New Zealand Journal of Marine and Freshwater Research

ISSN: 0028-8330 (Print) 1175-8805 (Online) Journal homepage: http://www.tandfonline.com/loi/tnzm20

Two new genera and three new species of leeches (Hirudinida: Piscicolidae) from New Zealand marine fishes

Eugene M. Burreson & Julianne I. Williams

To cite this article: Eugene M. Burreson & Julianne I. Williams (2008) Two new genera and three new species of leeches (Hirudinida: Piscicolidae) from New Zealand marine fishes, New Zealand Journal of Marine and Freshwater Research, 42:4, 379-387, DOI: 10.1080/00288330809509966

To link to this article: http://dx.doi.org/10.1080/00288330809509966

Published online: 19 Feb 2010.

Submit your article to this journal

Article views: 111

View related articles

Full Terms & Conditions of access and use can be found at
http://www.tandfonline.com/action/journalInformation?journalCode=tnzm20

Download by: [124.170.184.11] **Date:** 15 February 2016, At: 16:53

New Zealand Journal of Marine and Freshwater Research, 2008, Vol. 42: 379–387
0028–8330/08/4204–0379 © The Royal Society of New Zealand 2008

Two new genera and three new species of leeches (Hirudinida:Piscicolidae) from New Zealand marine fishes

EUGENE M. BURRESON
JULIANNE I. WILLIAMS
Virginia Institute of Marine Science
College of William and Mary
Gloucester Point
Virginia 23062, United States
email: gene@vims.edu

Downloaded by [124.170.184.11] at 16:53 15 February 2016

Abstract The marine leech fauna of New Zealand is poorly known and based primarily on studies by Richardson in the 1950s. Three new species have recently been discovered. *Dollfusobdella kaikourae* n. gen., n. sp. is described from Kaikoura, New Zealand parasitising pectoral fins of *Scorpaena cardinalis*, and thornfish, *Bovichtus variegatus*. It is characterised by a cylindrical body widest at the posterior portion of the urosome and tapering gradually to the oral sucker; the total length is not known to exceed 10 mm. The urosome segments are 3-annulate, each with large tubercles dorsally and smaller tubercles ventrally, but lacking pulsatile vesicles. The reproductive system has five pairs of testisacs and a small bursa. *Leporinabdella digglesi* n. gen., n. sp. is described from Manukau Harbour, Auckland, from the body and mouth of yellowbelly flounder, *Rhombosolea leporina*. It is characterised by a wide, flat body not known to exceed 10 mm total length and a large caudal sucker. Urosome segments are 3-annulate with lateral conical tubercles on each annulus, but lacking pulsatile vesicles. The reproductive system has five pairs of testisacs and a large bursa. *Pontobdella novaezaelandiae* n. sp. is described from a single specimen collected near Wellington. It is characterised by a large oral sucker without a fringe and lacking papillae, a moderate-size caudal sucker, and four annuli per segment with large tubercles on the first three annuli.

M08027; Online publication date 31 October 2008
Received 11 June 2008; accepted 8 October 2008

Keywords *Dollfusobdella kaikourae* n. gen., n. sp; *Leporinabdella digglesi* n. gen., n. sp.; *Pontobdella novaezealandiae* n. sp.; parasites; *Bovichtus variegatus*; *Scorpaena cardinalis*; *Rhombosolea leporina*

INTRODUCTION

Leeches (Piscicolidae) from New Zealand marine fishes are still poorly known. Most of our knowledge is based on studies by Richardson in the 1940s and 1950s (Richardson 1947, 1949, 1950, 1953, 1959), Richardson & Meyer (1973), and a more recent report by Williams & Burreson (2005). Currently there are six species of piscicolid leeches known from New Zealand marine waters—*Branchellion parkeri* Richardson 1949 from various skates and rays; *Bdellamaris eptatreti* Richardson 1953 from hagfish *Eptatretus cirrhatus* (Forster 1801); *B. manteri* (Richardson 1959) from dark ghost shark *Hydrolagus novaezealandiae* (Fowler 1911); *Galatheabdella bruuni* Richardson & Meyer 1973, no host known, from deep water in the Tasman Sea; *Notobdella nototheniae* Benham 1909, no host known, from Snares Island; and *Stibarobdella benhami* (Richardson 1950) from various rays and small sharks. Llewellyn (1966) synonymised *S. benhami* with *S. macrothela* Schmarda, but did not examine specimens of *S. benhami* and the synonymy appears to be not valid (E. M. Burreson unpubl. data).

Examination of marine leeches in museum collections in New Zealand, and specimens sent to the authors by New Zealand fisheries biologists or fish parasitologists have revealed the presence of two undescribed genera and three undescribed species. They are described here based on external and internal morphology.

