Two new nematode species (Plectida: Leptolaimidae,Rhadinematidae) from Chatham Rise, New Zealand

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Two new species of the order Plectida are described from Chatham Rise, New Zealand. *Leptolaimus dififtinus* sp. nov. is characterised by the short body 319-420 microns long, truncate labial region slightly offset from body contour and bearing conspicuous outer labial papillae, cephalic setae 1.3-1.4 microns long, amphid located 4-9 microns from anterior end, lateral alae originating from middle of buccal cavity length, female without supplements, male with precloacal and postcloacal pairs of subventral setae, nine tubular supplements (alveolar supplements absent), tubular supplements weakly S-shaped with pointed tip, spicules arcuate 24 microns or 1.4 cloacal body diameters long and dorsal gubernacular apophyses. *Lavareda iramscotti* sp. nov. is characterised by adult body length 3023-3121 microns long, eight longitudinal rows of body pores each with short papilla, cephalic setae 4-5 microns long, tail 146-165 microns long, male with spicules 54 microns long, gubernaculum with triangular apophyses, 20 precloacal supplements with bifid distal tips arranged in 9+1+10 pattern, female with vulva at 55% of body length from anterior and cuticularisation perpendicular to vagina at level of vulva. The present study provides the first record of a *Leptolaimus* species from the New Zealand region and the first description of a female specimen of the genus *Lavareda*.

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Abstract

Two new species of the order Plectida are described from Chatham Rise, New Zealand. *Leptolaimus dififtinus* sp. nov. is characterised by the short body 319-420 μm long, truncate labial region slightly offset from body contour and bearing conspicuous outer labial papillae, cephalic setae 1.3-1.4 μm long, amphid located 4-9 μm from anterior end, lateral alae originating from middle of buccal cavity length, female without supplements, male with precloacal and postcloacal pairs of subventral setae, nine tubular supplements (alveolar supplements absent), tubular supplements weakly S-shaped with pointed tip, spicules arcuate 24 μm or 1.4 cloacal body diameters long and dorsal gubernacular apophyses. *Lavareda iramscotti* sp. nov. is characterised by adult body length 3023-3121 μm, eight longitudinal rows of body pores each with short papilla, cephalic setae 4-5 μm long, tail 146-165 μm long, male with spicules 54 μm long, gubernaculum with triangular apophyses, 20 precloacal supplements with bifid distal tips arranged in 9+1+10 pattern, female with vulva at 55% of body length from anterior and cuticularisation perpendicular to vagina at level of vulva. The present study provides the first record of a *Leptolaimus* species from the New Zealand region and the first description of a female specimen of the genus *Lavareda*.

Introduction

The order Plectida Gadea, 1973 comprises nematode taxa inhabiting marine, brackish, freshwater and soil habitats, as well as a few commensal and potentially parasitic taxa (Holovachov 2014). To date, only six marine plectid species have been recorded from New Zealand waters by Allgén (1927, 1932), Ditlevsen (1930) and Leduc & Wilson (2016). The family Leptolaimidae Örley, 1880 is a globally distributed, largely marine and brackish family with *Leptolaimus* de Man, 1876 one of most common and diverse plectid genus. Sixty valid *Leptolaimus* species are currently known (Holovachov & Boström 2013, Tchesunov 2015, Qiao et al. 2020), but no *Leptolaimus* species have yet been recorded from the New Zealand region.

The Rhadinematidae Lorenzen, 1981, is a small, rare group of marine plectids comprising three genera and five valid species (Holovachov 2014, Holovachov & Boström 2014). Two genera, viz., *Cricolaimus* Southern, 1914 and *Lavareda* da Fonsêca-Genevois, Smol & Bezerra,

43 2011 are so far known only from males. One species, *Lavareda coronatus* (Ditlevsen, 1930) da

44 Fonsêca-Genevois, Smol & Bezerra, 2011 has been recorded from the New Zealand region. This

45 species originally belonged to the genus *Cricolaimus* but was transferred to *Lavareda* based on

46 the structure of the cheilostom (da Fonsêca-Genevois et al.2011). Here, two new species of the

47 order Plectida are described from Chatham Rise, New Zealand: *Leptolaimus dififtinus* sp. nov.

48 and *Lavareda iramscotti* sp. nov.

49

50 **Materials & Methods**

51 Samples were obtained from Chatham Rise, a submarine ridge that extends eastwards from the

52 South Island of New Zealand, over water depths ranging from ca. 250 to 3000 m. Samples were

53 collected from Chatham Rise during NIWA cruise TAN0705 (March-April 2007) and TAN1103

54 (February 2011) under Special Permit 666 granted to NIWA by the Ministry for Primary

55 Industries. Sediment samples were collected and processed as described in Leduc (2012), using

56 an Ocean Instruments MC-800A multicorer (core internal diameter = 9.5 cm). Each sample

57 consisted of one subcore of internal diameter 26 mm taken to a depth of 5 cm. Samples were

58 fixed in 10% formalin and stained with Rose Bengal. Samples were subsequently rinsed on a 45

59 μm sieve to retain nematodes. Nematodes were extracted from the remaining sediments by

