Pittwater, New South Wales, 33°39'S, 151°18'E; AMS I.25380-002, 1 male, 35 mm SL, 1 female, 33 mm SL, and ZMUC P771552, male 40 mm SL and female 35 mm SL, S end of Pittwater, New South Wales, 33°39'S, 151°18'E; AMS I.40829-032, female, 63 mm SL, Sydney Harbour, Clark Island, New South Wales, 33°51'S, 151°14'E.

**Diagnosis.** Vertebrae 12–14 + 27–32 = 40–45, dorsal fin rays 69–82, anal fin rays 47–56; body sealed; supraorbital pore behind eye (mostly present); ventral spine on maxilla positioned behind rear of eye; vertical fins dark; single pair of pseudoelaspers, curved, not expanded, often with broad fleshy appendix anteriorly.

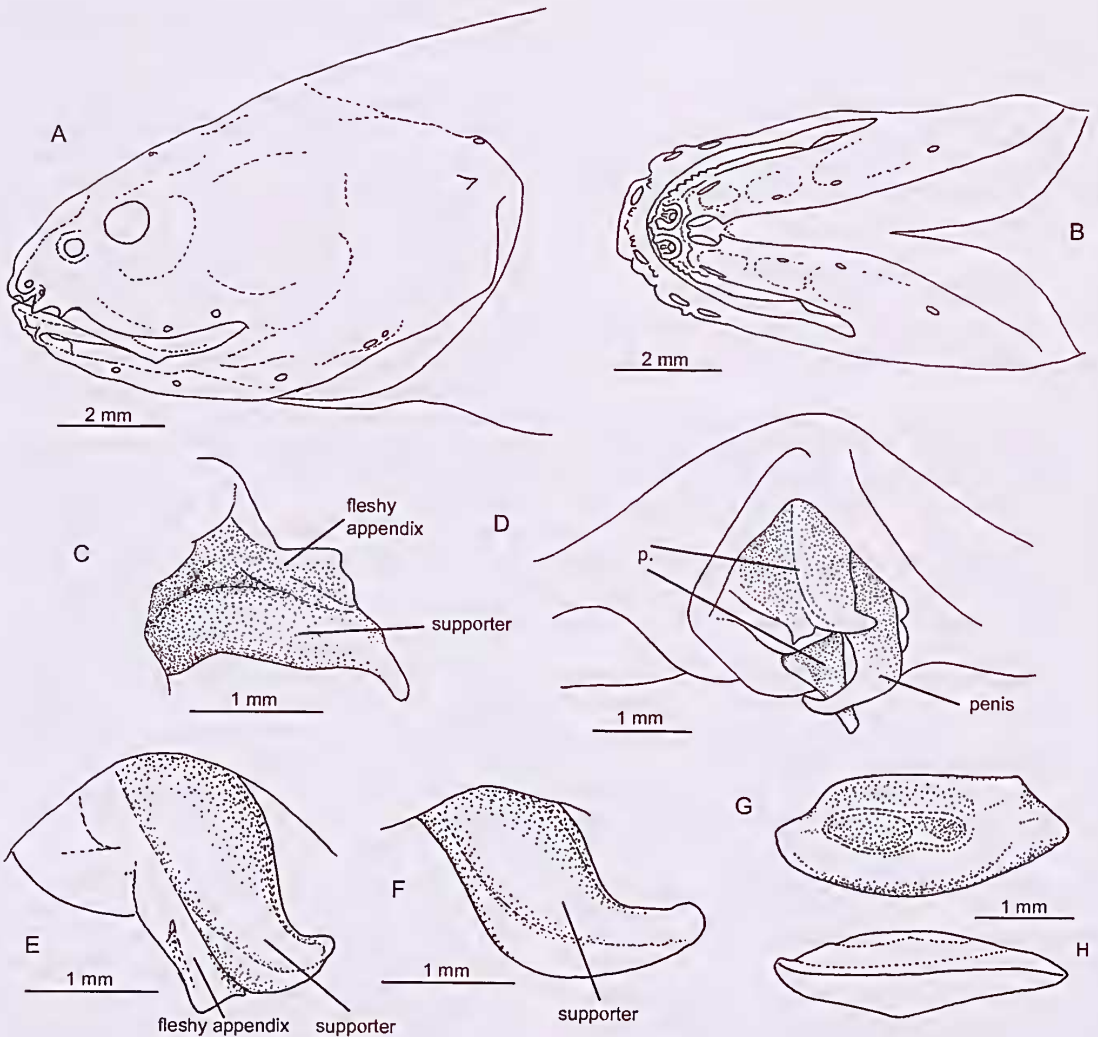
**Description.** The principal meristic and morphometric characters are shown in Table 7. Body slender, up to 73 mm SL, mature at about 35 to 40 mm SL. Head without scales. Horizontal diameter of scales on body about 0.6 % SL, in about 8–10 scattered horizontal rows in the holotype (see Whitley 1935: fig. 8). Maxillary not expanded posteriorly, with ventral spine positioned behind rear of eye. Anterior nostril on tip of snout. Posterior nostril large, about 1/3 the size of eye.

**Head sensory pores** (Fig. 10 A–B). Supraorbital pores mostly 3 (rarely 2, the female holotype is one of only two specimens lacking the supraorbital pore behind the eye). Infraorbital pores 5 (3 anterior and 2 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 2 lower with separate or (less common) joined opening, no upper preopercular pore. All pores small, about 1/2 the size of posterior nostril or smaller.

**Dentition** (in a 43 mm SL male, AMS I.16469-016). Premaxilla with 5 rows of small teeth anteriorly, merging into single row posteriorly. Anteriormost teeth in inner row up to 1/3 diameter of pupil. Vomer horseshoe-shaped, with 1 row of 8 large teeth up to 3/4 diameter of pupil. Palatine teeth in 2 rows with 4+2 small teeth up to 1/3



Fig. 9. *Dermatopsis macrodon* Ogilby, 1896. A, AMS I.3505, holotype, female, 73 mm SL; B, AMS I.15912-040, non-type male, 41 mm SL.



**Fig. 10.** *Dermatopsis macrodon* Ogilby, 1896. **A**, lateral view of head, AMS I.15912-040, non-type, male, 41 mm SL; **B**, ventral view of head, AMS I.15912-040, non-type, male, 41 mm SL; **C**, view of left pseudoclasper from inside, AMS I.15912-040, non-type, 41 mm SL; **D**, inclined lateral view of male eopulatory organ, AMS I.15912-040, non-type, 41 mm SL; **E**, view of left pseudoclasper from outside, AMS I.25380-001, non-type, 38 mm SL; **F**, view of left pseudoclasper from outside, AMS I.25380-001, non-type, 35 mm SL; **G**, median view of right otolith, ZMUC P771553, non-type, male, 40 mm SL; **H**, ventral view of right otolith, ZMUC P771553, non-type, male, 40 mm SL.

diameter of pupil. Dentary with 3 outer rows of granular teeth and 1 inner row of larger teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about size of pupil diameter.

**Otolith** (Fig. 10G–H). Elongate, length to height ratio 2.2–2.4 (35–63 mm SL), thick; otolith length to sulcus length ratio 1.9–2.1; sulcus divided into ostium and cauda, marked by indentation of ventral sulcus margin, colliculi also divided; length of ostial colliculum to length of caudal colliculum ratio 1.8–2.2; anterior tip of otolith sharply pointed, with small concavity dorsally, posterior tip less sharply pointed, no predorsal angle,

sharp postdorsal angle; inner face with weak ventral furrow close to ventral rim and broad, well defined dorsal depression. A mild form of sexual dimorphism was observed in the sense that otoliths from females are slightly less thick than those of males.

**Axial skeleton** (of holotype). First neural spine half the length of second. Neural spine of vertebrae 2–3 elongate and 4–9 depressed. Parapophyses present from vertebrae 5 to 12. Pleural ribs on vertebrae 2–10. First anal fin pterygiophore slightly elongate, not reaching tip of last precaudal parapophysis.



Table 7. Meristic and morphometric characters of *Dermatopsis macrodon* Ogilby, 1896.

	Holotype AMS 1.3505	Holotype + 27 non-types Mean (range)	n
Standard length in mm	73	43.9 (27–73)	28
<b>Meristic characters</b>			
Dorsal fin rays	80	74.5 (69–82)	28
Anal fin rays	55	51.6 (47–56)	28
Pectoral fin rays	20	19.8 (18–22)	21
Preecaudal vertebrae	13	13.0(12–14)	28
Caudal vertebrae	31	29.2 (27–32)	28
Total vertebrae	44	42.3 (40–45)	28
Rakers on anterior gill arch	15	10.7 (5–17)	9
Pseudobranchial filaments	0	1.4 (0–2)	10
D/V	7	5.9 (5–7)	28
D/A	29	28.0 (24–31)	28
V/A	17	16.7 (16–18)	28
<b>Morphometric characters in % of SL</b>			
Head length	21.9	23.0 (21.6–24.8)	27
Head width	12.0	11.5 (9.0–14.6)	26
Head height	13.0	13.8 (12.4–15.8)	26
Snout length	5.5	5.6 (5.0–6.5)	26
Upper jaw length	11.4	11.5 (10.4–12.5)	26
Diameter of pigmented eye	1.4	1.9 (1.4–2.3)	28
Diameter of pupil	0.7	1.1(0.7–1.8)	24
Interorbital width	5.0	4.9 (4.2–5.5)	26
Postorbital length	15.9	16.3 (14.9–18.2)	26
Precanal length	50.6	52.1 (47.6–56.2)	25
Predorsal length	30.9	29.1 (26.7–31.3)	25
Body depth at origin of anal fin	11.7	12.6 (10.4–14.4)	26
Pectoral fin length	9.8	12.8 (9.8–14.3)	23
Pectoral fin base height	4.8	5.6(4.8–6.6)	23
Ventral fin length	11.8	14.9 (10.2–20.3)	23
Base ventral fin – anal fin origin	31.5	34.9 (29.8–38.0)	24

**Male copulatory organ** (Fig. 10C–F). A single pair of large pseudoclaspers, curved, not expanded, underpinned by narrow massive supporter. Pseudoclasper with broad fleshy appendages anteriorly. Isthmus between pseudoclaspers wide. Penis thick, with angularly inclined narrow tip, about the length of pseudoclaspers.

**Coloration.** Live colour not known. Medium brown when preserved, often darker dorsally and on vertical fins, even after extended preservation.

**Comparison.** *Dermatopsis macrodon* is distinguished from the three other species of the genus by the broad fleshy appendages anteriorly on the pseudoclasper, which has a narrow supporter, the dark coloration of the vertical fins and the usual presence of a supraorbital pore behind the eye. From *D. joergenielsenii* from New Zealand it is distinguished by the long broad pseudoclasper with fleshy anterior appendages (vs short and spiny, of about half the length of the penis) and the number of posterior infraorbital pores (2 vs 3). From *D. greenfieldi* from Fiji it is distinguished by the higher number of vertebrae (40–45 vs 39–41) and dorsal fin rays (69–82 vs 64–70). From the sympatric *D. hoesei* it also differs by having scales on body (vs absent) and smaller eye (Fig. 5).

**Remarks.** The holotype of *D. macrodon* is a female, which lacks one of the important diagnostic characters for the species (presence of a supraorbital pore behind the eye). Despite these two shortcomings, it is still distinct from the sympatrically occurring *D. hoesei* in the following characters: presence of scales on the body (vs absent), total vertebrae (44 vs 40–42, rarely 43), dorsal fin rays (80 vs 67–77 in *D. hoesei*) and the large size (73 mm SL vs up to 48 mm SL).

In any event, female specimens, and more so juveniles of the two species *D. hoesei* and *D. macrodon*, can not always be distinguished reliably. We have left 37 juvenile specimens belonging to the one or the other species in open nomenclature.

*Dermatopsis macrodon* may be less common in its area of distribution than would be suggested from previous records in literature, mainly because a second sympatric new species (*D. hoesei*) was not recognized. Records of *D. macrodon* from New Zealand (e.g. Cohen 1966; Paulin *et al.* 1989) represent a different species (*D. joergenielsenii*).

**Distribution** (Fig. 6). *Dermatopsis macrodon* is distributed along the rocky shores of south-eastern

Australia south of the Great Barrier Reef, chiefly the shores of New South Wales between the latitudes 29°S and 35°S.

**Ecology.** Lives on rocky shores, often buried in sand, mud or silt below stones or other hard substrate. Specimens in collections often had medium to coarse grained quartz sand trapped in the gill opening. This could point to a more sand-bottom adaptation and explain why *D. macrodon* is so rarely caught together with *D. hoesei*, even though both species live in the same general area of south-eastern Australia between 29°S and 37°S. Depths down to 5 m. A 62 mm SL female (AMS I.16469-016) contains two pale unpigmented embryos, 6–7 mm SL.