MATERIALS AND METHODS

Leeches labelled W.1404 (three specimens) from *Scorpaena cardinalis* Solander & Richardson 1842 and W.1406 (eight specimens) from thornfish,

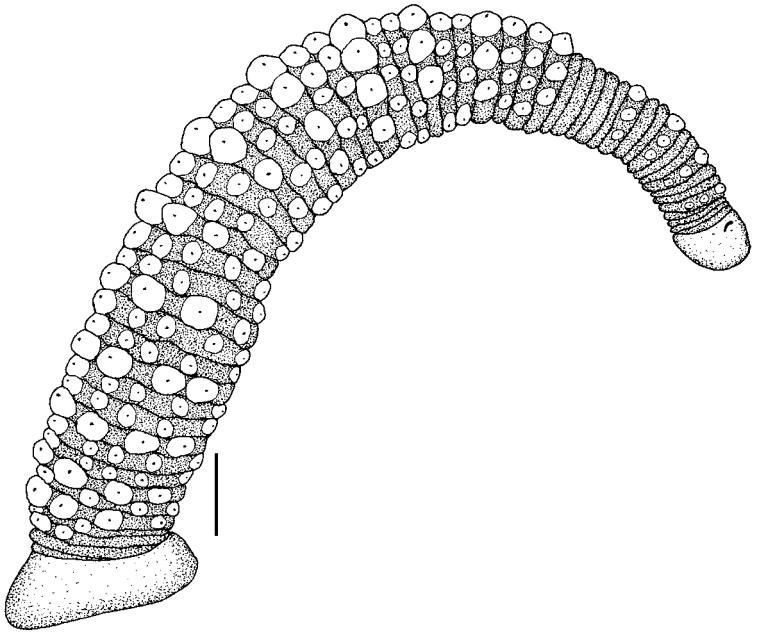

Fig. 1 *Dollfusobdella kaikourae* n. gen., n. sp. External morphology, lateral view. Scale bar = 1.0 mm.

Downloaded by [124.170.184.11] at 16:53 15 February 2016

Bovichtus variegatus Richardson 1846 were borrowed from the Museum of New Zealand Te Papa Tongarewa. Leeches (five specimens) collected on yellowbelly flounder, *Rhombosolea leporina* Günther 1862 from Manukau Harbour, Auckland, and a single, large, leech collected unattached to a host off Cape Farewell, New Zealand were sent to the first author by scientists at the National Institute of Water and Atmospheric Research (NIWA), Wellington.

All leeches were examined with a dissecting microscope and drawings made with the aid of a camera lucida. Internal morphology of two of the species was determined from haematoxylin and eosin (H&E)-stained, 5 μm serial transverse histological sections of paraffin-embedded leeches following the methods by Burreson & Kalman (2006). The internal anatomy of the large leech collected off Cape Farewell was not studied because the leech had been previously frozen and was severely contracted after fixation in 95% ethanol. Fish host common and scientific names were taken from FishBase (Froese & Pauly 2006).

SYSTEMATICS

Family Piscicolidae

***Dollfusobdella* n. gen.**

Type species

Dollfusobdella kaikourae n. sp.

Diagnosis

Body cylindrical, not distinctly divided into trachelosome and urosome. Body widest at posterior portion of urosome, tapering gradually to oral sucker. Urosome segments 3-annulate, each annulus with large dorsal tubercles and smaller ventral tubercles. Pulsatile vesicles absent. Body musculature, especially longitudinal muscles, well developed. Five pairs of testisacs. Acessory gland cells on terminal portion of male reproductive system absent. Conducting tissue absent. Postceca present, fused with fenestrae.

Etymology

Named for Robert P. Dollfus, who first described, but did not name, a leech belonging to this genus collected at subantarctic Marion Island; and bdella, the Greek word for leech.

Dollfusobdella kaikourae n. sp. (Fig. 1–2)

Material examined

Holotype

Museum of New Zealand Te Papa Tongarewa, Wellington W.1404
Host: *S. cardinalis*.
Locality/collection date: laboratory rocks at Kaikoura, New Zealand, 20 June 1973.
Collected by: I. Mannering.