60 Ludox flotation and transferred to pure glycerol (Somerfield & Warwick, 1996).

61   Species descriptions were made as described in Leduc (2020), based on glycerol mounts

62 using differential interference contrast microscopy and drawings were made with the aid of a

63 camera lucida. Measurements were obtained using an Olympus BX53 compound microscope

64 with cellSens Standard software. All measurements are in μm, and all curved structures are

65 measured along the arc. The terminology used for describing the arrangement of morphological

66 features such as setae follows Coomans (1979). Type specimens are held in the NIWA

67 Invertebrate Collection (Wellington).

68   **Abbreviations:**

69   a: body length/maximum body diameter

70   b: body length/pharynx length

71   c: body length/tail length

72   c': tail length/anal or cloacal body diameter

73   cbd: corresponding body diameter

74   L: total body length; n, number of specimens

75   V: vulva distance from anterior end of body

76   %V: V/total body length × 100

77   The electronic version of this article in Portable Document Format (PDF) will represent a

78   published work according to the International Commission on Zoological Nomenclature (ICZN),

79   and hence the new names contained in the electronic version are effectively published under that

80   Code from the electronic edition alone. This published work and the nomenclatural acts it

81   contains have been registered in ZooBank, the online registration system for the ICZN. The

82   ZooBank LSIDs (Life Science Identifiers) can be resolved and the associated information viewed

83   through any standard web browser by appending the LSID to the prefix http://zoobank.org/. The

84   LSID for this publication is: urn:lsid:zoobank.org:pub:4689626F-D42C-464A-BB0B-

85   55D593DD3E71. The online version of this work is archived and available from the following

86   digital repositories: PeerJ, PubMed Central and CLOCKSS.

87

88   **Results**

89   Order Plectida Gadea, 1973

90   Family Leptolaimidae Örley, 1880

91   Genus *Leptolaimus* de Man, 1876

92   = *Halaphanolaimus* Southern, 1914

93   = *Aplectus* Cobb, 1914

94   = *Dermatolaimus* Steiner, 1916

95   = *Polyaimium* Cobb, 1920

96   = *Alveolaimus* Alekseev & Rassadnikova, 1977

97   = *Boveelaimus* Alekseev, 1979

98   = *Tubulaimus* Alekseev & Rassadnikova, 1977

99   **Generic diagnosis: (from Holovachov (2014))** Lateral alae present. First annule anterior
100   to cephalic setae bases and amphids, cephalic capsule absent. Cephalic sensilla papilliform or
101   setiform. Amphideal aperture ventrally unispiral, without central elevation. Secretory-excretory
102   system present; excretory canal short, excretory ampulla present. Ovary branches reflexed
103   antidromously. Alveolar or tubular supplements present in females of some species, either in
104   pharyngeal or pre-anal regions, or in both positions. Male reproductive system diorchic. Number
105   of supplements varies from zero to 40 for alveolar and zero to 11 for tubular; males may have
106   both types of supplements, one or no supplements at all. Caudal glands and spinneret present or
107   absent.

108   Type species: *L. papilliger* de Man, 1876

109   **Remarks.** The genus was revised by Holovachov and Boström (2013) who provided a
110   key to the identification of all 58 valid species based on features of both males and females. Two
111   species were subsequently described by Tchesunov (2015) and Qiao et al. (2020).

112   ***Leptolaimus dififtinus* sp. nov.**

113   Figs. 1-4, Table 1

114   urn:lsid:zoobank.org:act:C4FE8E90-6481-4E1E-9780-561C4D1D8D9E

115   **Type locality:** Northern flank of Chatham Rise, 1194 m water depth (*RV Tangaroa*
116   voyage TAN0705, station 196, site D15; 42.6147°S, 178.3338°W). Muddy sand sediments (68%
117   sand, 19% silt, 13% clay), calcium carbonate content 59.9%.

118   **Type material**: Holotype male (NIWA 139251), and one paratype female (NIWA
119   139252), collected on 19 April 2007.

120   **Measurements:** See Table 1 for detailed measurements.

121   **Description:** Male. Body colourless except for dense brown granules in anterior portion
122 of intestine, fusiform, strongly curved ventrally (maybe as a result of formalin fixation), strongly
123 tapering anteriorly in pharyngeal region and posteriorly on tail. Cuticle annulated, annules ca. 1.3
124 μm apart; lateral alae present consisting of raised, non-annulated cuticle ca. 2.5-3.0 μm wide
125 extending from middle of buccal cavity length (close to first body pore) to almost half of tail
126 length. Four longitudinal rows of sublateral body pores, extending from middle of buccal cavity
127 to two thirds of tail length, pores in pharyngeal region with short papilla, pores posterior to
128 pharynx without papillae; epidermal glands not observed. Somatic setae absent except for a pair
129 of subventral setae, 2 μm long, anterior to cloaca, and second pair of subventral setae posterior to
130 cloaca. Labial region truncate, slightly offset from body contour, lips fused. Inner labial sensilla
131 indistinct; outer labial sensilla conspicuous and papillose, located on the outer surface of lips.
132 Cephalic sensilla setiform, 0.25-0.30 cbd long. Ocelli absent. Amphideal fovea round, located at
133 level of anterior quarter of buccal cavity. Buccal cavity uniformly tubular: cheilostom and
134 gymnostom short, undifferentiated; stegostom tubular, with uniformly thickened lumen. Pharynx
135 muscular, cylindrical anteriorly, with distinct oval basal bulb, distinctly cuticularized lumen from
136 posterior to buccal cavity to near posterior end of pharynx; valvular apparatus absent. Pharyngeal
137 glands and their orifices indistinct. Nerve ring surrounding pharynx near middle of pharynx
138 length. Secretory-excretory system not observed. Cardia cylindrical, with posterior part
139 embedded in intestine