*Dermatopsis* sp.

(Figs 6, 11; Tables 1–3)

**Material examined.** (1 specimen, 50 mm SL). AMS I.34306-001, NW corner of Bay Island, Shoalwater Bay, Queensland, 22°19'S, 150°18'E, 0–0.3 m, AMS party, 15 Sept. 1993.

**Remarks.** This single large female specimen is the only one known from the Great Barrier Reef, i.e. considerably north of the occurrence of both *D. hoesei* and *D. macrodon*. With the latter it shares the small mandibular pores, the presence of scales on the body, a supraorbital pore behind the eye and the relatively large size. It differs in its pale colour and the low meristic counts (41 vertebrae, 72 dorsal rays, 49 anal rays), characters, in which it more resembles *D. hoesei*. The otoliths are elongate, as in *D. macrodon* (vs compressed in *D. hoesei*), but with a prominent predorsal projection, which is missing in those of *D. macrodon*. It is possible that this specimen represents another new species, but without males this can not be judged with reasonable certainty.

*Dermatopsoides* Smith, 1947

(Tables 1–3)

*Dermatopsoides* Smith, 1947: 361 (type species *Dermatopsis kasougae* Smith, 1943, by monotypy; see Eschmeyer 1998).

*Dermatopsoides*. – Cohen 1966: 194; Cohen and Nielsen 1978: 57; Smith and Heemstra 1986: 355; Nielsen *et al.* 1999: 127.

**Diagnosis.** Anterior nostril placed very close above upper lip; head without scales; opercular spine covered by skin, not exposed; maxilla not vertically expanded postventrally, with spine below rear of eye; lower lip smooth (except with skin folds in *D. morrisonae* n. sp.); male copulatory organ with one pair of simple, stick-like pseudoclaspers (probably representing the outer pseudoclasper in the terminology of Møller *et al.* (2004a)); sulcus of otolith with separated ostium and cauda marked by a step-change at ventral margin of sulcus due to cauda being much narrower than ostium, colliculi of ostium and cauda indistinctly separated; anterior anal fin ray pterygiophore short, except long in *D. kasougae*; lower preopercular pores 1, 2 or 3; upper preopercular pore absent; posterior infraorbital pores 2; precaudal vertebrae 11–14.

**Comparison.** *Dermatopsoides* appears to be closely related to *Dermatopsis* and, more distantly, to *Dipulus*, which are all readily distinguished from the other Indo-west Pacific genera so far described by the absence of scales on the head and the maxilla not vertically expanded postventrally (see also key above).

Within this group of three genera, *Dermatopsoides* is readily recognized by the covered, not exposed opercular spine (vs free). From *Dermatopsis* it differs further in the mostly smooth lower lip (except *D. morrisonae*), and the sulcus outline. *Dipulus* is more elongate with high numbers of precaudal vertebrae (13–25 vs 11–14), and has a hook on the penis (vs absent).

**Distribution.** *Dermatopsoides* was recognized as a valid genus by Cohen (1966), Cohen and Nielsen (1978) as well as by Nielsen *et al.* (1999), containing two species (*D. kasougae* and *D. talboti*) endemic to the shores of South Africa (Indian Ocean). An additional species is described here from South Africa and another one from Western Australia.

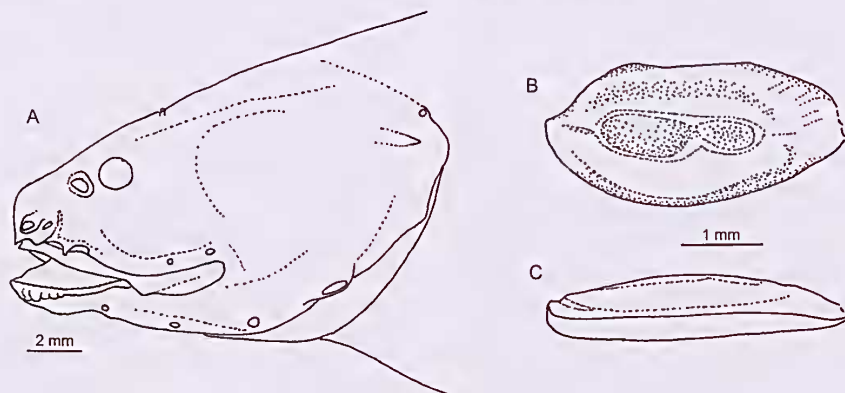


Fig. 11. *Dermatopsis* sp., AMS I.34306-001, non-type, female, 51 mm SL. A, lateral view of head; B, median view of right otolith; C, ventral view of right otolith.

*Dermatopsoides andersoni* n. sp.

(Figs 12–13, 16; Tables 1–3, 8)

*Dermatopsoides talboti*. – Cohen 1966 (in part): 199; Anderson 2004: 2, photo.

**Material examined.** (3 specimens, 39–54 mm SL).

**HOLOTYPE** – RUSI 20096, male, 39 mm SL, Algoa Bay, South Africa, 34°S, 25°E, D. Bickell, 17 April 1984. **PARATYPES** – SAM 21493, female, 51 mm SL, Saldanha Bay, Langebaan, South Africa, U.C.T. Ecol. Survey, Sta. L.B. 441A, 3 May 1954; SAIAB 70867, female, 54 mm SL, South Africa, Algoa Bay, NW end of Bird Island, P.C. Heemstra, Nov. 25, 2003.

**Diagnosis.** Vertebrae 13 + 30–31 = 43–44, dorsal fin rays 80–86, anal fin rays 51–59; snout terminal to slightly inferior; eye small 1.4–1.6 % SL; pectoral fin length 9.5–9.9 % SL; scales absent on head and body; posterior nostril moderately small, more than half the size of eye; lower preopercular pore 1, small; weak ventral spine on maxilla positioned behind rear of eye; single pair of pseudoclaspers dorsally curved at their distal ends, thin, about half the length of penis.

**Description.** The principal meristic and morphometric characters are shown in Table 8. Body slender, up to 54 mm SL, mature at about 50 mm SL. Head and body without



Fig. 12. *Dermatopsoides andersoni* n. sp. A, RUSI 20096, holotype, male, 39 mm SL; B, SAIAB 70867, paratype, female, 54 mm SL.

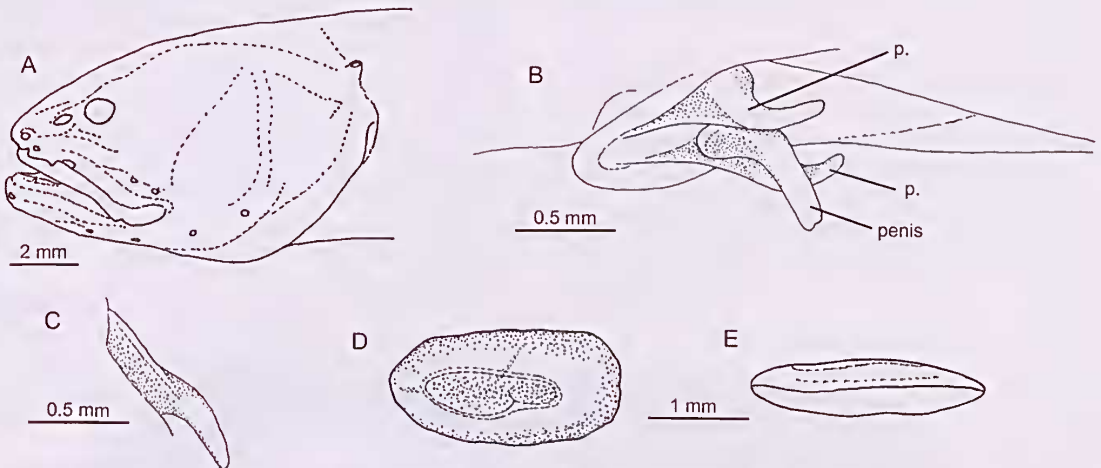


Fig. 13. *Dermatopsoides andersoni* n. sp. A, lateral view of head, SAM 21493, paratype, female, 51 mm SL; B, inclined lateral view of male copulatory organ, RUSI 20096, holotype, 39 mm SL; C, view of left pseudoclasper from inside, holotype, RUSI 20096, 39 mm SL; D, median view of right otolith, SAIAB 70867, paratype, female, 54 mm SL; E, ventral view of right otolith, SAIAB 70867, paratype, female, 54 mm SL.

**Table 8.** Meristic and morphometric characters of *Dermatopsoides andersoni* n. sp.

	Holotype RUSI 20096	Holotype + 2 paratypes Mean (range)	n
Standard length in mm	39	48.0 (39–54)	3
<b>Meristic characters</b>			
Dorsal fin rays	86	82.7 (80–86)	3
Anal fin rays	59	54.7 (51–59)	3
Pectoral fin rays	18	17.7 (16–19)	3
Precaudal vertebrae	13	13	3
Caudal vertebrae	31	30.7 (30–31)	3
Total vertebrae	44	43.7 (43–44)	3
Rakers on anterior gill arch	10	12.0(10–14)	2
Pseudobranchial filaments	1	0.3 (0–1)	3
D/V	5	5.7 (5–6)	3
D/A	26	29.7 (26–33)	3
V/A	16	17.3 (16–18)	3
<b>Morphometric characters in % of SL</b>			
Head length	20.2	20.7 (20.2–20.9)	3
Head width	6.8	9.1 (6.8–12.0)	3
Head height	12.4	12.5 (12.4–12.5)	3
Snout length	5.0	5.1 (4.9–5.4)	3
Upper jaw length	9.8	10.4 (9.8–10.8)	3
Diameter of pigmented eye	1.6	1.5 (1.4–1.6)	3
Diameter of pupil	0.8	0.9(0.8–1.1)	3
Interorbital width	3.3	3.9 (3.3–4.4)	3
Postorbital length	14.2	14.8 (14.2–15.5)	3
Precanal length	49.2	52.3 (49.2–54.0)	3
Predorsal length	24.1	25.4 (24.1–26.9)	3
Body depth at origin of anal fin	9.8	10.3 (9.8–11.3)	3
Pectoral fin length	9.5	9.7 (9.5–9.9)	3
Pectoral fin base height	3.5	4.0 (3.5–4.5)	3
Ventral fin length	11.8	11.5 (10.6–12.1)	3
Base ventral fin – anal fin origin	33.8	36.7 (33.8–39.7)	3

scales. Maxillary not expanded posteriorly, with weak spine positioned behind rear of eye. Anterior nostril at tip of snout. Posterior nostril moderately small, more than half the size of eye.

*Head sensory pores* (Fig. 13A). Supraorbital pores 2. Infraorbital pores 4–5 (3 anterior and 1–2 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 1 lower, no upper preopercular pore. All pores small, about half the size of posterior nostril.

*Dentition*. (of holotype). Premaxilla with 4 rows of small teeth anteriorly, merging into single row posteriorly. Anteriormost 2 teeth in inner rows fang-like, up to 3/4 diameter of pupil. Vomer horseshoe-shaped, with 2 irregular rows of 6 large teeth in total, up to 3/4 diameter of pupil. Palatine teeth in 2 irregular rows with 10 large teeth in total, size equal to diameter of pupil. Dentary with 3 outer rows of granular teeth and 1 inner row of larger teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about size of pupil diameter.

*Otolith* (Fig. 13D–E). Moderately elongate, length to height ratio 2.0 (54 mm SL); otolith length to sulcus length ratio 1.7; sulcus of otolith deepened, with separated ostium and cauda marked by step-change at ventral margin of

sulcus due to cauda being much narrower than ostium, colliculi of ostium and cauda indistinctly separated; length of ostial colliculum to length of caudal colliculum ratio 1.9; anterior tip of otolith rounded without concavity dorsally, posterior tip abrupt, directly behind broad postdorsal angle; inner face with weak ventral furrow close to ventral rim and shallow dorsal depression.

*Axial skeleton* (RUSI 20096, holotype). First neural spine half the length of second. Neural spine of vertebrae 2–3 elongate and 4–10 depressed. Parapophyses present from vertebrae 6 to 13. Pleural ribs on vertebrae 2–11. First anal fin pterygiophore slightly elongate, not reaching tip of last precaudal parapophysis.

*Male copulatory organ* (Fig. 13B–C). A single pair of pseudoclaspers, dorsally curved at their distal ends, thin, about half the length of penis, probably underpinned by broad supporter. Isthmus between pseudoclaspers moderately wide. Penis tapering, curved, with broad base.

*Coloration*. Live colour red (Fig. 12B). Preserved colour uniformly light brown (Fig. 12A).