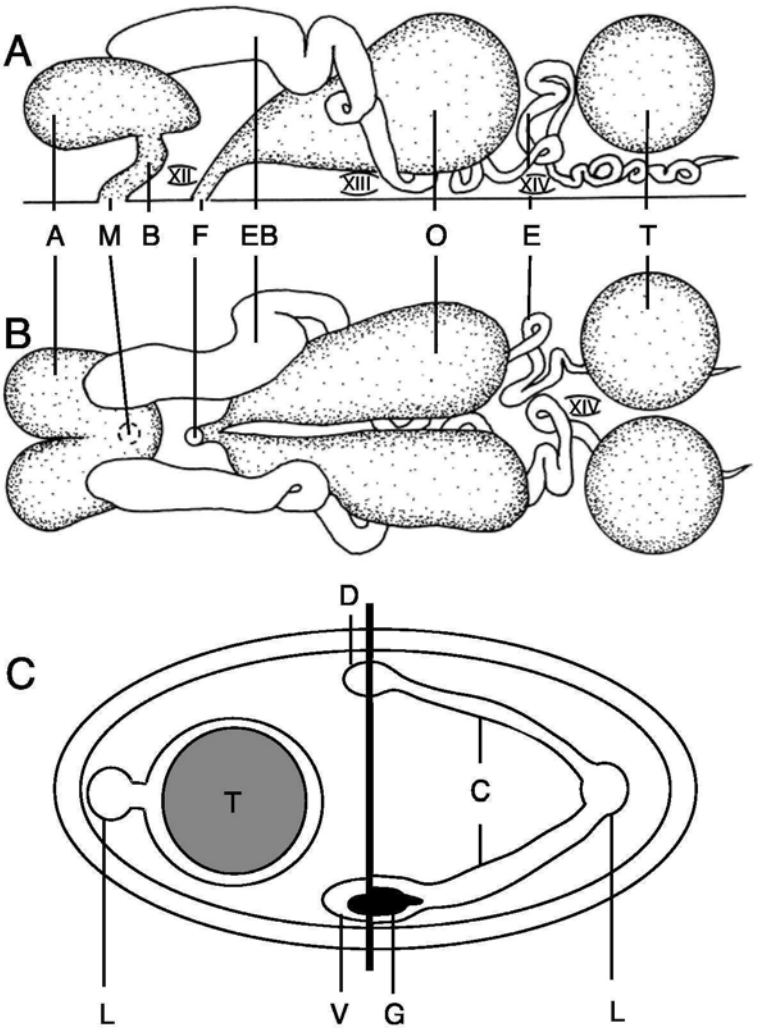

Fig. 2 *Dollfusobdella kaikourae* n. gen., n. sp. **A, B**, terminal portions of reproductive system, **A**, lateral view; **B**, dorsal view. Roman numerals indicate ganglion number. (A, atrium; B, bursa; E, epididymis; EB, ejaculatory bulb; F, female gonopore; M, male gonopore; O, ovisac; T, testisac.); **C**, diagrammatic view of coelomic system, left side intersegmental, right side segmental. (C, connecting sinus; D, dorsal sinus; G, nerve ganglion; L, lateral sinus; V, ventral sinus; T, testisac.)

Downloaded by [124.170.184.11] at 16:53 15 February 2016

Paratypes

Museum of New Zealand Te Papa Tongarewa, Wellington W.1404, two individuals, one sectioned transversely.
Host: *S. cardinalis*
Locality/collection date: laboratory rocks at Kaikoura, 20 June 1973.
Collected by: I. Mannering.

Museum of New Zealand Te Papa Tongarewa, Wellington W.1406, eight individuals, two sectioned transversely.
Host: thornfish, *B. variegatus*, on pectoral fin.
Locality/collection date: in craypot off laboratory rocks, Kaikoura, 28 May 1970.
Collected by: I. Mannering.

Diagnosis

Total length including suckers up to 10.0 mm. Oral sucker small with one pair of eyespots; caudal sucker about as wide as greatest body width, eccentrically attached, lacking marginal ocelli. Annulus a_2 with four large dorsal tubercles, one pair of large ventrolateral tubercles, and at least two small ventral tubercles. Annuli a_1 and a_3 with four small dorsal tubercles, one pair of small lateral tubercles, and at least two ventral tubercles. Tubercles also occur on each a_2 annulus of trachelosome segments.

Downloaded by [124.170.184.11] at 16:53 15 February 2016

Description

External Length up to 10.0 mm including suckers; width 1.7 mm. Body indistinctly divided into trachelosome and urosome. Body widest at posterior end of urosome, tapering gradually to oral sucker. Three annuli per urosome segment. Annulus a_2 with four large dorsal tubercles, one pair of large ventrolateral tubercles, and at least two small ventral tubercles. Annuli a_1 and a_3 with four small dorsal tubercles, one pair of small lateral tubercles, and at least two ventral tubercles (Fig. 1). Total number of ventral tubercles could not be determined with the material available. Oral sucker small, with one pair of eyespots. Caudal sucker moderately large, somewhat oval in shape, about as wide as greatest body width, eccentrically attached, lacking marginal ocelli. Pigmentation of suckers and body unknown.

Musculature Body musculature extremely well developed, with a thick layer of circular and especially longitudinal muscles.

Digestive system Mouthpore centrally located in oral sucker. Proboscis extends to ganglion in IX. Mycetomes connect to oesophagus at ganglion in XI and extend anteriorly to IX. Crop expands only slightly between testisacs. Nature of intestinal diverticula not determined from material available. Postcaeca present, fused with fenestrae.

Coelomic system Pulsatile vesicles absent. Large ventral, dorsal and lateral coelomic sinuses present in urosome segments, with connections between ventral and lateral and dorsal and lateral sinuses at each urosome ganglion (Fig. 2). Testisac coelomic sinsuses present, with connection to lateral sinus intersegmentally.