140   Reproductive system diorchic with both testes directed anteriorly; one larger outstretched
141 testis located to the right of intestine with globular sperm ca. 2 μm in diameter, one smaller
142 outstretched (possibly reflexed) testis located ventrally with smaller globular sperm ca. 1 μm in
143 diameter. Spicules paired, symmetrical, arcuate, 1.4 cloacal body diameter long, only slightly
144 cuticularised; capitulum rounded, shaft and blade gradually tapering distally. Gubernaculum with
145 lightly cuticularized, bent dorsal apophysis. Ventral precloacal seta not observed. Accessory
146 apparatus composed of nine more or less evenly spaced midventral tubular supplements
147 (posterior supplements appear closer together due to body curvature), ca. 16-23 μm apart,
148 extending for 8 μm from cloaca towards anterior end; alveolar supplements absent. Tubular
149 supplements weakly S-shaped, with pointed tip, 11-14 μm long, each with small drop-shaped

150   subsurface cuticularisation immediately anterior. Tail conical; three caudal glands and spinneret
151   present.

152   Females. Similar to males, but without any somatic setae, lower values of 'a' and shorter
153   tail. Reproductive system with single anterior reflexed ovary located ventrally; posterior ovary
154   likely present but obscured by large egg in uterus. Spermathecae not observed. Vulva situated
155   slightly posterior to mid-body. Vagina slightly anteriorly directed, short, proximal portion
156   encircled by single sphincter muscle. Vaginal glands not observed. Supplements absent.

157   **Diagnosis:** *Leptolaimus dififtinus* sp. nov. is characterised by short body 319-420 μm
158   long, truncate labial region slightly offset from body contour and bearing conspicuous outer
159   labial papillae, cephalic setae 1.3-1.4 μm long,, amphid located 4-9 μm from anterior end, lateral
160   alae originating from middle of buccal cavity length, female without supplements, male with
161   precloacal and postcloacal pairs of subventral setae, nine tubular supplements (alveolar
162   supplements absent), tubular supplements weakly S-shaped with pointed tip, spicules arcuate 24
163   μm or 1.4 cloacal body diameters long and dorsal gubernacular apophyses.

164   **Differential diagnosis:** The new species is similar to *Leptolaimus alatus* Vitiello, 1971,
165   *L. sextus* Holovachov & Boström, 2013 and *L. septimus* Holovachov & Boström, 2013
166   particularly in having distinct outer labial sensilla and a labial region offset from body contour,
167   but also in males having relatively short spicules (less than three cloacal body diameters), four or
168   more weakly S-shaped tubular supplements without distal discs and in a continuous row, alveolar
169   supplements absent, and females without supplements. *Leptolaimus dififtinus* sp. nov. is most
170   similar to *L. alatus* but can be differentiated from the latter by the slightly shorter cephalic setae
171   (1.3-1.4 μm or 0.25-0.30 cbd *versus* 1.5-2.0 μm or 0.30-0.50 cbd), anterior body pores with short
172   papillae (*versus* long setae in *L. alatus*), number of precloacal supplements (9 *versus* 6-8
173   supplements in *L. alatus*) and shape of the gubernacular apophysis (bent and dorsally-directed
174   *versus* plate-like and dorsocaudally-directed in *L. alatus*). In the original description of *L. alatus*
175   by Vitiello (1971) based on specimens from the Mediterranean, the supplements have pointed
176   tips (as in *L. dififtinus* sp. nov.), however Holovachov & Boström (2013) describe the tips as
177   blunt in their *L. alatus* specimens from Skagerrak and Swedish fjords.

178   *Leptolaimus dififtinus* sp. nov. can be differentiated from *L. sextus* by the shorter body

179   length (319-420 *versus* 626-728 μm in *L. sextus*), anterior body pores with short papillae (*versus*

180   long setae in *L. sextus*), shorter spicules (24 *versus* 39-46 μm in *L. sextus*), and number and

181   shape of precloacal supplements (9 supplements with pointed tips *versus* 5-6 supplements with

182   bifid tips in *L. sextus*). *Leptolaimus dififtinus* sp. nov. can be differentiated from *L. septimus* by

183   the shorter body length (319-420 *versus* 679-821 μm in *L. septimus*), anterior body pores with

184   short papillae (*versus* long setae in *L. septimus*), lower 'a' ratio (12-20 *versus* 24-37 in *L.*

185   *septimus*), shorter cephalic setae (1.3-1.4 μm *versus* 2.5-3.5 μm in *L. septimus*), smaller amphid

186   (4 *versus* 5-6 μm wide in *L. septimus*), shorter tail (2.9-3.4 *versus* 4.7-7.1 cloacal/anal body

187   diameters long in *L. septimus*), shorter spicules (24 *versus* 31-34 μm in *L. septimus*) and number

188   and shape of precloacal supplements (9 supplements with pointed tips *versus* 4-5 supplements

189   with bifid tips in *L. septimus*).