*Comparison*. *Dermatopsoides andersoni* is intermediate in vertebrae and finray counts to the two

other species of the genus known from South Africa (see respective discussions). Further, it differs from all other species of the genus in the short pectoral fin length (< 10% vs 11.8–16.2 of SL).

**Remarks.** Cohen (1966) noted the considerable meristic variation among specimens of his newly described *D. talboti*, with one specimen from the west coast of Saldanha Bay being the “geographically farthest from the type-locality of *D. kasongae*”, but yet the “closest to it in count”. The two additional specimens now available from Francis Bay and Algoa Bay not only confirm the taxonomic separation from *D. talboti*, but also the broadly overlapping sympatric distribution pattern.

**Biology.** A recently caught female from Bird Island, Algoa Bay (SAIAB 70867) was found to be gravid at 54 mm SL. For some unknown reason, bony calcification is severely reduced in this specimen to the extent that counting of fin rays is almost impossible. Its dorsal fin ray count of 80 and anal fin ray count of 51 are the lowest numbers recorded for the species and lack ultimate accuracy. In any case, all meristic values are well distinct from *D. talboti*.

**Distribution** (Fig. 16). *Dermatopsoides andersoni* is known from Saldanha Bay on the west coast of South Africa to Algoa Bay near Port Elizabeth, on the south-east coast.

**Ecology.** A 54 mm SL female contains four 20–23 mm SL, fully developed embryos; their preserved coloration is uniformly light brown, slightly darker than their mother.

**Etymology.** Named in honour of M. Eric Anderson, Grahamstown, SAIAB, in recognition of his great help to the present revision.

#### *Dermatopsoides kasongae* (Smith, 1943)

(Figs 14–16; Tables 1–3, 9)

*Dermatopsis kasongae* Smith, 1943: 72, fig. 3 (type locality: Kasouga River estuary, west of Port Alfred, South Africa).

*Dermatopsoides kasongae*. – Smith 1947: 344; Cohen 1966: 198; Smith and Heemstra 1986: 355.

**Material examined.** (2 specimen, 57 mm SL). Holotype, RUSI 333, 70 mm TL, Kasouga river estuary, west of Port Alfred, South Africa (only x-ray examined). Non-type: RUSI 8547, male, 57 mm SL, Port Alfred to Bushmans River, Eastern Cape, South Africa, no more data.

**Table 9.** Meristic and morphometric characters of *Dermatopsoides kasongae* (Smith, 1943).

	Holotype RUSI 333*,**	Non-type RUSI 8547***
Standard length in mm	63	57
<b>Meristic characters</b>		
Dorsal fin rays	100	93
Anal fin rays	71	70
Pectoral fin rays	22* or 24**	–
Precaudal vertebrae	14	14
Caudal vertebrae	32	33
Total vertebrae	46	47
Rakers on anterior gill arch	12–13*	–
Pseudobranchial filaments	0	–
D/V	6	6
D/A	31	32
V/A	17	17
<b>Morphometric characters in % of SL</b>		
Head length	24.0	–
Head width	–	–
Head height	–	–
Snout length	4.3	–
Upper jaw length	–	–
Diameter of pigmented eye	2.4	–
Diameter of pupil	–	–
Interorbital width	–	–
Postorbital length	13.6	–
Precanal length	49.9	–
Predorsal length	26.2	–
Body depth at origin of anal fin	16.3	–
Pectoral fin length	11.8	–
Pectoral fin base height	–	–
Ventral fin length	18.8	–
Base ventral fin – anal fin origin	–	–

\* Data from Smith (1943) included.

\*\* Data from Cohen (1966) included.

\*\*\* Specimen dried, so no morphometric data are included.

**Remarks.** *Dermatopsoides kasongae* is known from two specimens, the holotype, which we have not been able to borrow for study, and a more recently collected specimen from near the type locality, which we borrowed, but which was completely dried up. As a result of this, certain investigations such as head pores and some morphometric measurements unfortunately could not be evaluated.



**Fig. 14.** *Dermatopsoides kasongae* (Smith, 1943). RUSI 8547, non-type, male, 57 mm SL.

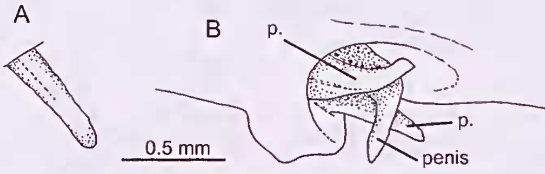


Fig. 15. *Dermatopsoides kasongae* (Smith, 1943). A, inclined lateral view of male copulatory organ, RUSI 8547, non-type, 57 mm SL; B, view of left pseudoelasper from outside, RUSI 8547, non-type, 57 mm SL.



Fig. 16. Sample sites of *Dermatopsoides kasongae*, *D. talboti* and *D. andersoni* n. sp. One symbol may represent several samples.

**Diagnosis.** Vertebrae  $14 + 32-33 = 46-47$ , dorsal fin rays  $93-100$ , anal fin rays  $70-71$ ; body scaled; pelvic fin extending beyond posterior end of pectoral fin; single pair of pseudoelaspers thin, straight, not quite as long as penis.

**Description.** Partly based on Smith (1943) and Cohen (1966). The restricted number of meristic and morphometric characters measurable from the only available dry specimen are shown in Table 9. Body slender, up to 57 mm SL. Head without scales. Horizontal diameter of scales on body about 0.8 % SL, covering the whole body (Smith 1943). Maxillary not expanded posteriorly. Anterior nostril on tip of snout. Posterior nostril moderate in size.

**Head sensory pores.** Cannot be identified on the dried specimen available.

**Dentition.** (of holotype, from Smith 1943). Premaxilla with 3 rows of small teeth anteriorly, merging into single row posteriorly. Vomer horseshoe-shaped, with 2 irregular rows of total of 10 large teeth. Palatine teeth in 2 irregular rows with 20 teeth in total. Dentary with 3 outer rows anteriorly, merging into 1 row posteriorly, up to about size of pupil diameter.

**Otolith.** Not known.

**Axial skeleton** (RUSI 333, holotype). First neural spine half the length of second. Neural spine of vertebrae 2-4

elongate and 4-8 depressed. Parapophyses present from vertebrae 7 to 13. Pleural ribs on vertebrae 2-12. First anal fin pterygiophore slightly elongate, not reaching tip of last precaudal parapophysis.

**Male copulatory organ** (Fig. 15A-B). A single pair of pseudoelaspers, thin, straight, not quite as long as penis. Isthmus between pseudoelaspers narrow. Penis tapering, curved.

**Coloration.** Live colour uniformly light salmon-pink, fins light (Smith 1943). Preserved colour light brown.

**Comparison.** Despite the limited amount of data available, it is obvious that *D. kasongae* can be readily recognized by the high number of vertebrae (46-47), dorsal fin rays (93-100) and anal fin rays (70-71). The values of the other two species of *Dermatopsis* from South Africa are < 45 for vertebrae, < 87 for dorsal fin rays and < 60 for anal fin rays. Also, it has larger eyes (2.4 vs 1.1-2.2 % SL) and is the only one with straight pseudoelaspers (vs inwardly curved, not known for *D. morrisonae*).

**Distribution** (Fig. 16). *Dermatopsoides kasongae* has in previous literature been cited as being distributed from Algoa Bay to Port Alfred (Smith and Heemstra 1986). However, there are only two confirmed records of the species, both originating from the Port Alfred area (holotype from the Kasouga River estuary near Port Alfred). These geographically extremely restricted records may indicate a specific environmental adaptation of the species.

***Dermatopsoides morrisonae* n. sp.**

(Figs 6, 17-18; Table 1-3, 10)

**Material examined.** (2 specimens, 26-29 mm SL). HOLOTYPE - WAM P.28292-010, female, 26 mm SL, Lucky Bay, Western Australia, 34°00'S, 122°14'E, 7-10 m, J.B. Hutehins, 11 April 1984. PARATYPE - WAM P.28284-006, female, 29 mm SL, NW side of Six Mile Island, Israelite Bay, Western Australia, 33°37'S, 123°53'E, 5-6 m, N. Sinclair *et al.*, 4 April 1984.

**Diagnosis.** Vertebrae  $13-14 + 28-31 = 42-44$ , dorsal fin rays 72-76, anal fin rays 52-54; scales present on body; dorsal and anal fins dark; snout terminal; lower lip with skin folds; ventral fin length 15.8-18.5 % SL; posterior nostril moderately small, more than half the size of eye; lower preopercular pores 3, small; weak ventral spine on maxilla positioned behind rear of eye.

**Description.** The principal meristic and morphometric characters are shown in Table. 10. Head without scales. Horizontal diameter of scales on body of paratype about 0.8 % SL in about 18 horizontal rows. No scales present in juvenile holotype. Maxillary not expanded posteriorly, with weak ventral spine. Lower lip with skin folds. Anterior nostril directly above snout. Posterior nostril moderately small, more than half the size of eye.

**Head sensory pores** (Fig. 18A-B). Supraorbital pores 2. Infraorbital pores 5 (3 anterior and 2 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 3

lower, no upper preopercular pore. All pores small, mostly half the size of posterior nostril.

**Dentition** (of holotype). Premaxilla with 3 rows of small teeth anteriorly, merging into single row posteriorly. Anterior teeth in inner row up to 1/3 diameter of pupil. Vomer horseshoe-shaped, with single row of 6 large teeth up to 3/4 diameter of pupil. Palatine teeth in single row with 5 large teeth up to 1/3 diameter of pupil. Dentary with 2 outer rows of small teeth and 1 inner row of larger teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about 2/3 of pupil diameter.

**Otolith.** Not known.

**Axial skeleton** (of holotype). First neural spine half the length of second. Neural spine of vertebrae 2–4 elongate and 5–9 depressed. Parapophyses present from vertebrae 6 to 13. Pleural ribs on vertebrae 3–10. First anal fin pterygiophore slightly elongate, not reaching tip of last precaudal parapophysis.

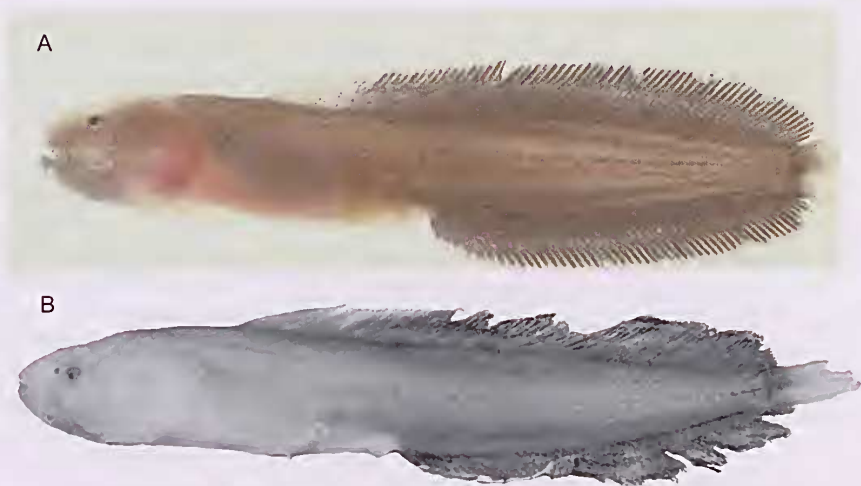
**Male copulatory organ.** So far only female specimens known.

**Coloration.** WAM P.28292-010 was photographed freshly dead by Barry Hutchins (Fig. 17A). It shows medium brownish body coloration; lighter at the head and shading to reddish over the operculum (gills shining through). The anal fin and most of the dorsal fin are black, the latter except for the anterior part, which is translucent like the pelvic and the caudal fins. The dark coloration of the dorsal and anal fins is still well visible after an extended period of preservation; visible also in the paratype.

**Comparison.** *Dermatopsoides morrisonae* is readily distinguished from the three South African species by the presence of three lower preopercular pores (vs 1–2), the presence of skin folds on the lower lip (vs smooth lower lip), the dark coloration of the dorsal and anal fins and the large pectoral fin length (>16 vs < 13 % SL). In vertebrae

**Table 10.** Meristic and morphometric characters of *Dermatopsoides morrisonae* n. sp.

	Holotype	Paratype
	WAM P.28292-010	WAM P.28284-006
Standard length in mm	26	29
<b>Meristic characters</b>		
Dorsal fin rays	72	76
Anal fin rays	52	54
Pectoral fin rays	20	20
Precaudal vertebrae	14	13
Caudal vertebrae	28	31
Total vertebrae	42	44
Rakers on anterior gill arch	11	12
Pseudobranchial filaments	2	2
D/V	5	6
D/A	26	26
V/A	17	17
<b>Morphometric characters in % of SL</b>		
Head length	25.2	25.4
Head width	10.8	12.6
Head height	14.5	14.6
Snout length	6.9	6.3
Upper jaw length	11.8	12.4
Diameter of pigmented eye	2.2	2.1
Diameter of pupil	1.3	1.3
Interorbital width	6.7	4.4
Postorbital length	16.6	17.8
Preanal length	50.1	50.5
Predorsal length	25.9	30.4
Body depth at origin of anal fin	13.5	15.3
Pectoral fin length	16.2	–
Pectoral fin base height	7.4	–
Ventral fin length	15.8	18.5
Base ventral fin – anal fin origin	32.7	31.6



**Fig. 17.** *Dermatopsoides morrisonae* n. sp., WAM P.28292-010, holotype, female, 26 mm SL. **A**, fresh dead; **B**, after preservation.