Reproductive system Five pairs of testisacs intersegmentally from XIV/XV to XVIII/XIX. Testisacs large, filling available body space, overlapping to some degree. Vasa deferentia/ejaculatory bulbs large, entering atrial cornua on their postero-dorsal surface (Fig. 2). Accessory gland cells on atrial cornua absent; bursa small. Large vasa deferentia enter convoluted dorsal epididymides in XIII and XIV (Fig. 2). Vasa deferentia pass ventrally and are highly convoluted ventral to first pair of testisacs. Ovisacs large, filling available body space in XIII/XIV, extending to ganglion in XIV (Fig. 2). Vector tissue and conducting tissue absent.

Etymology

Named for the collection location of Kaikoura.

Remarks

The external morphology of this leech, especially the 3-annulate urosome with multiple large tubercles on each annulus, resembles the genus *Stibarobdella* closely. The internal anatomy, however, is markedly different. All species of *Stibarobdella* for which the internal anatomy is known have six pairs of testisacs and two pairs of pulsatile vesicles per urosome segment (Llewellyn 1966). *Dollfusobdella kaikourae* n. sp. has only five pairs of testisacs and lacks pulsatile vesicles. In addition, all species of *Stibarobdella* are parasites of elasmobranchs, not teleosts (Llewellyn 1966).

Dollfusobdella n. sp. has some external resemblance to the Antarctic genus *Moorebdellina*, which also possesses large tubercles on each annulus of the urosome. However, all species of *Moorebdellina* in which the coelomic system has been characterised have external pulsatile vesicles, and all species have conducting tissue leading to the ovisacs (Utevsky 2007); both are lacking in *D. kaikourae* n. sp. In addition, all species of *Moorebdellina* have small, terminal caudal suckers, whereas *D. kaikourae* n. sp. has a large eccentrically-attached caudal sucker. No other piscicolid leech genus has a cylindrical body, eccentrically-attached caudal sucker, 3-annulate segments, eight or more large tubercles on each urosome annulus, lacks pulsatile vesicles, and has only five pairs of testisacs.

Dollfus (1971) reported a leech from subantarctic Marion Island in the Indian Ocean; he did not name the leech, but stated that it belonged to an unknown genus. Dollfus (1971) reported the leech as having large tubercles and photographs in his paper show a leech almost identical to *D. kaikourae* n. sp., except that there appear to be fewer tubercles than on *D. kaikourae* n. sp. These differences may be real or they may be fixation artifacts. Nonetheless, the leech reported by Dollfus (1971) from Marion Island appears to belong in *Dollfusobdella* n. gen., although it may be a separate species. Attempts to locate Dollfus's specimens (no. 1002) in the Muséum National d'Histoire Naturelle, Paris were unsuccessful. The genus *Dollfusobdella* n. gen. is likely widespread in the Southern Ocean, although *D. kaikourae* n. sp. may be endemic to New Zealand.

Family Piscicolidae

Leporinabdella n. gen.

Type species

Leporinabdella digglesi n. sp.

Downloaded by [124.170.184.11] at 16:53 15 February 2016

Diagnosis

Body flat, distinctly divided into trachelosome and urosome, widest at anterior/middle portion of urosome tapering gradually to caudal sucker. Urosome segments 3-annulate, each with dorsal, lateral, or ventrolateral tubercles. Pulsatile vesicles absent. Body musculature weakly developed. Five pairs of testisacs. Accessory gland cells on terminal portion of male reproductive system absent. Conducting tissue absent. Postceca present, fused with fenestrae.

Etymology

Named for the host fish species *R. leporina*, and bdella, the Greek word for leech.

Leporinabdella digglesi n. sp. (Fig. 3–5)

Material examined

Holotype

Museum of New Zealand Te Papa Tongarewa, Wellington W.2074.
Host: yellowbelly flounder, *R. leporina*, gill cavity.
Locality/collection date: Manukau Harbour, Auckland, New Zealand, 14 October 1998.
Collected by: B. Diggles.

Paratypes

Museum of New Zealand Te Papa Tongarewa, Wellington W.2075. Three specimens, one sectioned transversely.
Host: yellowbelly flounder, *R. leporina*, on dorsal surface of head.
Locality/collection date: Manukau Harbour, Auckland, 14 October 1998.
Collected by: B. Diggles.

Museum of New Zealand Te Papa Tongarewa, Wellington W.2076. One specimen.
Host: yellowbelly flounder, *R. leporina*, imbedded in isthmus tissue in gill cavity.
Locality/collection date: Manukau Harbour, Auckland, 18 April 1998.
Collected by: B. Diggles.

Diagnosis

Body wide and flat, up to 10.0 mm total length including suckers, and 2.0 mm wide. Oral sucker well developed, lacking eyespots; caudal sucker large, 2.0 mm in diameter, eccentrically attached, lacking marginal ocelli. Annulus a_2 with one pair dorsolateral tubercles and one pair ventrolateral tubercles. Annuli a_1 and a_3 with one pair lateral tubercles.