190   **Etymology:** The species name is an arbitrary combination of letters (ICNZ Article 11.3) and also

191   refers to the sampling site (D15) where the type specimens were collected.

192

193   Family Rhadinematidae Lorenzen, 1981

194   Genus *Lavareda* da Fonsêca-Genevois, Smol & Bezerra, 2011

195   **Generic diagnosis: (modified from da Fonsêca-Genevois et al. (2011) and**

196   **Holovachov (2014))** Body long, cylindrical, slender. Cuticle annulated, lateral alae absent.

197   Epidermal glands and body pores present or absent. Lips low, inner and outer labial papilla

198   indistinct. Cheilostom consists of a cuticularised ring with six anteriorly directed projections

199   (one dorsal, one ventral, and four sublateral in position). Amphideal aperture loop-shaped,

200   ventrally unispiral. Buccal cavity funnel-shaped to tubiform. Pharynx cylindrical with posterior

201   oval bulb, muscular. Cardia embedded in intestine. Male reproductive system diorchic or

202   monorchic, testes directed anteriorly. Spicules relatively short, strongly curved, manubrium

203   enlarged, gubernaculum with apophysis. Nineteen or twenty midventral precloacal tubular

204   supplements, precloacal seta present or absent. Female without supplements.

205   Type species: *L. decraemerae* da Fonsêca-Genevois, Smol & Bezerra, 2011

206   *Lavareda iramscotti* **sp. nov.**

207   Figs. 5-7, Table 1

208   urn:lsid:zoobank.org:act:79592D96-3AAE-4B67-9D23-14A158799216

209   **Type locality:** Chatham Rise crest, 347 m water depth (*RV Tangaroa* voyage TAN1103,
210   station 69, 41.3352 °S, 178.2962 °E). Sandy mud sediments (44% sand, 55% silt, 1% clay).

211   **Type material**: Holotype male (NIWA 139253), one paratype female and two paratype
212   juveniles (NIWA 139254), collected on 2 February 2011.

213   **Measurements:** See Table 1 for detailed measurements.

214   **Description:** Male. Body colourless in glycerin preparations, long, slender, uniform in
215   diameter throughout most of body, tapering towards both ends. Cuticle annulated from posterior
216   to cephalic setae to spinneret, annules ca. 1.2 µm apart, without ornamentation or lateral
217   differentiation. Eight longitudinal rows of body pores (two subdorsal, two subventral and four
218   sublateral) extending from posterior to buccal cavity to tail region; each pore with a short conical
219   papilla and connected to small, barely visible epidermal gland. Cephalic region slightly rounded,
220   with reduced labial region. Inner labial sensilla indistinct, outer labial sensilla papilliform, four
221   cephalic setae 0.4-0.5 cbd long. Amphideal fovea ca. 1 cbd from anterior extremity, ventrally
222   unispiral; corpus gelatum not observed. Buccal cavity narrow, deep, tubular, without teeth;
223   cheilostom distinct, resembling a crown, 5 µm in diameter, consisting of a cuticularized ring with
224   six small anteriorly-directed projections (one dorsal, one ventral and four lateral in position).
225   Pharynx muscular, gradually widening posteriorly from posterior to buccal cavity and ending in
226   an oval posterior bulb; pharyngeal lumen cuticularized from posterior to buccal cavity and most
227   thickly cuticularized within posterior pharyngeal bulb. Nerve ring located slightly posterior to
228   middle of pharynx length. Cardia small, 8 µm long, embedded within intestine. Secretory-
229   excretory system with slightly cuticularized pore located posterior to nerve ring and small
230   ampulla; four pairs of medium to large glands with clear cytoplasm located on each side of
231   intestine, up to 33 x 16 µm, starting from ca. 1-2 cbd posterior to pharynx, followed by two pairs
232   of glands with more opaque cytoplasm immediately posteriorly, each gland with duct extending
233   anteriorly.

234   Reproductive system with two anteriorly directed testes, anterior testis outsretched, 430

235 µm long, located to the right of intestine, posterior testis reflexed, 180 µm long, located ventrally

236 relative to intestine. Mature sperm cells globular, dimorphic; 14-20 × 11-15 µm in anterior testis,

237 6-7 × 4-5 µm in posterior testis. Spicules paired, equal, 1.7 cloacal body diameters long, strongly

238 ventrally curved and narrowing distally, with well-developed capitulum; gubernaculum strongly

239 cuticularized with triangular, dorsocaudally directed apophyses. Twenty tubular precloacal

240 supplements, ca. 22 µm long, swollen proximally and with bifid tip, each connected to a gland

241 near proximal end and extending anteriorly; posterior group of nine supplements situated

242 gradually further apart anteriorly (19-52 µm distance), posterior group of ten supplements more

243 or less equidistant from each other (39-53 µm distance), and single supplement located between

244 the posterior and anterior groups of supplements. Precloacal seta present. Tail conical, curved

245 ventrally, with three caudal glands and well-developed spinneret.