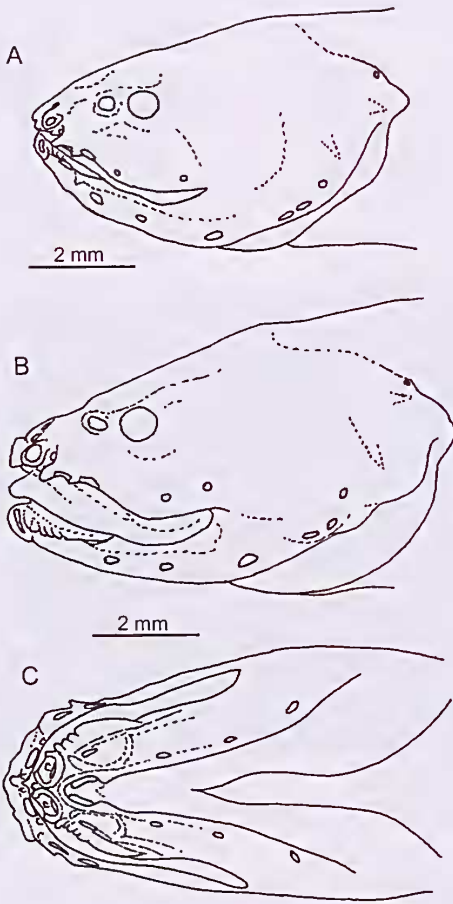


Fig. 18. *Dermatopsoides morrisonae* n. sp. A, lateral view of head, WAM P.28292-010, holotype, female, 26 mm SL; B, lateral view of head, WAM P.28284-006, paratype, female, 29 mm SL; C, ventral view of head, WAM P.28284-006, paratype, female, 29 mm SL.

and fin ray counts it is intermediate between *D. talboti* and *D. andersoni*.

*Dermatopsoides morrisonae* is separated from the three species of *Dermatopsoides* in South Africa by nearly 8000 km across the southern Indian Ocean. Despite this long distance, we could not allocate it to a separate genus. In fact the hidden opercular spine is a rare character amongst the Dinematchthyini, which *Dermatopsoides* only shares with one other genus, *Gunterichthys*, from the Atlantic and Pacific shores of tropical America.

**Distribution** (Fig. 6). *Dermatopsoides morrisonae* is exclusively known from two small specimens caught at the south-westernmost tip of Western Australia near the township of Esperance.

**Ecology.** Known from depths between 5 and 10 m.

**Etymology.** Named in honour of Sue M. Morrison, Perth, WAM, in recognition of her great help with our revision of the Dinematchthyini.

***Dermatopsoides talboti* Cohen, 1966**

(Figs 16, 19–20; Tables 1–3, 11)

*Dermatopsoides talboti* Cohen, 1966: 195, Fig. 5A, 5B (type locality: Bird Island, Algoa Bay, South Africa).

*Dermatopsoides talboti*. – Smith and Heemstra 1986: 356.

**Material examined.** (6 specimens, 25–46 mm SL). Holotype, RUSI 340, male, 40 mm SL, Bird Island, Algoa Bay, South Africa, tidepools, J.L.B. and M.M. Smith, 11 May 1964 (only x-ray examined). Paratypes: RUSI 339, sex unknown, data as for holotype (only x-ray examined); SAM 21693, male, 25 mm SL, locality unknown, coll. by Stellenbosch University, 1958; SAM 21800, female, 45 mm SL, Somerset Strand, False Bay, coll. by Stellenbosch University, date unknown. Non-types: RUSI 8546, female, 43 mm SL, Tsitsikama coast, Knysna, Eastern Cape, South Africa, 32°13'S, 26°35'E, R. Liversidge, 19 June 1965; RUSI 17297, female, 46 mm SL, Bird Island, Algoa Bay, South Africa, 33°59'S, 25°40'E, 12 September 1982.

**Diagnosis.** Vertebrae 11–12 + 26–28 = 37–40, dorsal fin rays 60–67, anal fin rays 40–45; snout inferior; scales absent; pelvic fin not extending beyond posterior end of pectoral fin; pectoral fin length 12.3–12.7% SL; posterior nostril small, about half the size of eye; lower preopercular pores 2, small; weak spine on maxilla positioned behind rear tip of eye; single pair of pseudoclaspers dorsally curved at their distal ends, about half the length of penis.

**Description.** The principal meristic and morphometric characters are shown in Table 11. Body moderately slender, up to 46 mm SL; mature at about 40 to 45 mm SL. Scales absent. Maxillary not expanded posteriorly, with weak spine positioned behind rear of eye. Anterior nostril on tip of snout. Posterior nostril small, about 1/2 the size of eye.

**Head sensory pores** (Fig. 20). Supraorbital pores 2. Infraorbital pores 5 (3 anterior and 2 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 2 lower, no upper preopercular pore. All pores small, about the size of posterior nostril or smaller.

**Dentition** (of paratype, SAM 21800). Premaxilla with 4 rows of small teeth anteriorly, merging into single row posteriorly. Anterior teeth in inner row up to 1/4 diameter of pupil. Vomer horseshoe-shaped, with single row of 7 large teeth up to 3/4 diameter of pupil. Palatine teeth in single row with 6 large teeth up to 3/4 diameter of pupil. Dentary with 3 outer rows of small teeth and 1 inner row of large teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about size of pupil diameter.

**Otolith.** Not known.

**Axial skeleton** (of holotype). First neural spine half the length of second. Neural spine of vertebrae 2–4 elongate and 4–10 depressed. Parapophyses present from vertebrae 3 to 18. Pleural ribs on vertebrae 2–8. First anal





Fig. 19. *Dermatopsoides talboti* Cohen, 1966. WAM P.28284-006, holotype, female, 29 mm SL.

fin pterygiophore elongate, almost reaching tip of last precaudal parapophysis.

**Male copulatory organ.** Description based on Cohen (1966). A single pair of pseudoclaspers, dorsally curved at their distal ends, thin, about half the length of penis, probably underpinned by broad supporter. Isthmus between pseudoclaspers wide, fleshy. Penis tapering, curved.

**Coloration.** Live colour unknown. Preserved specimens light brown.

**Comparison.** *Dermatopsoides talboti* is the least slender of the three species of the genus occurring in South Africa and also the one with the lowest vertebrae count (37–40 vs > 42), dorsal fin ray count (60–67 vs > 79) and anal fin ray count (40–45 vs > 50). Another typical character for *D. talboti* seems to be the usually distinctly

Table 11. Meristic and morphometric characters of *Dermatopsoides talboti* Cohen, 1966.

	Holotype RUSI 340	Holotype + 5 paratypes Mean (range)	n
Standard length in mm	40*	39.8 (25–46)	6
<b>Meristic characters</b>			
Dorsal fin rays	67	63.0 (60–67)	5
Anal fin rays	43	42.3 (40–45)	4
Pectoral fin rays	–	17.5 (17–18)	2
Precaudal vertebrae	12	11.7(11–12)	6
Caudal vertebrae	27	27.3 (26–28)	6
Total vertebrae	39	39.0 (37–40)	6
Rakers on anterior gill arch	–	17	1
Pseudobranchial filaments	–	0	1
D/V	6	6.5 (6–7)	6
D/A	28	25.0 (22–28)	6
V/A	17	16.5 (16–17)	6
<b>Morphometric characters in % of SL</b>			
Head length	22.2	24.6 (22.2–27.3)	4
Head width	–	11.1 (10.2–12.1)	2
Head height	16.7	14.5 (13.9–16.7)	3
Snout length	5.6	5.4 (5.1–5.7)	3
Upper jaw length	10.8	11.4 (10.8–11.8)	3
Diameter of pigmented eye	1.6	1.3 (1.1–1.6)	5
Diameter of pupil	–	0.6	1
Interorbital width	–	3.5 (2.9–4.1)	2
Postorbital length	14.6	16.7 (14.6–17.4)	3
Precanal length	59.0	56.2 (54.4–59.0)	3
Predorsal length	33.0	32.1 (31.3–33.0)	3
Body depth at origin of anal fin	11.8	13.0 (11.8–13.3)	3
Pectoral fin length	12.5	12.5 (12.3–12.7)	3
Pectoral fin base height	6.3	5.6 (5.5–6.3)	3
Ventral fin length	15.3	11.1–15.3	2
Base ventral fin – anal fin origin	41.0	37.2 (33.2–41.2)	3

\* Data from Cohen (1966) included, including measurements of Fig. 5.

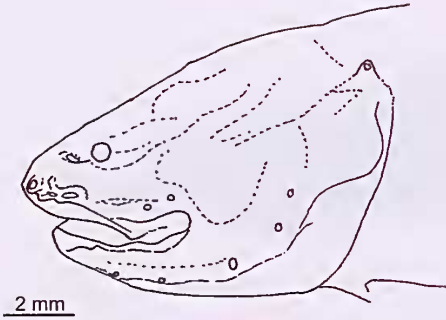


Fig. 20. *Dermatopsoides talboti* Cohen, 1966. Lateral view of head, SAM 21800, paratype, female, 45 mm SL.

inferior snout. It differs from *D. andersoni* also in the longer pectoral fin (>12 vs <10 % of SL). From *D. kasougae* it is further distinguished by the small eye size (1.1–1.6 vs 2.4 % SL).

**Remarks.** Cohen (1966) included a single specimen as paratype of *D. talboti*, with much higher meristic counts, that now with two more available specimens, it is recognized as a separate species (*D. andersoni*).

**Distribution** (Fig.16). *Dermatopsoides talboti* is known from False Bay, near Cape Town, to Algoa Bay, near Port Elizabeth in South Africa.

**Ecology.** Appears to live in shallow waters including tide pools.

***Dipulus* Waite, 1905**

(Tables 1–3)

*Dipulus* Waite, 1905: 361 (type species *D. caecus* Waite, 1905 by monotypy; see Eschmeyer 1998).

*Dipulus*. – Cohen and Nielsen 1978: 59; Smith and Heemstra 1986: 355; Machida 1993a: 43; Nielsen *et al.* 1999: 128.

**Diagnosis.** Body long to eel-like; anterior nostril placed very close above upper lip; head without scales; opercular spine free, exposed; maxilla not vertically expanded postventrally, with spine or broad angle below rear of eye; lower lip with skin folds; male copulatory organ with one pair of large to very large pseudoclaspers, much longer than penis, hockey stick-shaped or expanded; penis with hook at tip; sulcus of otolith with separated ostium and cauda, each with separate colliculi, ventral sulcus margin with indentation at ostium-cauda joint; anterior anal fin ray pterygiophore long; lower preopercular pores 2 or 3; upper preopercular pore absent; posterior infraorbital pores 2 or

3; precaudal vertebrae variable between 13 and 25; dorsal fin rays 86–191; anal fin rays 56–124.

**Comparison.** *Dipulus* contains some of the most elongate, almost eel-like fishes within the Dinematoichthyini. It contains species with extremely high vertebrae and fin ray counts. The most “compressed” species of the four now recognized in *Dipulus*, *D. norfolkanus*, still has meristic counts similar to the most elongate species of the two other genera, with which it is related, i.e. *Dermatopsis kasougae*. A unique autapomorphous character found in all *Dipulus* species is the hooked tip of the penis.

**Distribution.** *Dipulus* is chiefly known from Australian shores, containing three species along the subtropical southern shores and one along the Western Australian coast. A fourth species of *Dipulus* is endemic to small Norfolk Island, located in an isolated position between New Caledonia and New Zealand and is one of the few species in this group found associated with reefs.