Description

External Length up to 10.0 mm including suckers; width up to 2.0 mm. Body distinctly divided into subcylindrical trachelosome and wide, flat urosome. Body widest at anterior portion of urosome, tapering gradually to caudal sucker. Three annuli per urosome segment. In the holotype, each urosome annulus finely subdivided into four or five striations. Annulus a_2 with one pair of dorsolateral tubercles and one pair of ventrolateral tubercles (Fig. 3, 4). Annuli a_1 and a_3 with one pair of lateral tubercles; tubercle on a_3 slightly more dorsal than tubercle on a_1 (Fig. 4). All tubercles are conical in shape and equal in size. No tubercles observed on clitellum or trachelosome. Oral sucker well developed, lacking eyespots. Caudal sucker large, 2.0 mm in diameter, eccentrically attached, lacking marginal ocelli (Fig. 3). Smallest specimens unpigmented, appearing white. Larger leeches appear uniformly green; the largest, imbedded leech had green longitudinal stripes alternating with cream-coloured stripes.

Musculature Body musculature weakly developed.

Digestive system Mouthpore centrally located in oral sucker. Proboscis extends to ganglion in IX. Mycetomes connect to oesophagus at ganglion in XI and extend anteriorly to IX. Nature of crop expansions and intestinal diverticula not determined from material available. Postceca present, fused with fenestrae.

Coelomic system Pulsatile vesicles absent. Large ventral, dorsal, lateral and testisac coelomic sinuses present in urosome segments, with connections between ventral and lateral sinuses segmentally and connections between dorsal, testisac and lateral sinuses intersegmentally (Fig. 5).

Reproductive system Five pairs of testisacs intersegmentally from XIV/XV through XVIII/XIX. Vasa deferentia/ejaculatory bulbs unusually small, entering atrial cornua on anterolateral portion (Fig. 5). Accessory gland cells on atrial cornua absent. Bursa large and convoluted. Vasa deferentia expand posteriorly in segments XII/XIII as thin-walled, convoluted epididymides (Fig. 5). Vector tissue and conducting tissue absent. Ovisacs small.

Etymology

Named in honour of Ben Diggles (DigsFish Services

Downloaded by [124.170.184.11] at 16:53 15 February 2016

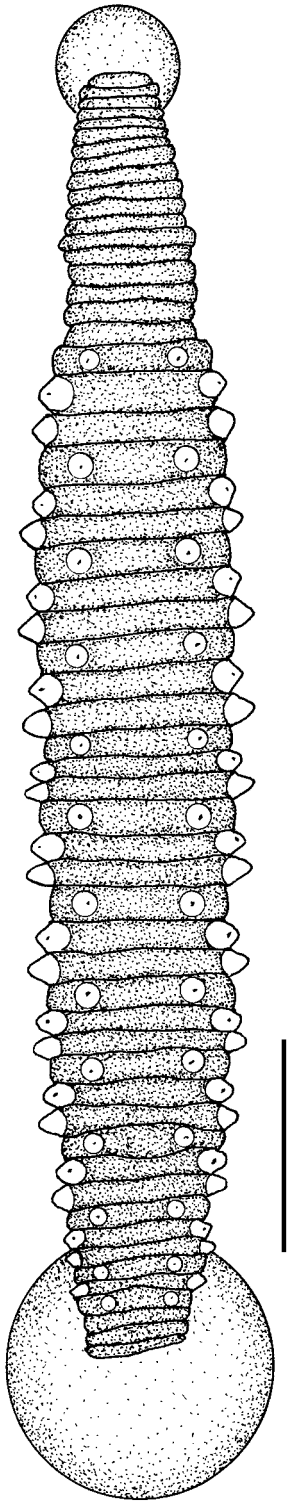

Fig. 3 *Leporinabdella digglesi* n. gen., n. sp. External morphology, dorsal view. Scale bar = 1.0 mm.

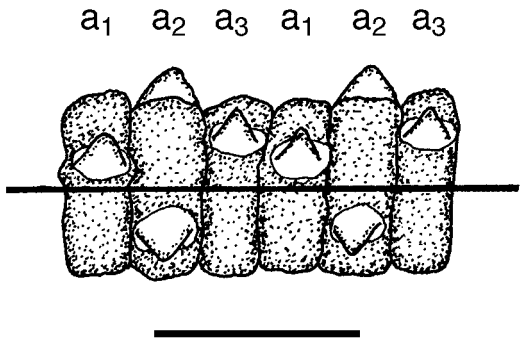

Fig. 4 *Leporinabdella digglesi* n. gen., n. sp. External morphology, lateral view of two urosome segments showing position of tubercles on a_1, a_2, and a_3 annuli. Heavy line is mid-lateral. Scale bar = 0.5 mm.

Pty., Australia) who discovered the leech while he was at NIWA and sent it to the first author.

Remarks

Even though the diagnoses of *Dollfusobdella* n. gen. and *Leporinabdella* n. gen. are similar, both with five pairs of testisacs, absence of pulsatile vesicles, 3-annulate segments, each with tubercles, and absence of accessory gland cells on the atrium; the body shape, tubercle pattern, details of the male reproductive system, and musculature are markedly different. These differences may seem trivial, but body shape, tubercle pattern, and degree of musculature are important generic criteria in the Piscicolidae (Sawyer 1986), and the differences warrant placement of *D. kaikourae* n. sp. and *L. digglesi* n. sp. in different genera. *Leporinabdella digglesi* n. sp. differs from species of *Stibarobdella* and *Moorebdellina* for the same reasons given above for *D. kaikourae* n. sp.