246   Female. Similar to male, but with lower 'a' ratio and smaller amphid. Reproductive

247 system with two opposed, reflexed ovaries; anterior ovary situated to the right of intestine and

248 posterior ovary situated to the left of intestine. Spermathecae not observed. Vulva situated

249 slightly posterior to mid-body. Vagina straight, with thick cuticle, two vaginal glands present.

250 Thin cuticularisation centred at level of vulva and perpendicular to vagina, ca. 1 vulval body

251 diameter long. Sphincter muscle not observed. Supplements absent.

252   Juveniles. Similar to female but body slightly shorter and 'c′′' ratio slightly lower. Genital

253 primordium present.

254   **Diagnosis:** *Lavareda iramscotti* sp. nov. is characterised by adult body length 3023-3121

255 µm, eight longitudinal rows of body pores each with a short papilla, cephalic setae 4-5 µm or

256 0.4-0.5 cbd long, tail 146-165 µm or 5.2-5.3 cloacal/anal body diameters long, male with

257 spicules 54 µm or 1.7 cbd long, gubernaculum with triangular apophyses, 20 precloacal

258 supplements with bifid distal tips arranged in 9+1+10 pattern, female with vulva at 55% of body

259 length from anterior and cuticularisation perpendicular to vagina at level of vulva.

260   **Differential diagnosis:** The new species differs from the two other *Lavareda* species, *L.*

261 *coronatus* (Ditlevsen, 1930) da Fonsêca-Genevois, Smol & Bezerra, 2011 and *L. decraemerae*,

262 by the presence of longitudinal rows of body pores (*versus* pores absent in *L. coronatus* and *L.*

263   *decreamerae*). Additional differences between the male of *L. iramscotti* sp. nov. and *L.*

264   *decraemerae* are: greater body length (3.0 *versus* 2.5 mm in *L. decraemerae*), shorter cephalic

265   setae (4-5 *versus* 9 μm in *L. decraemerae*), absence of cervical setae (*versus* eight cervical setae

266   in *L. decraemerae*), longer spicules (54 *versus* 30 μm in *L. decraemerae*), and number and

267   arrangement of precloacal supplements (20 supplements in 9+1+10 arrangement *versus* 19

268   supplements in continuous row in *L. decraemerae*). Furthermore, the secretory-excretory system

269   in *L. decraemerae* comprises five glands, two of which are located on the right of the intestine

270   and three on the left side of the intestine; *Lavareda iramscotti* sp. nov. is characterised by an

271   secretory-excretory system with ten glands, five located on either side of the intestine. *Lavareda*

272   *iramscotti* sp. nov. can be differentiated from *L. coronatus* by the higher 'a' ratio (104 *versus* 63

273   in *L. coronatus*), higher 'b' ratio (17 *versus* 14 in *L. coronatus*), lower 'c' ratio (18 *versus* 24 in

274   *L. coronatus*), presence of cephalic setae (*versus* absent in *L. coronatus*), longer tail (165 *versus*

275   114 μm in *L. coronatus*), male reproductive system with two testes (*versus* one testis in *L.*

276   *coronatus*), presence of precloacal seta (*versus* absent in *L. coronatus*), and arrangement of

277   precloacal supplements (9+1+10 *versus* 9+11 arrangement in *L. coronatus*).

278   **Etymology:** The species name is an arbitrary combination of letters (ICNZ Article 11.3)

279   which also acknowledges my colleague Scott Nodder, who owing to his persistence and bloody-

280   mindedness (the latin *ira* translates to wrath, anger, fury), managed to obtain the large number of

281   sediment cores required for my postdoctoral research.

282

283   Discussion

284   The present study provides the first record and description of a *Lavareda* female. *Lavareda*

285   *iramscotti* sp. nov. females are characterized by two reflexed genital branches, as in the closely-

286   related genus *Rhadinema* Cobb, 1920 and like the majority of other plectid taxa. The new species

287   does not exhibit pronounced sexual dimorphism in features such as the buccal cavity, amphids,

288   or tail. The diagnosis of the genus was modified to take into account the presence of body pores

289   and epidermal glands in both sexes of the new species.

290   *Lavareda coronatus* was described from ca. 64 m water depth in the Colville Channel

291   (Hauraki Gulf), North Island of New Zealand. *Lavareda iramscotti* sp. nov., also described from

292   a New Zealand locality though from greater depth and further south, shows some close

293 similarities with *L. coronatus* in the structure and size of the amphids and spicular apparatus, and
294 both species have the same number of precloacal supplements. Some of the features of *L.*
295 *coronatus* which differ from the new species, i.e., the apparent absence of body pores, cephalic
296 setae, and precloacal seta in *L. coronatus*, may conceivably be the result of poor specimen
297 condition (e.g., broken cephalic setae) or may have been missed in the original description.
298 However, given the additional differences between Ditlevsen's and my male specimens, notably
299 in the 'a', 'b', and 'c' ratios, arrangement of the precloacal supplements, and number of testes, I
300 consider it most likely that the two species are indeed different, even though they belong to a rare
301 genus and were both described from New Zealand localities.