***Dipulus caecus* Waite, 1905**

(Figs 21–23; Tables 1–3, 12)

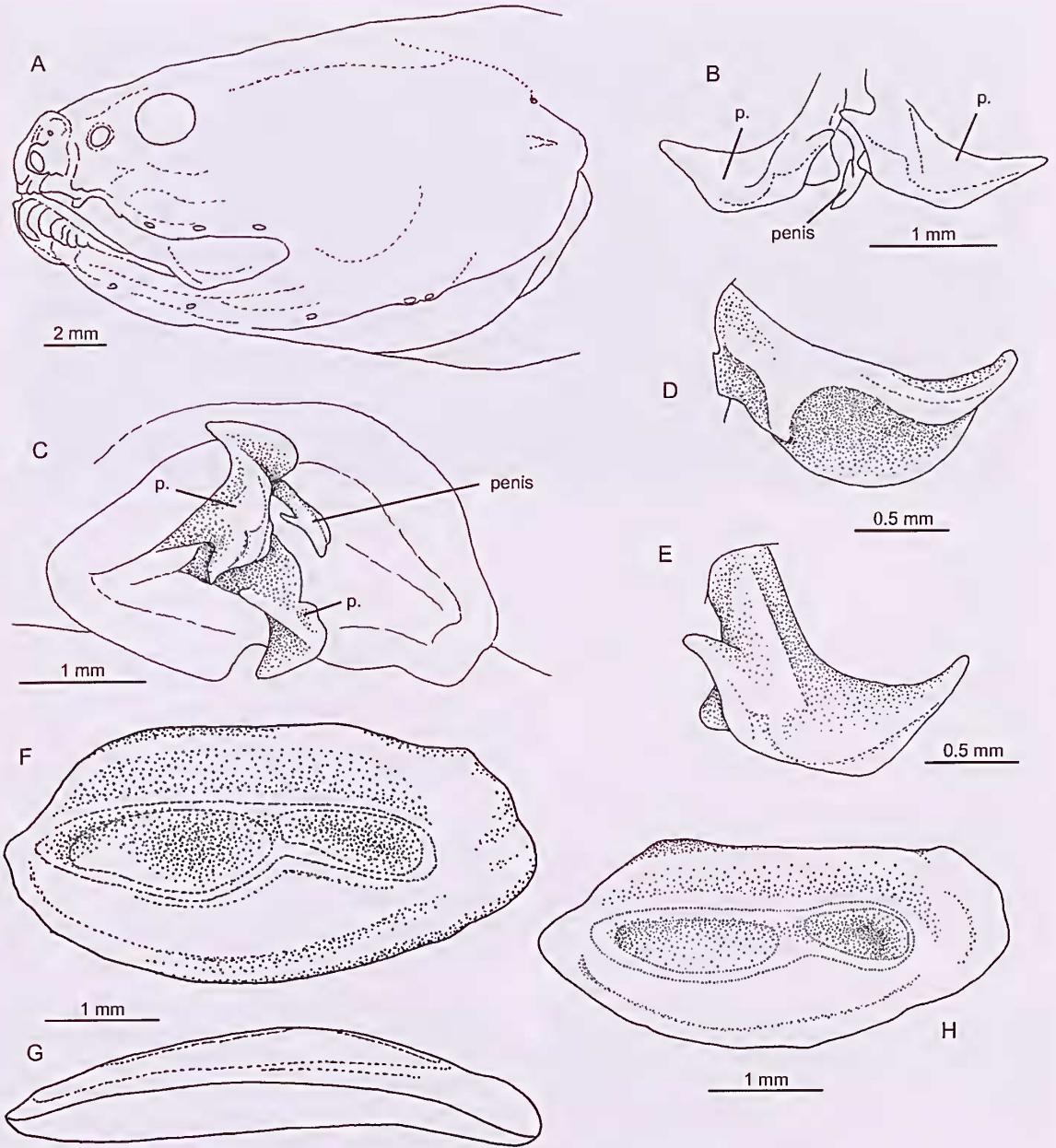
*Dipulus caecus* Waite, 1905: 140, fig. 2 (type locality: Fremantle, Western Australia).

*Dipulus caecus*. – Hubbs 1938: 289; Mccs 1962 (part): 27; Thinès 1969: 159; Paxton *et al.* 1989: 317; Machida 1993a: 43; Gomon *et al.* 1994: 370; Nielsen *et al.* 1999: 131.

**Material examined.** (15 specimens, 38–197 mm SL). Holotype, WAM P.13261-001, male, 146 mm SL, Fremantle, Western Australia (only a photo investigated). Non-types: AMS I.14247, Swan River, Western Australia, 32°01’S, 115°48’E, 9 m, A. Abjornssen, 21 August 1917; AMS I.20229-022, 3 males, 146–197 mm SL, 3 females, 145–162 mm SL, Cockburn Sound, Carnac Island, Western Australia, 32°10’S, 115°40’E, 6–8 m, B.C. Russell, 26 March 1978; AMS I.20229-023, female, 63 mm SL, Cockburn Sound, Carnac Island, Western Australia, 32°10’S, 115°40’E, 6–8 m, B.C. Russell, 26 March 1978; AMS I.20245-011, male, 129 mm SL, Rottneest Island, Horse Shoe Reefs, Western Australia, 32°00’S, 115°28’E, 12–15 m, B.C. Russell, 12 April 1978; WAM P.29884-012, subadult male, 51 mm SL, Abrolhos Islands, Western Australia, 28°53’S, 113°59’E, G.R. Allen, 4 March 1988; WAM P.29886-007, juvenile, 38 mm SL, Abrolhos Islands, Western Australia, 28°55’S, 114°02’E, G.R. Allen, 6 March 1988; ZMUC P77485, female, 130 mm SL, Point Peron, near Fremantle, Western Australia, R.J. McKay, 8 Dec. 1961; ZMUC P77486-87, 147 mm SL, male, 98 mm SL,



Fig. 21. *Dipulus caecus* Waite, 1905. AMS I.20229-022, non-type, male, 147 mm SL.



**Fig. 22.** *Dipulus caecus* Waite, 1905. **A**, lateral view of head, ZMUC P77486, non-type, male, 148 mm SL; **B**, ventral view of male copulatory organ, ZMUC P77486, non-type, 148 mm SL; **C**, inclined lateral view of male copulatory organ, ZMUC P77486, non-type, 148 mm SL; **D**, view of left pseudoelasper from inside, ZMUC P77486, non-type, 148 mm SL; **E**, view of left pseudoelasper from ventral, ZMUC P77486, non-type, 148 mm SL; **F**, median view of right otolith, AMS I.20229-022, non-type, male, 192 mm SL; **G**, ventral view of right otolith, AMS I.20229-022, non-type, male, 192 mm SL; **H**, median view of right otolith, AMS I.20229-022, non-type, male, 192 mm SL.

female, W end of Nancy Cove, Rottneest Island, Western Australia, R.J. McKay, 21 Jan. 1954.

**Diagnosis.** Body very elongate, almost eel-like, attaining sizes up to 197 mm SL; vertebrae 22–25 + 57–65 = 79–87, dorsal fin rays 161–191, anal fin rays 109–124,

D/A 58–75, V/A 27–28; scales absent; no supraorbital pore behind eye; lower preopercular pores 2; posterior infraorbital pores 3; broad angle on ventral maxilla positioned behind rear of eye; exposed opercular spine small, short, straight; lower lip with prominent skin folds;

**Table 12.** Meristic and morphometric characters of *Dipulus caecus* Waite, 1905.

	Holotype WAM P.13261 -001*	Holotype + 14 non-types Mean (range)	n
Standard length in mm	146	128.4 (38–197)	15
<b>Meristic characters **</b>			
Dorsal fin rays	–	175.6 (161–191)	14
Anal fin rays	–	117.2 (109–124)	14
Pectoral fin rays	–	18.5 (17–21)	13
Precaudal vertebrae	–	23.4(22–25)	14
Caudal vertebrae	–	61.2 (57–65)	14
Total vertebrae	–	84.6 (79–87)	14
Rakers on anterior gill arch	–	9.0(8–10)	7
Pseudobranchial filaments	–	0.8(0–1)	6
D/V	–	6.1 (6–7)	14
D/A	–	64.7 (58–75)	14
V/A	–	27.6 (27–28)	14
<b>Morphometric characters in % of SL</b>			
Head length	13.0	13.0 (10.9–17.4)	15
Head width	–	6.4 (5.0–7.9)	12
Head height	7.2	7.2 (6.5–9.4)	15
Snout length	2.7	2.9 (2.0–4.2)	15
Upper jaw length	5.5	6.3 (5.2–8.6)	15
Diameter of pigmented eye	–	1.3 (1.0–1.7)	14
Diameter of pupil	–	0.8 (0.6–1.2)	14
Interorbital width	–	2.4 (1.9–3.6)	13
Postorbital length	10.3	9.4 (7.7–12.2)	14
Precanal length	41.1	43.2 (39.2–47.6)	15
Predorsal length	16.4	15.6 (13.2–20.2)	14
Body depth at origin of anal fin	7.5	6.0 (4.0–8.3)	15
Pectoral fin length	4.8	5.8 (4.6–8.3)	13
Pectoral fin base height	2.7	2.5 (1.9–3.6)	15
Ventral fin length	–	7.9(5.9–12.1)	11
Base ventral fin – anal fin origin	31.5	34.6 (27.7–43.9)	15

\* Data from Waite, 1905 included, incl. measurement from Fig. 2.

\*\* The holotype is so poorly ossified, that vertebrae and fin ray counts could not be seen on x-rays (B. Hutchins, per. comm., Aug. 2006).

single pair of pseudoclaspers curved outwards, with narrow base and pointed tip, with broadly expanded fleshy flaps anteriorly and posteriorly; penis small, less than half the length of pseudoclaspers, with hook at tip; otoliths pointed anteriorly, rounded posteriorly, their predorsal angle more pronounced than postdorsal angle.

**Description.** The principal meristic and morphometric characters are shown in Table 12. Body elongate, eel-like, attaining sizes up to almost 200 mm SL. Head and body without scales. Maxillary not expanded posteriorly, but with broad angle ventrally just behind rear of eye. Anterior nostril on tip of snout. Posterior nostril about 1/3 the size of eye.

*Head sensory pores* (Fig. 22A). Supraorbital pores 2. Infraorbital pores 6 (3 anterior and 3 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 2 lower, no upper preopercular pore. All pores small, about 1/2 the size of posterior nostril or smaller.

*Dentition* (of 197 mm SL male, AMS I.20229-022). Premaxilla with 4 rows of small teeth anteriorly, merging into single row posteriorly. Anterior teeth in inner row up to 1/5 diameter of pupil. Vomer horseshoe-shaped, with 3 irregular row of totally 10 small teeth, up to 1/4 diameter of pupil. Palatine teeth in 3 rows with 14+4+10 small teeth up to 1/4 diameter of pupil. Dentary with 4 rows of small teeth anteriorly, merging into 2 rows posteriorly, up to about 1/3 of pupil diameter.

*Otolith* (Fig. 22F–H). Elongate, length to height ratio 2.1–2.3 (51–197 mm SL); otolith length to sulcus length ratio 1.3–1.5; sulcus deepened, divided into ostium and cauda, marked by indentation of ventral sulcus margin, colliculi also divided and rather small inside ostium and cauda; length of ostial colliculum to length of caudal colliculum ratio 1.5–1.6; anterior tip of otolith moderately pointed, posterior tip rounded, predorsal angle developed, sometimes slightly projecting, postdorsal angle indistinct;



Fig. 23. Sample sites of *Dipulus caecus*, *D. hutchinsi* n. sp., *D. multiradiatus* and *D. norfolkanus*. One symbol may represent several samples.

inner face with marked ventral furrow close to ventral rim and large, well defined dorsal depression.

**Axial skeleton** (of non-type, ZMUC P77486, 148 mm SL, male). First neural spine half the length of second. Neural spine of vertebrae 2–3 elongate and 3–8 depressed. Parapophyses present from vertebrae 6 to 22. Pleural ribs on vertebrae 3–10. First anal fin pterygiophore elongate, but not reaching tip of last precaudal parapophysis.

**Male copulatory organ** (Fig. 22B–E). A single pair of large pseudoclaspers, curved outwards, with pointed tip and narrow, stem-like base, underpinned by massive supporter. Pseudoclasper with broad fleshy appendices anteriorly and posteriorly, each ending in pointed tip about 1/4 above the base of the pseudoclasper. Isthmus between pseudoclaspers narrow. Penis thin, short, about half the length of pseudoclaspers, with distinct hook near tip.

**Coloration.** Live colour reported as red, orange or yellow, but it is uncertain if all colour morphs belong to this species. Uniformly light brown when preserved.

**Comparison.** *Dipulus caecus* is probably the most unmistakable dinematichthyine fish and is easily recognized by the very elongate body shape, the extremely high meristic counts and the distinctive pseudoclasper morphology.

**Distribution** (Fig. 23). *Dipulus caecus* is distributed along the shores of Western Australia from about 34°S

(near Perth) north to about 25°S (Carnarvon, Shark Bay).