Because of fixation in formalin, any pigmentation that may have been present had faded in all specimens examined. Eyespots and ocelli usually survive formalin fixation, but not in all instances. Thus, the statements about absence of eyespots and ocelli should be viewed with caution.

No other genus in the Piscicolidae is characterised by a wide, flat body distinctly divided into trachelosome and urosome, 3-annulate urosome with only one or two tubercles on each annulus, five pairs of testisacs, and absence of pulsatile vesicles.

Leporinabdella digglesi n. sp. may be a permanent parasite in the mouth of yellowbelly flounder. Smaller specimens were collected in the spring from

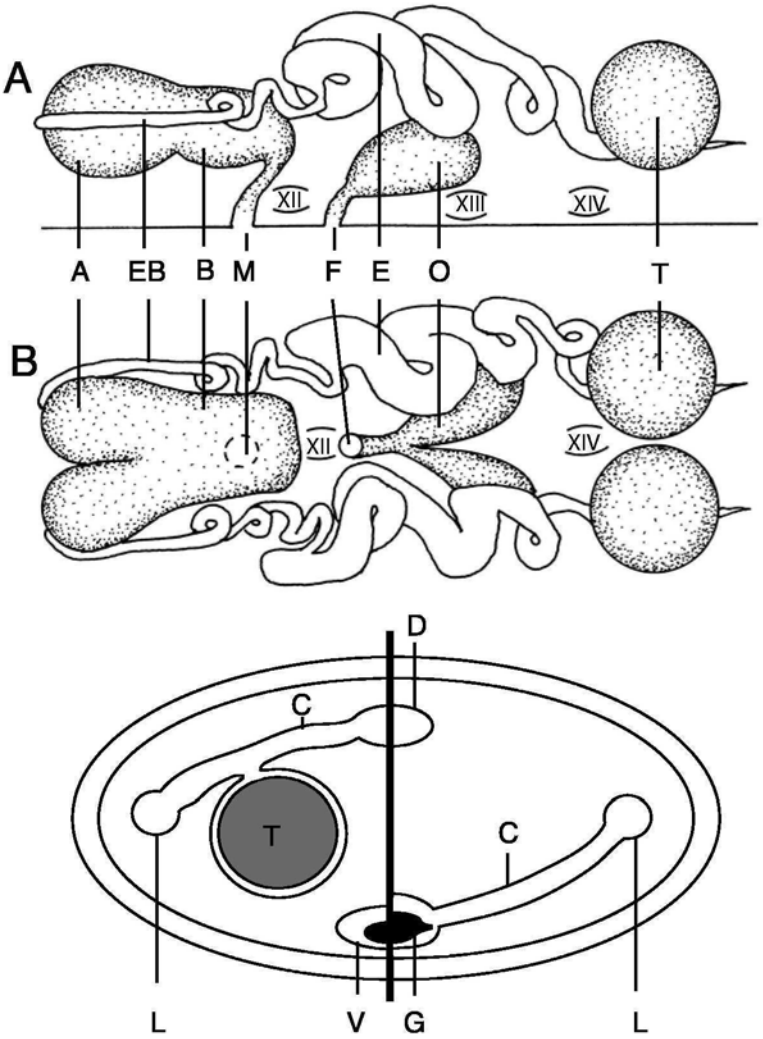

Fig. 5 *Leporinabdella digglesi* n. gen., n. sp. **A, B**, terminal portions of reproductive system, **A**, lateral view; **B**, dorsal view. Roman numerals indicate ganglion number. (A, atrium; B, bursa; E, epididymis; EB, ejaculatory bulb; F, female gonopore; M, male gonopore; O, ovisac; T, testisac.); **C**, diagrammatic view of coelomic system, left side intersegmental, right side segmental. (C, connecting sinus; D, dorsal sinus; G, nerve ganglion; L, lateral sinus; V, ventral sinus; T, testisac.)

Downloaded by [124.170.184.11] at 16:53 15 February 2016

the dorsal surface of the head or gill cavity, but the largest specimen was collected from the gill cavity in autumn and host tissue of the isthmus had grown over the caudal sucker of the leech, completely enclosing it so that the leech had to be excised. This individual leech had a posterior urosome greatly constricted by the host tissue. Engulfment of the caudal sucker by host tissue is unusual for fish leeches, although not unprecedented (Appy & Cone 1982). Leeches may hatch from the cocoon in spring, attach to the dorsal surface of the host and eventually move into the mouth. This leech is capable of swimming.

Yellowbelly flounder, *R. leporina*, is endemic to New Zealand (Froese & Pauley 2006). If *L. digglesi* n. sp. is a specific parasite of this host, as appears likely, then the leech is likely endemic also. Prevalence is low; a single leech was found on five of 518 (0.96%) *R. leporina* examined. (B. Diggles unpubl. data).