302

Conclusions

304 The present study provides the first record of a *Leptolaimus* species from the New Zealand
305 region and the first description of a female specimen of the genus *Lavareda*. At least a dozen
306 additional, yet to be described *Leptolaimus* species inhabit continental slope environments of
307 New Zealand (D. Leduc, unpublished data). Further research is needed to better characterise the
308 diversity of this genus as well as that of other plectid nematodes across the region's seabed
309 habitats.

310

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315

References

317 Alekseev VM., Rassadnikova IV. 1977. A new species and taxonomic analysis of the genus
318   Leptolaimus (Nematoda, Araeolaimida). *Zoologicheskii Zhurnal* **56**:1766–1774 [in Russian]
319
320 Alekseev VM. 1979. Evolution of supplementary organs in nematodes *Leptolaimus* and
321   establishment of the genus *Boveelaimus* (Nematoda, Leptolaimidae). *Zoologicheskii Zhurnal*
322   **58**:1296–1301 [in Russian]
323

324 Allgén CA. 1927. Freilebende marine Nematoden von der Küste Tasmaniens. *Zoologischer*
325   *Anzeiger* **9**:197–217
326

327 Allgén C.A. 1932. Weitere Beiträge zur Kenntnis der marinen Nematodenfauna der
328   Campbellinsel. *Nyt Magazin for Naturvidenskaberne* **70**:97–198
329

330 Cobb NA. 1914. The North American free-living fresh-water nematodes. *Transactions of the*
331   *American Microscopical Society* **33**:69–119
332

333 Cobb NA. 1920. One hundred new nemas (type species of 100 new genera). *Contributions to a*
334   *Science of Nematology* **9**:217–343
335

336 Coomans A. 1979. Addendum I. A proposal for a more precise terminology of the body regions
337   in the nematode. *Annales de la Societee Royale Zoologique de Belgique* **108**:115–117.
338

339 da Fonsêca-Genevois V, Smol N, Bezerra TN. 2011. Free-living nematodes from a colonization
340   experiment in the upwelling area of Arraial do Cabo, Rio de Janeiro, Brazil: *Lavareda*
341   *decraemerae* gen. n., sp. n. and emended diagnosis of *Cricolaimus* Southern, 1914 (Plectida:
342   Rhadinematidae). *Nematology* **13**:761–772
343

344 de Man JG. 1876. Onderzoekingen over vrij in de aarde levende Nematoden. *Tijdschrift*
345   *Nederlandsche Dierkundig Vereeiging* **2**:78–196
346

347 Ditlevsen H. 1930. Marine free-living Nematodes from New Zealand. (Papers from Dr. Th.
348   Mortensen's Pacific Expedition 1914 - 16). *Videnskabelige Meddelelser fra Dansk*
349   *naturhistorisk Forening i Kjøbenhavn* **87**:201–242
350

351 Gadea E. 1973. Sobre la filogenia interna de los nematodos. *Publicación del Instituto de*
352   *Biologiá Aplicada* **54**:87–92
353

354 Holovachov O., Boström S. 2013. Swedish Plectida (Nematoda). Part 4. The genus *Leptolaimus*
355   de Man, 1876. *Zootaxa* **3739**:1–99
356

357 Holovachov O. 2014. Order Plectida Gadea, 1973. Pp. 487–535 in: Schmidt-Rhaesa A. ed.
358   *Handbook of Zoology* Volume 2: Nematoda. Hamburg: De Gruyter, xv + 759 pp.
359

360 Holovachov O., Boström, S. 2014. Swedish Plectida (Nematoda). Part 5. *Rhadinema timmi*
361   (Vitiello, 1971) comb. n. *Zootaxa* **3779**:477–486
362

363 Leduc D. 2012. Deep-sea nematodes (Comesomatidae) from the Southwest Pacific Ocean: five
         new species and three new species records. *European Journal of Taxonomy* **24**:1–42

364

365 Leduc D, Wilson J. 2016. Benthimermithid nematode parasites of the amphipod *Hirondellea*
366   *dubia* in the Kermadec Trench. *Parasitology Research* **115**:1675–1682

367

368 Leduc D. 2020. A new nematode species, *Chromadorina tangaroa* sp. nov. (Chromadorida:
369   Chromadoridae) from the hull of a research vessel, New Zealand. *PeerJ* **8**:e9233

370

371 Örley L. 1880. Monographie der Anguilluliden. *Természetrajzi Füzetek* **4**:1–165.

372

373 Qiao C., Jia S., Huang Y. 2020. *Leptolaimus holovachovi* sp. nov. (Nematoda) from Shenzhen
374   Mangrove Nature Reserve, Shenzhen, South China. Journal of Oceanology and Limnology.