**Ecology.** Caught at 6 to 15 m depth.

***Dipulus hutchinsi* n. sp.**

(Figs 23–25; Tables 1–3, 13)

*Dermatopsis multiradiatus* (in part). – Mees 1962: 27; Cohen 1966: 191.

**Material examined.** (8 specimens, 66–118 mm SL). **HOLOTYPE** – WAM P.4677-001, male, 102 mm SL, Rottnest Island, west end of Nancy Cove, Western Australia, Zool. Dept. W.A. University, 20 January 1954. **PARATYPES** – CSIRO H4651-01, female, 118 mm SL, NW of Port Hedland, Western Australia, 19°37'S, 117°48'E, 58–60 m, 23 August 1997; AMS I.20245-013, female, 74 mm SL, Rottnest Island, Horse Shoe Reefs, 32°00'S, 115°28'E, 12–15 m, B.C. Russell, 12 April 1978; WAM P.4677-002, 2 males, 69–75 mm SL, and ZMUC P771551, male, 70 mm SL, same data as for holotype; WAM P.27953-006, female, 66 mm SL, Jurien Bay, Western Australia, 30°18'S, 115°00'E, 10–14 m, J.B. Hutchins *et al.*, 11 April 1983; WAM P.28522-005, male, 95 mm SL, NW corner of Flinders Island, Western Australia, 34°23'S, 115°11'E, 12–13 m, J.B. Hutchins, 18 April 1985.

**Diagnosis.** Body very elongate, attaining sizes of more than 100 mm SL; vertebrae 16–17 + 36–40 = 53–56,



Fig. 24. *Dipulus hutchinsi* n. sp. WAM P.4677-001, holotype, male, 102 mm SL.

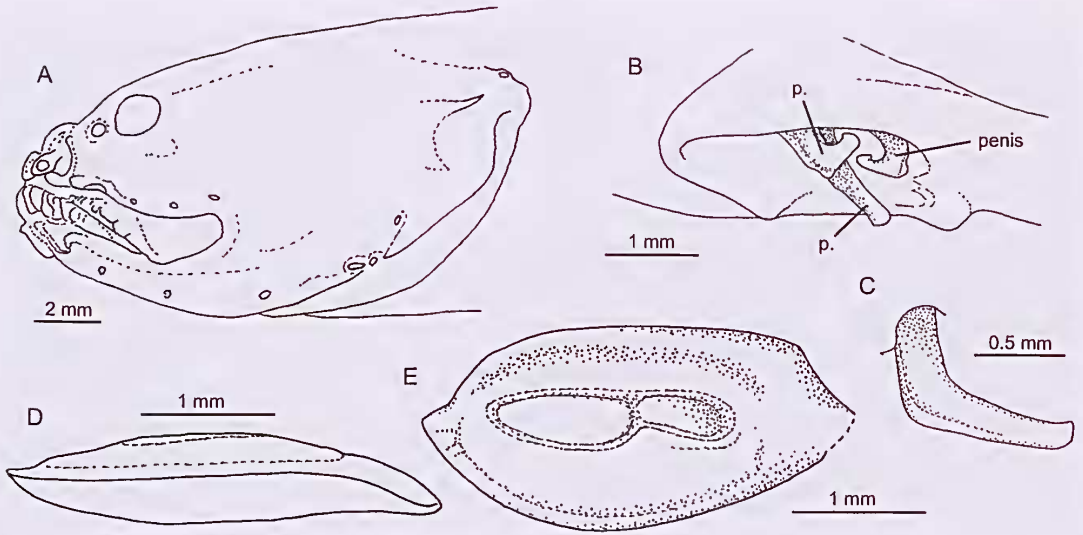


Fig. 25. *Dipulus hutchinsi* n. sp. A, lateral view of head, WAM P.4677-001, holotype, male, 102 mm SL; B, inclined lateral view of male copulatory organ, WAM P.4677-001, holotype, 102 mm SL; C, view of left pseudoclasper from outside, WAM P.4677-001, holotype, 102 mm SL; D, ventral view of right otolith, WAM P.28522-005, paratype, male, 95 mm SL; E, median view of right otolith, WAM P.28522-005, male, 95 mm SL.

dorsal fin rays 104–110, anal fin rays 66–73, D/A 41–43, V/A 19–20; scales present on body; no supraorbital pore behind eye; lower preopercular pores 3, non-tubular; posterior infraorbital pores 3; broad angle on ventral maxilla positioned behind rear of eye; exposed opercular spine bent upwards; lower lip with skin folds; single pair of pseudoclaspers curved, hockey stick-like, thin; penis slightly shorter than pseudoclaspers, with hook at tip; otoliths pointed anteriorly and posteriorly, their predorsal and postdorsal angles similar in expression, otolith length to height ratio 2.1–2.2, sulcus narrow.

**Description.** The principal meristic and morphometric characters are shown in Table 13. Body elongate; fishes attaining up to 118 mm SL. Head without scales. Horizontal diameter of scales on body about 0.6 % SL in 6–7 irregular horizontal rows. Maxillary not expanded posteriorly, but with broad angle just behind rear of eye. Anterior nostril on tip of snout. Posterior nostril small, about 1/4 the size of eye.

**Head sensory pores** (Fig. 25A). Supraorbital pores 2. Infraorbital pores 6 (3 anterior and 3 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 3 lower, not tubular, no upper preopercular pore. All pores small, about 1/2 the size of posterior nostril or smaller.

**Dentition** (of holotype). Premaxilla with 4 rows of small teeth anteriorly, merging into single row posteriorly. Anterior teeth in inner row up to 1/3 diameter of pupil. Vomer horseshoe-shaped, with 2 irregular rows of totally 9 small teeth, up to 1/4 diameter of pupil. Palatine teeth in 2 rows with 5+5 small teeth up to 1/4 diameter of pupil. Dentary with 3 outer rows of granular teeth and 1 inner

row of larger teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about 1/3 of pupil diameter.

**Otolith** (Fig. 25D–E). Elongate, length to height ratio 2.1–2.2 (66–95 mm SL); otolith length to sulcus length ratio 1.7–1.8; sulcus not deepened, narrow, divided into ostium and cauda, marked by indentation of ventral sulcus margin, colliculi also divided; length of ostial colliculum to length of caudal colliculum ratio 1.6–1.8; anterior and posterior tips of otolith pointed, each with small concavity above, predorsal and postdorsal angles similarly developed; inner face with weak ventral furrow close to ventral rim and narrow dorsal depression.

**Axial skeleton** (of holotype). First neural 2/3 the length of second. Neural spine of vertebrae 2–3 elongate and 3–8 depressed. Parapophyses present from vertebrae 6 to 16. Pleural ribs on vertebrae 3–14. First anal fin pterygiophore slightly elongate, not reaching tip of last precaudal parapophysis.

**Male copulatory organ** (Fig. 25B–C). A single pair of moderately large pseudoclaspers, curved like a hockey stick, thin, underpinned by supporter. Isthmus between pseudoclaspers narrow. Penis thin, slightly shorter than pseudoclaspers, with hook near tip.

**Coloration.** Live colour bright uniformly yellow, light brown when preserved.

**Comparison.** *Dipulus hutchinsi* closely resembles *D. multiradiatus*, with which it has been confused in the past (see remarks to *D. multiradiatus*).

**Distribution** (Fig. 23). *Dipulus hutchinsi* is distributed along the shores of south-westernmost Western Australia from 30°S–115°E to 34°S–115°E, including Rottne

Table 13. Meristic and morphometric characters of *Dipulus hutchinsi* n. sp.

	Holotype WAM P.4677-001	Holotype + 6 paratypes Mean (range)	n
Standard length in mm	102	78.7 (66–118)	8
<b>Meristic characters</b>			
Dorsal fin rays	110	106.8 (104–110)	6
Anal fin rays	73	69.3 (66–73)	6
Pectoral fin rays	22	20.7 (20–22)	6
Preecaudal vertebrae	16	16.5 (16–17)	6
Caudal vertebrae	40	38.0 (36–40)	6
Total vertebrae	56	54.5(53–56)	6
Rakers on anterior gill arch	12	9.6(8–12)	5
Pseudobranchial filaments	–	0.5(0–1)	4
D/V	6	5.7 (5–6)	6
D/A	42	42.0 (41–43)	5
V/A	20	19.8 (19–20)	6
<b>Morphometric characters in % of SL</b>			
Head length	14.5	16.9 (14.5–18.2)	8
Head width	7.8	8.5 (7.4–9.3)	8
Head height	8.0	9.3 (8.0–10.6)	8
Snout length	3.4	4.0 (3.4–4.5)	8
Upper jaw length	6.7	7.4 (6.6–8.1)	8
Diameter of pigmented eye	1.1	1.3 (1.1–1.5)	8
Diameter of pupil	0.7	0.9 (0.7–1.1)	8
Interorbital width	3.2	3.4 (3.2–3.7)	8
Postorbital length	10.4	12.2 (10.4–14.0)	8
Prenasal length	46.0	48.1 (46.0–50.2)	7
Predorsal length	19.1	21.4 (19.1–23.4)	8
Body depth at origin of anal fin	7.6	8.8 (7.3–10.7)	8
Pectoral fin length	8.5	9.2 (8.5–10.5)	8
Pectoral fin base height	4.1	4.4 (4.1–4.7)	8
Ventral fin length	8.1	10.2(8.1–12.1)	8
Base ventral fin – anal fin origin	34.0	35.4 (34.0–38.5)	8

Island. A single record from 19°S, 117°E, indicates a wider distribution.

**Ecology.** Depth range 10–60 m.

**Etymology.** Named in honour of J. Barry Hutchins, Perth, WAM, in recognition of his many great contributions to Australian ichthyology.

***Dipulus multiradiatus* (McCulloch and Waite, 1918)**

(Figs 23, 26–27; Tables 1–3, 14)

*Dermatopsis multiradiatus* McCulloch and Waite, 1918: 63, pl. 5, fig. 4 (type locality: Kangaroo Island, South Australia).

*Dermatopsis multiradiatus*. – Seott 1962: 172; Cohen 1966: 191; Glover 1976: 172; Paxton *et al.* 1989: 316; Gomon *et al.* 1994: 371; Nielsen *et al.* 1999: 127.

*Dipulus caecus* (in part). – Mees 1962: 27.

**Material examined.** (95 specimens, 22–103 mm SL). Holotype, SAMA F480, male, 83 mm SL, Kangaroo Island, South Australia, 35°50'S, 138°30'E, depth and precise location unknown, Waite 1917 (only drawing examined). Paratypes: AMS I.14614, male, 74 mm SL, female, 69 mm SL, same data as for holotype.

**Additional specimens.** AMS I.17613-009, 3 males, 69–70 mm SL, 4 females, 65–82 mm SL, Port Victoria, Spencer Gulf, South Australia, 34°30'S, 137°29'E; AMS I.17613-013, male, 57 mm SL, Port Victoria, Spencer Gulf, South Australia, 34°30'S, 137°29'E; AMS I.17614-016, 16 males, 55–81 mm SL, 34 females, 54–97 mm SL, 11 juveniles, 22–27 mm SL, and ZMUC P771556-57, male 86 mm SL, female 80 mm SL, Tiekera, Speneer Gulf, South Australia, 33°49'S, 137°40'E; AMS I.20180-008, 6 females, 34–103 mm SL, Kangaroo Island, South Australia, 35°44'S, 137°58'E; WAM P.27140-001, subadult male, 41 mm SL, female, 63 mm SL, Boston Island, South Australia, 34°42'S, 135°55'E; WAM P.28290-001, 2 males, 75–76 mm SL, 3 females, 70–86 mm SL, Twilight Cove, Western Australia, 32°16'S, 126°02'E; WAM P.28292-009, subadult male, 49 mm SL, 2 females, 49–84 mm SL, Lueky Bay, Western Australia, 34°00'S, 122°14'E; WAM P.28293-012, 3 males, 78–83 mm SL, juvenile, 40 mm SL, Lueky Bay, Western Australia, 34°00'S, 122°14'E; WAM P.28513-005, female, 70 mm SL, John Island, Duke of Orleans Bay, Western Australia, 33°54'S, 122°37'E.



Fig. 26. *Dipulus multiradiatus* (McCulloch and Waite, 1918). ZMUC P771556, non-type, male, 86 mm SL.