Pontobdella novaezealandiae n. sp. (Fig. 6)

Material examined

Holotype

Museum of New Zealand Te Papa Tongarewa, Wellington W.2077.

Host: unknown, collected free in trawl, but likely elasmobranchs.

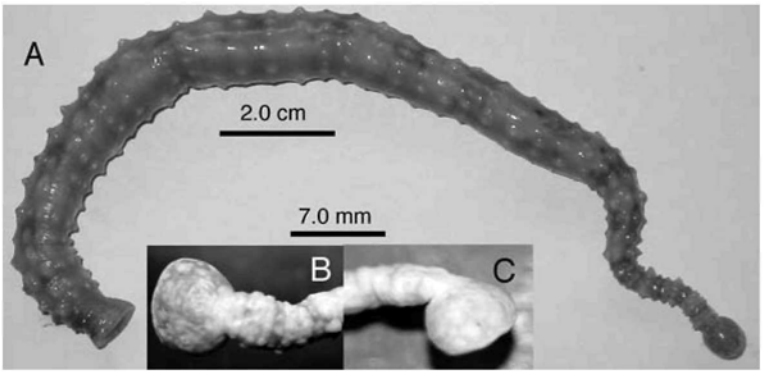

Fig. 6 *Pontobdella novaezealandiae* n. sp. **A**, entire leech when alive; photograph by Owen Anderson, NIWA. **B**, oral sucker, dorsal view, after preservation, showing absence of papillae. **C**, oral sucker, lateral view, after preservation, showing absence of oral fringe and papillae. Scale bar applies to both B and C.

Downloaded by [124.170.184.11] at 16:53 15 February 2016

Locality/collection date: west of north end of South Island off Cape Farewell, 40°30.5′S, 171°49.5′E, 200 m, R/V *Kaharoa*, KAH0608, tow 11, 7 July 2006.
Collected by: O. Anderson, NIWA.

Diagnosis

Large leech, up to 20.0 cm total length including suckers. Oral sucker large, deeply cupped, lacking marginal fringe, papillae and eyespots. Caudal sucker moderately large, terminal. Urosome segments 4-annulate. Annulus a_1 with eight small dorsal/dorsolateral tubercles and six small ventral tubercles. Annulus a_2 with four large dorsal tubercles and four smaller ventral tubercles. Annulus b_5 with six large dorsal/dorsolateral tubercles and four smaller ventral tubercles. Annulus b_6 lacks tubercles. Annulus a_2 is widest, annuli a_1 and b_5 are slightly narrower, and annulus b_6 is much narrower than the others. Pigmentation is uniformly green when alive.

Description

Nothing is known of the internal anatomy, but other species in *Pontobdella* have six pairs of testisacs and two pairs of pulsatile vesicles per urosome segment.

Remarks

The single specimen available for study had been frozen and then placed in 95% ethanol, causing it to compress dorso-ventrally and making dissection impossible. Nevertheless, members of the genera *Pontobdella* and *Stibarobdella* are remarkably consistent internally and species are distinguished on the basis of external characters, mainly number of tubercles on each annulus, and morphology of the suckers (Llewellyn 1966). Tubercle pattern was also difficult to determine on the contracted specimen, especially the presence of tubercles on annulus b_6. None was observed, but tubercles are typically small on this annulus and may have been obliterated by the fixation process. This leech differs from the two recognised species in *Pontobdella*, *P. muricata* (Linnaeus 1758) and *P. vosmaeri* Apathy 1888, both known from the North Atlantic Ocean. The oral sucker on *P. muricata* has a marginal fringe (Llewellyn 1966), which is lacking on *P. novaezealandiae* n. sp.; the oral sucker on *P. vosmaeri* is small, lacks a marginal fringe, but has three pairs of papillae (Llewellyn 1966), which are also lacking on *P. novaezealandiae* n. sp. In addition, *P. novaezealandiae* n. sp. has 14 tubercles on a_1, 8 tubercles on a_2, 10 tubercles on b_5 and no tubercles on b_6, whereas *P. muricata* has 12 tubercles on a_1, 8 tubercles on a_2, 10 tubercles on b_5 and 14 small tubercles on b_6; and *P. vosmaeri* has 14 tubercles on a_1, 9 tubercles on a_2, 12 tubercles on b_5, and 14 small tubercles on b_6.

Etymology

Named for the collection locality, New Zealand.