375

376 Somerfield PJ, Warwick RM. 1996. *Meiofauna in Marine Pollution Monitoring Programmes: a*
377   *Laboratory Manual.* Lowestoft: Ministry of Agriculture, Fisheries and Food.

378

379 Southern R. 1914. Nemathelmaia, Kinorhyncha, and Chaetognatha (Clare Island Survey, Part
380   54). *Proceedings of the Royal Irish Academy* **31**:1–80

381

382 Steiner G. 1916. Freilebende Nematoden aus der Barentssee. *Zoologische Jahrbücher* **39**:511–
383   664.

384

385 Tchesunov AV. 2015. Free-living nematode species (Nematoda) dwelling in hydrothermal sites
386   of the North Mid-Atlantic Ridge. *Helgoland Marine Research* **69**:343–384

387

388 Vitiello P. 1971. Espèces nouvelles de Leptolaimidae (Nematoda) et description du genre
389   *Leptolaimoides* n. gen. *Cahiers de Biologie Marine* **12**:419–432

390

391 **Figure captions.**

392 **Figure 1. *Leptolaimus dififtinus* sp. nov.** A & C: Anterior body region of male; B: anterior body
393 region of female; D: posterior body region of female; E posterior body region of male. Scale bar:
394 A, B, C & D = 20 μm, E = 25 μm.

395 **Figure 2. *Leptolaimus dififtinus* sp. nov.** A: Entire male; B: entire female. Scale bar: A = 25
396 μm, B = 20 μm.

397 **Figure 3. *Leptolaimus dififtinus* sp. nov. light micrographs.** A: Optical cross section of entire
398 female; B: surface view of female; C: optical cross-section of entire male; D: surface view of
399 entire male. Scale bar = 20 μm.

400 **Figure 4. *Leptolaimus dififtinus* sp. nov. light micrographs of male.** A: Optical cross-section
401 of pharyngeal region; B: surface view of cephalic region; C: optical cross-section of precloacal
402 supplements; D: tail. Scale bar: A & B = 10 μm, C & D = 11 μm.

403 **Figure 5. *Lavareda iramscotti* sp. nov.** A: Anterior body region of male; B: female cephalic
404 region; C: juvenile cephalic region; D: male cephalic region; E: male posterior body region; F:
405 female anterior body region; G: female posterior body region. Scale bar: A = 50 μm, B, C & D =
406 20 μm, E = 45 μm, F = 60 μm, G = 40 μm.

407 **Figure 6. *Lavareda iramscotti* sp. nov.** A: Entire male; B: female reproductive system. Scale
408 bar: A = 75 μm, B = 185 μm.

409 **Figure 7. *Lavareda iramscotti* sp. nov. light micrographs of male.** A: Lateral surface view of
410 anterior body region; B: optical cross-section of anterior body region; C: precloacal supplement;
411 D: copulatory apparatus; E: tail tip and spinneret. Scale bar: A & B = 10 μm, C & E = 12 μm, D
412 =14 μm.

413

Morphometrics (m m) of *Leptolaimus dififtinus* sp. nov. and*Lavareda iramscotti* sp. nov.

Morphometrics (m m) of *Leptolaimus dififtinus* sp. nov. and *Lavareda iramscotti* sp. nov. a, body length/maximum body diameter; b, body length/pharynx length; c, body length/tail length; c', tail length/anal or cloacal body diameter; cbd, corresponding body diameter; L, total body length; n, number of specimens; V, vulva distance from anterior end of body; %V, V/total body length × 100

1 **Table 1**. Morphometrics (μm) of *Leptolaimus dififtinus* sp. nov. and *Lavareda iramscotti* sp. nov. a, body length/maximum body
2 diameter; b, body length/pharynx length; c, body length/tail length; c', tail length/anal or cloacal body diameter; cbd, corresponding
3 body diameter; L, total body length; n, number of specimens; V, vulva distance from anterior end of body; %V, V/total body length ×
4 100
5

| | *Leptolaimus dififtinus* sp. nov. | | *Lavareda iramscotti* sp. nov. | | | |
| | Male | Female | Male | Female | Juvenile 1 | Juvenile 2 |
	Holotype	Paratype	Holotype	Paratype	Paratype	Paratype
L	430	319	3023	3121	2491	2846
a	20	12	104	82	92	66
b	4	4	17	17	16	15
c	8	8	18	21	19	19
c'	3.4	2.9	5.3	5.2	5.1	5.0
Head diam. at cephalic setae	5	5	10	11	11	11
Head diam. at amphids	8	7	18	20	18	20
Length of cephalic setae	1.3-1.4	1.3	4.5	4.4	5.5	4.5
Amphid height	4	3	8	7	8	9
Amphid width	4	4	9	8	8	7
Amphid width/cbd (%)	50	57	50	40	44	45
Amphid from anterior end	9	4	21	19	18	21
First body pore from anterior	24	22	40	36	36	39
Lateral alae from anterior	24	33	-	-	-	-
Buccal cavity length	41	34	28	30	26	29
Nerve ring from anterior end	67	52	94	84	82	82
Nerve ring cbd	20	18	26	29	29	34
Pharynx length	110	90	176	181	160	185
Pharyngeal bulb length	19	17	28	31	25	32
Pharyngeal bulb diam.	13	16	17	20	19	23
Pharynx cbd	22	20	29	34	32	38
Max. body diam.	22	27	29	38	27	43
Spicule length	24	-	54	-	-	-
Gubernaculum length	4	-	11	-	-	-
Cloacal/anal body diam.	17	13	31	28	25	30
Tail length	57	38	165	146	128	150
V	-	174	-	1725	-	-
%V	-	55	-	55	-	-
Vulval body diam.	-	26	-	35	-	-