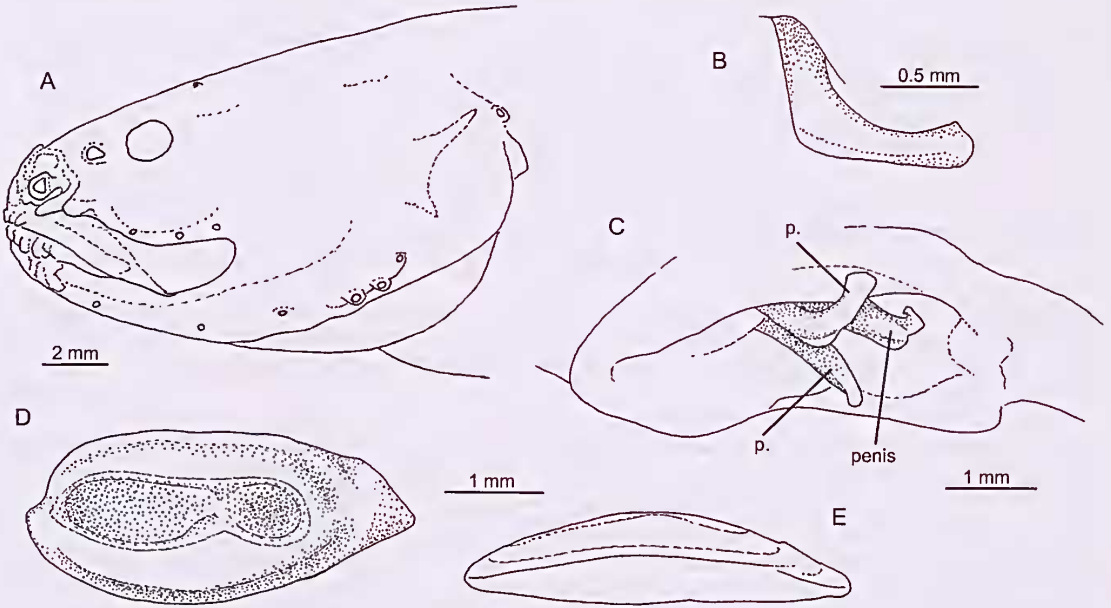


Fig. 27. *Dipulus multiradiatus* (McCulloch and Waite, 1918), WAM P.28293-012, non-type, male, 83 mm SL. A, lateral view of head; B, view of left pseudoclasper from outside; C, inclined lateral view of male copulatory organ; D, median view of right otolith; E, ventral view of right otolith.

**Diagnosis.** Body very elongate, attaining sizes of more than 100 mm SL; vertebrae 19–22 + 33–36 = 52–57, dorsal fin rays 97–112, anal fin rays 57–64, D/A 42–51, V/A 23–26; body sealed; supraorbital pore behind eye present; lower preopercular pores 3, the 2 first tubular; posterior infraorbital pores 3; broad angle on ventral maxilla positioned behind rear of eye; exposed opercular spine bent upwards; lower lip with skin folds; single pair of pseudoclaspers curved, hoekey stick-like, thin; penis slightly shorter than pseudoclaspers, with hook at tip; otoliths rounded anteriorly and expanded posteriorly, without postdorsal angle, otolith length to height ratio 2.3–2.4, sulcus wide.

**Description.** The principal meristic and morphometric characters are shown in Table 14. Body elongate; attaining more than 100 mm SL. Head without scales. Horizontal diameter of scales on body about 1.0% SL (in a 81 mm SL male, AMS I.17614-016), in 8–12 irregular horizontal rows. Maxillary not expanded posteriorly, but with broad ventral angle just behind rear of eye. Anterior nostril on tip of snout. Posterior nostril small, about 1/4 the size of eye.

**Head sensory pores** (Fig. 27A). Supraorbital pores 3. Infraorbital pores 6 (3 anterior and 3 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 3 lower, the first two tubular, no upper preopercular pore. All pores small, about 1/2 the size of posterior nostril or smaller.

**Dentition** (of a non-type, 81 mm SL male, AMS I.17614-016). Premaxilla with 3 rows of small teeth anteriorly, merging into single row posteriorly. Anterior teeth in inner row up to 1/2 diameter of pupil. Vomer horseshoe-shaped, with 3 irregular rows of totally 17 small teeth, up to 1/4 diameter of pupil. Palatine teeth in 3 rows with 11+3+7 small teeth up to 1/3 diameter of pupil, larger in inner row. Dentary with 3 outer rows of granular teeth and 1 inner row of larger teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about 2/3 of pupil diameter.

**Otolith** (Fig. 27D–E). Very elongate, length to height ratio 2.3–2.4 (63–84 mm SL); otolith length to sulcus length ratio 1.5–1.7; sulcus deepened, wide, divided into ostium and cauda, marked by indentation of ventral sulcus margin, colliculi also divided; length of ostial colliculum



Table 14. Meristic and morphometric characters of *Dipulus multiradiatus* (McCulloch and Waite, 1918).

	Holotype SAMA F480*	Holotype, 2 paratypes + 92 non-types Mean (range)	n
Standard length in mm	83	67.3 (22–103)	95
<b>Meristic characters</b>			
Dorsal fin rays	–	102.9 (97–112)	72
Anal fin rays	–	60.5 (57–64)	72
Pectoral fin rays	–	19.1 (17–21)	26
Preecaudal vertebrae	–	19.6 (19–22)	71
Caudal vertebrae	–	34.4 (33–36)	72
Total vertebrae	–	54.1(52–57)	72
Rakers on anterior gill arch	–	6.1(5–7)	9
Pseudobranchial filaments	–	0.7(0–1)	9
D/V	–	6.4 (5–7)	72
D/A	–	46.1 (42–51)	72
V/A	–	23.7 (23–26)	72
<b>Morphometric characters in % of SL</b>			
Head length	17.2	19.7 (17.0–22.3)	24
Head width	–	9.2 (8.3–11.4)	20
Head height	11.2	11.0 (9.1–12.0)	21
Snout length	4.3	4.7 (4.0–6.0)	23
Upper jaw length	9.1	9.4 (8.5–10.1)	24
Diameter of pigmented eye	1.3	1.7 (1.3–2.1)	31
Diameter of pupil	–	1.0 (0.8–1.3)	29
Interorbital width	–	3.7 (2.9–5.6)	23
Postorbital length	12.1	13.9 (12.0–15.8)	23
Preeanal length	57.8	55.8 (51.8–60.3)	23
Predorsal length	25.9	24.4 (21.5–27.3)	24
Body depth at origin of anal fin	12.9	11.0 (8.9–13.2)	24
Pectoral fin length	11.2	10.2 (8.6–12.4)	24
Pectoral fin base height	4.3	4.5 (3.8–5.8)	24
Ventral fin length	11.2	10.9(7.6–16.3)	34
Base ventral fin – anal fin origin	43.1	42.3 (35.4–54.9)	24

\* Data from McCulloch and Waite, 1918, included, incl. measurement from Plate V, Fig. 4.

to length of caudal colliculum ratio 1.7–1.8; anterior tip rounded, posterior tip pointed, strongly expanded, predorsal rim broadly rounded, no postdorsal angle; inner fae with marked ventral furrow close to ventral rim and narrow dorsal depression.

*Axial skeleton* (of non-type, WAM P.28293-012, 83 mm SL, male). First neural spine half the length of second. Neural spine of vertebrae 2–3 elongate and 5–10 depressed. Parapophyses present from vertebrae 4 to 12. Pleural ribs on vertebrae 6–10. First anal fin pterygiophore slightly elongate, not reaching tip of last preecaudal parapophysis.

*Male copulatory organ* (Fig. 27B–C). A single pair of moderately large pseudoelaspers, curved like a hoekey stiek, thin, underpinned by supporter. Isthmus between pseudoelaspers narrow. Penis thin, slightly shorter than pseudoelaspers, with hook near tip.

**Coloration.** Live colour bright uniformly yellow, light brown when preserved.

**Comparison.** *Dipulus multiradiatus* is intermediate in vertebrae and fin rays counts between *D. caecus* and *D. norfolkauus*, but its vertebra count of 52 to 57 is higher than that found in other dinematiichthyine genera except for *Brosmolus* Maehida, 1993b, which has scales on the echeeks (vs naked head) and an otolith with an undivided suleus and fused colliculi (vs both separated). It differs from the two other species of *Dipulus* in the more slender and smaller pseudoelaspers and details of the otolith morphology (Fig. 27 vs Figs 22 and 29). From *D. caecus* it differs further in having three lower preopercular pores (vs 2) and from *D. norfolkauus* in having three posterior infraorbital pores (vs 2).

The most similar species is *D. hutchinsi*, with which it has commonly been confused in the past. With this species, *D. multiradiatus* shares the head pore system (although lower preopercular pores are non-tubular (vs tubular), total vertebrae and dorsal fin ray counts and the pseudoelasper morphology. It differs from *D. hutchinsi* in the higher

number of precaudal vertebrae (19–22 vs 16–17), lower number of caudal vertebrae (33–36 vs 36–40), the lower number of anal fin rays (57–64 vs 66–73), D/A (42–51 vs 41–43), V/A (23–26 vs 19–20) and the morphology of the otolith with a length to height ratio of 2.3–2.4 (vs 2.1–2.2), the absence of an obtuse postdorsal angle (vs present) and the wide sulcus (vs narrow).

**Remarks.** In all previous records, *D. multiradiatus* had been allocated to *Dermatopsis* rather than *Dipulus*, following its original assignment. Meristic measurements, elongate body shape and the presence of a hook at the tip of the penis clearly assigns it to *Dipulus*. In fact, the most similar of all *Dipulus* species to *Dermatopsis* in terms of meristic counts is *D. norfolkanus*.

Mees (1962) and Cohen (1966) discussed differences between the South Australian and the Western Australian specimens of *D. multiradiatus*. The three differences listed by Mees were degree of squamation, relative body depth and colour, all of which Cohen could not substantiate from his investigations. We agree with Cohen's assessment, however, as mentioned above, as there are other stable characters pointing to two species (precaudal and caudal vertebrae relations, anal fin ray counts, otolith morphology). Both species indeed seem to not overlap in geographic distribution; *D. multiradiatus* occurs chiefly east of 122°E and *D. hutchinsi* west of 116°E.

**Distribution** (Fig. 23). *Dipulus multiradiatus* is distributed along the shores of South and Western Australia from about 34°S, 122°E (Recherche Archipelago) to 36°S, 137°E (Kangaroo Island).

**Ecology.** Depth range 0–10 m. A 77 mm TL female was reported by McCulloch and Waite (1918) to contain three fully developed embryos, 28 mm in total length. Coloration is reported to include dark pigmentation dorsally. Specimens of *D. multiradiatus* are commonly found with copepod remains in the stomach (seen from x-rays).

#### *Dipulus norfolkanus* Machida, 1993a

(Figs 23, 28–29; Tables 1–3, 15)

*Dipulus norfolkanus* Machida, 1993a: 43, fig. 1–2 (type locality: Cascade Rocks, 29°15'S–167°58'E, Norfolk Island).

*Dermatopsis macrodou*. – Francis 1993: 158.

*Dipulus norfolkanus*. – Nielsen *et al.* 1999: 131, fig. 126.

**Material examined.** (114 specimens, 17–73 mm SL, all from Norfolk Island). Holotype, NTM S. 11422-00, male,

45 mm SL, Cascade rocks, 29°15'S, 167°58'E, 0–0.5 m, H. and J. Larson, 17 April 1984 (not investigated, data taken from Machida 1993a). Paratypes: AMS I.20256-010, 1 male and 5 females, Cooks Landing, 29°00'S, 167°56'E, 0–1 m, H. Larson and G. Anderson, 8 September 1975; AMS I.20257-017, 1 male and 4 females; Cooks Landing, 0–5 m, D. Hoese, 8 September 1975; AMS I.20260-014, 1 male; Nepean Island, 29°04'S, 167°57'E, 15–20 m, G. Anderson *et al.*, 9 September 1975; AMS I.20264-004, 1 male, Sydney Bay, 29°04'S, 167°57'E, 1–2 m, D. Hoese and H. Larson, 11 September 1975; AMS I.20268-021, 4 males and 9 females, Point Hunter, 29°04'S, 167°57'E, 0–1 m, D. Hoese *et al.*, 1975.

**Additional specimens** (all from Norfolk Island). AMS I.20271-020, 78 specimens, 17–68 mm SL, Bumbora beach tidepoles, 29°04'S, 167°56'E; NMNZ P.11706, female, 63 mm SL, 29°05'S, 168°00'E; NMNZ P.11742, female, 73 mm SL, 29°05'S, 168°00'E; NMNZ P.27162, male, 43 mm SL, 2 females, 40–42 mm SL, Crystal Pool, 29°03'S, 167°55'E; NMNZ P.27166, 2 males, 44–47 mm SL, 2 females, 19–52 mm SL, "Swiss Cheese" ca. 1 km S of Kingston Wharf, 29°03'S, 167°56'E.