DISCUSSION

The description of the new genera and species reported herein brings the total of New Zealand marine fish leeches (Piscicolidae) to eight genera and nine species. Of these, only *Notobdella nototheniae* (=*Trulliobdella capitis* Brinkmann 1947) and *Branchellion parkeri* have been collected outside New Zealand waters. *Notobdella nototheniae* is circumpolar in Antarctica and subantarctic islands (Meyer & Burreson 1990; Utevsky 2007), and *Br. parkeri* is known from Tasmania (Ingram 1957). Based on present records seven species may be

endemic to New Zealand waters—*B. eptatreti*, *B. manteri*, *D. kaikourae* n. sp., *G. bruuni*, *L. digglesi* n. sp., *P. novaezealandiae* n. sp., and *S. benhami*. *Bdellamanis eptatreti* seems to be a specific parasite of the hagfish *E. cirrhatus* (Richardson 1953; Richardson & Meyer 1973). Although *B. eptatreti* is not known outside New Zealand waters, its host, *E. cirrhatus*, also occurs in southeastern Australia (Froese & Pauley 2006), so *B. eptatreti* may occur there as well. One host for *D. kaikourae* n. sp., *B. variegatus*, is endemic to New Zealand, but the other known host, *S. cardinalis*, also occurs in Australia (Froese & Pauley 2006). Thus, *D. kaikourae* n. sp. may occur in Australia. The fish hosts for *B. manteri* and *L. digglesi* n. sp., *H. novaezealandiae* and *R. leporina*, respectively, are endemic to New Zealand (Froese & Pauley 2006), so these leeches are almost certainly endemic as well. In addition, the genera *Bdellamaris* (with the caveats above for *B. eptatreti*), *Galatheabdella* and *Leporinabdella* n. gen. have not been reported outside New Zealand, and may be endemic genera.

Downloaded by [124.170.184.11] at 16:53 15 February 2016

ACKNOWLEDGMENTS

We thank Darren Stevens for sending the specimen and photograph of *P. novaezealandiae*, and Ben Diggles for sending specimens of *L. digglesi* as well as information on pigmentation, swimming ability and prevalence. Bruce Marshall, Museum of New Zealand Te Papa Tongarewa, assisted with specimen loans and accessions. Supported by NSF PEET DEB 0119329.

REFERENCES

Appy RG, Cone DK 1982. Attachment of *Myzobdella lugubris* (Hirudinea: Piscicolidae) to logperch, *Percina caprodes*, and brown bullhead, *Ictalurus nebulosus*. Transactions of the American Microscopical Society 101: 135–141.

Burreson EM, Kalman JE 2006. A new species of *Malmiana* (Oligochaeta: Hirudinida: Piscicolidae) from tidepool fishes in northern California. Journal of Parasitology 92: 89–92.

Dollfus RPh 1971. Hirudinea. In: van Zinderen Bakker EM et al. ed. Marion and Prince Edward islands. Cape Town, Balkema. Pp. 394–395.

Froese R, Pauly D 2006. FishBase. World wide web electronic publication, http://www.fishbase.org, version 10/2006 [accessed 23 September 2008].

Ingram DM 1957. Some Tasmanian Hirudinea. Papers and Proceedings of the Royal Society of Tasmania 91: 191–232.

Llewelyn LC 1966. Pontobdellinae (Piscicolidae: Hirudinea) in the British Museum (Natural History) with a review of the subfamily. Bulletin of the British Museum (Natural History) Zoology 14(7): 391–439.

Meyer MC, Burreson EM 1990. Some leeches (Hirudinea: Piscicolidae) of the southern oceans. Biology of the Antarctic Seas XXI. Antarctic Research Series 52: 219–236.

Moore JP 1938. Leeches. Australasian Antarctic Expedition 1911–14. Series C.—Zoology and Botany 10(3): 5–15.

Richardson LR 1947. A review of New Zealand leeches. The New Zealand Science Congress: 201–202.

Richardson LR 1949. Studies on New Zealand Hirudinea: Part II. *Branchellion parkeri*, a new ichthyobdellid leech. Zoology Publications from Victoria University College 1: 3–11.

Richardson LR 1950. Studies on New Zealand Hirudinea. Part 1. *Pontobdella benhami* n. sp. Transactions of the Royal Society of New Zealand 78(1): 97–100.

Richardson LR 1953. Studies on New Zealand Hirudinea. Part III. *Bdellamaris eptatreti* n. g., n. sp., and notes on other Piscicolidae. Transactions of the Royal Society of New Zealand 81(2): 283–290.

Richardson LR 1959. *Makarabdella manteri* n. g., n. sp., a new marine piscicolid leech. Transactions of the Royal Society of New Zealand 87(3/4): 283–290.

Richardson LR, Meyer MC 1973. Deep-sea fish leeches (Rhynchobdellae: Piscicolidae). Galathea Report 12: 113–126.

Sawyer RT 1986. Leech biology and behaviour. Vol. 2. Feeding biology, ecology, and systematics. Oxford, Clarendon Press. 375 p.

Utevsky AY 2007. Antarctic piscicolid leeches. Bonner Zoologische Monographien 54. Bonn, Zoologisches Forschungsmuseum Alexander Koenig. 80 p.

Williams J, Burreson E 2005. Revision of the genus *Bdellamaris* (Hirudinea: Piscicolidae) including a new combination, *Bdellamaris manteri*. New Zealand Journal of Marine and Freshwater Research 39: 1331–1337.