**Diagnosis.** Body elongate, attaining sizes of up to 73 mm SL; vertebrae 13–16 + 31–35 = 45–49, dorsal fin rays 86–104, anal fin rays 56–65, D/A 36–42, V/A 17–19; scales absent; no supraorbital pore behind eye; lower preopercular pores 3, non-tubular; posterior infraorbital pores 2; spine on maxilla positioned behind rear tip of eye; exposed opercular spine straight; lower lip with skin folds; single pair of pseudoclaaspers large, curved, broad club-shaped; penis about half the length of pseudoclaaspers, with hook at tip; otoliths pointed anteriorly and rounded posteriorly, postdorsal angle sharp, pronounced.

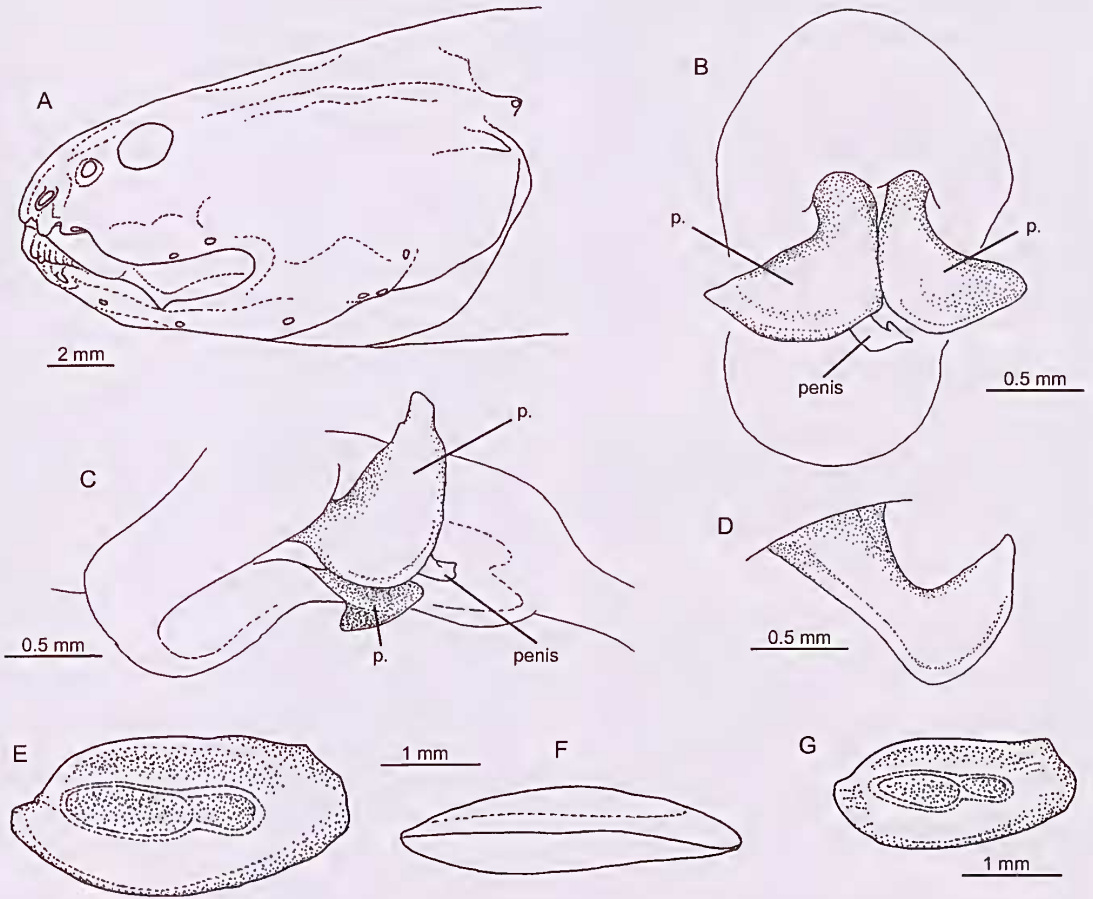
**Description.** The principal meristic and morphometric characters are shown in Table 15. Body elongate; fishes attaining up to 73 mm SL. Head and body without scales. Maxillary not expanded posteriorly, but with distinct ventral spine just behind rear tip of eye. Anterior nostril directly above snout. Posterior nostril about 1/3 the size of eye.

**Head sensory pores** (Fig. 29A). Supraorbital pores 2. Infraorbital pores 5 (3 anterior and 2 posterior). Mandibular pores 6 (3 anterior and 3 posterior). Preopercular pores 3 lower, not tubular, no upper preopercular pore. All pores small, about 1/2 the size of posterior nostril or smaller.

**Dentition** (of a 73 mm SL female, NMNZ P.11742). Premaxilla with 4 outer rows of small teeth and 1 inner



Fig. 28. *Dipulus norfolkanus* Machida, 1993a. AMS I.20271-020, non-type, female, 61 mm SL.



**Fig. 29.** *Dipulus norfolkanus* Machida, 1993a. **A**, lateral view of head, NMNZ P.11742, non-type, female, 73 mm SL; **B**, ventral view of male copulatory organ, NMNZ P.27166, non-type, 47 mm SL; **C**, inclined lateral view of male copulatory organ, NMNZ P.27166, non-type, 47 mm SL; **D**, view of left pseudoclasper from outside, NMNZ P.27162, non-type, 43 mm SL; **E**, median view of right otolith, NMNZ P.27166, non-type, female, 52 mm SL; **F**, ventral view of right otolith, NMNZ P.27166, non-type, female, 52 mm SL; **G**, median view of right otolith, NMNZ P.27162, non-type, female, 42 mm SL.

row of larger teeth anteriorly, merging into 2 rows posteriorly. Anterior teeth in inner row up to  $1/3$  diameter of pupil. Vomer horseshoe-shaped, with 2 irregular rows of totally 13 small teeth, up to  $1/4$  diameter of pupil. Palatine teeth in 2 rows with 6+19 small teeth up to  $1/4$  diameter of pupil. Dentary with 3 outer rows of granular teeth and 1 inner row of larger teeth anteriorly, merging into 1 row of larger teeth posteriorly, up to about  $1/2$  of pupil diameter.

**Otolith** (Fig. 29E–G). Elongate, length to height ratio 2.1–2.2 (42–52 mm SL); otolith length to sulcus length ratio 1.7; sulcus slightly deepened, divided into ostium and cauda, marked by indentation of ventral sulcus margin, colliculi also divided; length of ostial colliculum to length of caudal colliculum ratio 2.0–2.2; anterior tip of otolith pointed, with small concavity above, posterior tip rounded; predorsal angle indistinct, postdorsal angles

sharp, pronounced; inner face with weak ventral furrow very close to ventral rim and large, well defined dorsal depression.

**Axial skeleton** (of non-type NMNZ 27166, 47 mm SL, male). First neural spine  $4/5$  the length of second. Neural spine of vertebrae 3–6 depressed. Parapophyses present from vertebrae 5 to 14. Pleural ribs on vertebrae 2–6. First anal fin pterygiophore slightly elongated, not reaching tip of last precaudal parapophysis.

**Male copulatory organ** (Fig. 29B–D). A single pair of pseudoclaspers; large, curved, almost rectangular, sticking out from below hood, broad club-shaped, underpinned by massive supporter. Isthmus between pseudoclaspers narrow. Penis about half the length of pseudoclaspers, with hook at tip.

**Coloration.** Live colour not known, medium brown when preserved.

**Table 15.** Meristic and morphometric characters of *Dipulus norfolkanus* Machida, 1993a.

	Holotype* NTM S. 11422	Holotype, 26 paratypes* + 23 non-typcs	n
	Mcan (range)		
Standard length in mm	45	(17–73)	50
<b>Meristic characters</b>			
Dorsal fin rays	99	(86–104)	42
Anal fin rays	62	(56–65)	42
Pectoral fin rays	20	(19–22)	28
Precaudal vertebrae	16	(13–16)	43
Caudal vertebrae	33	(31–35)	43
Total vertebrae	49	(45–49)	43
Rakers on anterior gill arch	–	7.0(6–9)	5
Pseudobranchial filaments	–	0	7
D/V	–	5.5 (5–6)	15
D/A	–	38.7 (36–42)	15
V/A	–	18.4 (17–19)	15
<b>Morphometric characters in % of SL</b>			
Head length	19.3	(19.2–23.3)	28
Head width	–	9.4(8.4–11.6)	7
Head height	–	11.6(9.2–14.2)	12
Snout length	4.7	5.2(4.6–6.3)	12
Upper jaw length	9.3	10.7(9.3–12.4)	12
Diameter of pigmented eye	2.4	1.8(1.5–2.4)	12
Diameter of pupil	–	1.1(0.9–1.4)	12
Interorbital width	3.3	3.2(2.4–4.0)	12
Postorbital length	–	15.1(13.7–16.7)	12
Prcanal length	55.6	(52.6–58.8)	28
Predorsal length	25.3	(24.4–29.4)	28
Body depth at origin of anal fin	15.1**	10.7(8.1–12.3)	9
Pectoral fin length	13.3	(8.3–14.5)	28
Pectoral fin base height	–	4.9(3.9–6.0)	9
Ventral fin length	17.1	(14.5–18.2)	28
Base ventral fin – anal fin origin	–	36.8(32.3–42.0)	12

\* Data from Machida (1993a) included.

\*\* Measured as maximum body depth.

**Comparison.** *Dipulus norfolkanus* is the species of the genus *Dipulus* with the lowest vertebrae and fin ray counts. Also characteristic are the pseudoelasper and otolith morphology, the ventral spine at the maxilla positioned behind the eye and two posterior infraorbital pores (vs three). From *D. caecus* it differs further in the presence of three lower preopercular pores (vs two).

The low meristic counts resemble species of *Dermatopsis*. Dorsal fin ray counts still are higher than in any *Dermatopsis* species (86–97 vs <86). The hook at the tip of the penis is also regarded as a synapomorphic character of all species of the genus *Dipulus*.

**Distribution** (Fig. 23). *Dipulus norfolkanus* is restricted to Norfolk Island, located in the south-west Pacific between New Caledonia and New Zealand.

**Ecology.** Depth range 0–15 m.

## GEOGRAPHIC DISTRIBUTION

The three related genera *Dermatopsis*, *Dermatopsoides* and *Dipulus* are distributed south of the main reef belt of the Indo-west Pacific species, a pattern that they share with very few other Dinematichthyini, chiefly the monotypic genus *Monothrix* (southern and south-eastern Australia). The only exception is *Dermatopsis greenfieldi* from Fiji and a single record of a *Dermatopsis* sp. from the southern Great Barrier Reef. Occasional fossil otolith-based records of *Dipulus* or *Dermatopsis* from the northern hemisphere are thus very unlikely, since they would have had to be a result of crossing of the broad tropical belt. So far, there is no evidence in the recent or fossil record of an antitropical distribution pattern in the Dinematichthyini, as was described for other groups of Indo-West-Pacific fishes by Randall (1981).

The three genera in question are also remarkable for their very narrowly distributed endemic species. *Dermatopsis* is restricted with two species to the subtropical shores of south-eastern Australia, one species to northern New Zealand (with fossil evidence dating back to about 2.0 to 2.4 mya) and an out of range occurrence around Fiji. *Dipulus* is restricted with three species in southern and south-western Australia, thereof two in Western Australia from the Abrolhos Islands to the Flinders Bay, including Perth and the Rottnest Island. This seems to be a particularly rich area in dinematichthyine endemisms. A fourth species of *Dipulus* – *D. norfolkianus* – occurs 'out of range', endemic as the only representative of the Dinematichthyini around Norfolk Island, and therewith constituting one of the most narrow distribution patterns in the group. It is also the least elongate species of this genus, probably indicating a plesiomorphic character status. *Dermatopsoides* was finally understood as endemic to southern Africa. All three South African species are restricted to the southernmost tip of the continent, chiefly south of 33°S, more common on the Indian Ocean side, but present on the Atlantic side as well. One of them – *D. kasougae* – is known from only two specimens from the Kasouga river estuary near Port Alfred, and therefore possibly adapted to a very specific environment. Again, there is a (new) out of area find – *D. morrisonae* – from the south-western tip of Western Australia, 8000 km across open ocean from the South African species. Also, *D. morrisonae* appears to be the most plesiomorphic of the group with three lower preopercular pores and skin folds on the lower lip.

Southern Australia is the only area where all three genera are represented. From this it could be concluded that it represents the core area of evolution for this small sub-group of the Dinematichthyini, but that will have to be tested further with phylogentic and biogeographic analyses. The present paper provides an update of the known diversity of the group.

Several species, however, are known from very few specimens, indicating that much more field work is needed before we truly know the ranges of these fishes. They appear to be rare, but are probably just rarely caught. Even for the most abundant species, the biology is almost unstudied.

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