Figure 1

Leptolaimus dififtinus **sp. nov.** Drawings.

Leptolaimus dififtinus **sp. nov.** A & C: Anterior body region of male; B: anterior body region of female; D: posterior body region of female; E posterior body region of male. Scale bar: A, B, C & D = 20 m m, E = 25 m m.
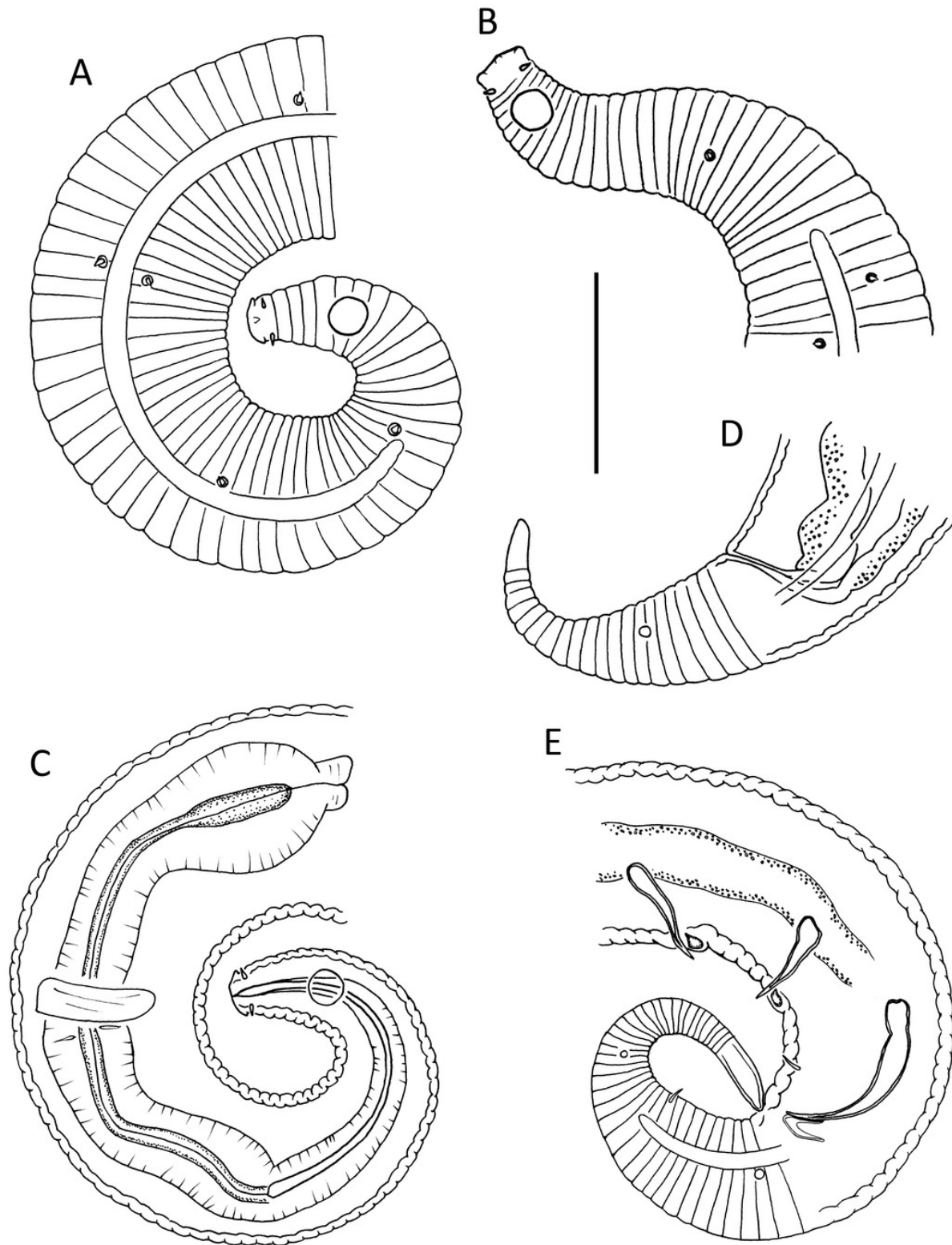
Figure 2

Figure 2. *Leptolaimusdififtinus* sp. nov. Drawings.

***Leptolaimus dififtinus* sp. nov.** A: Entire male; B: entire female. Scale bar: A = 25 m m, B = 20 m m.
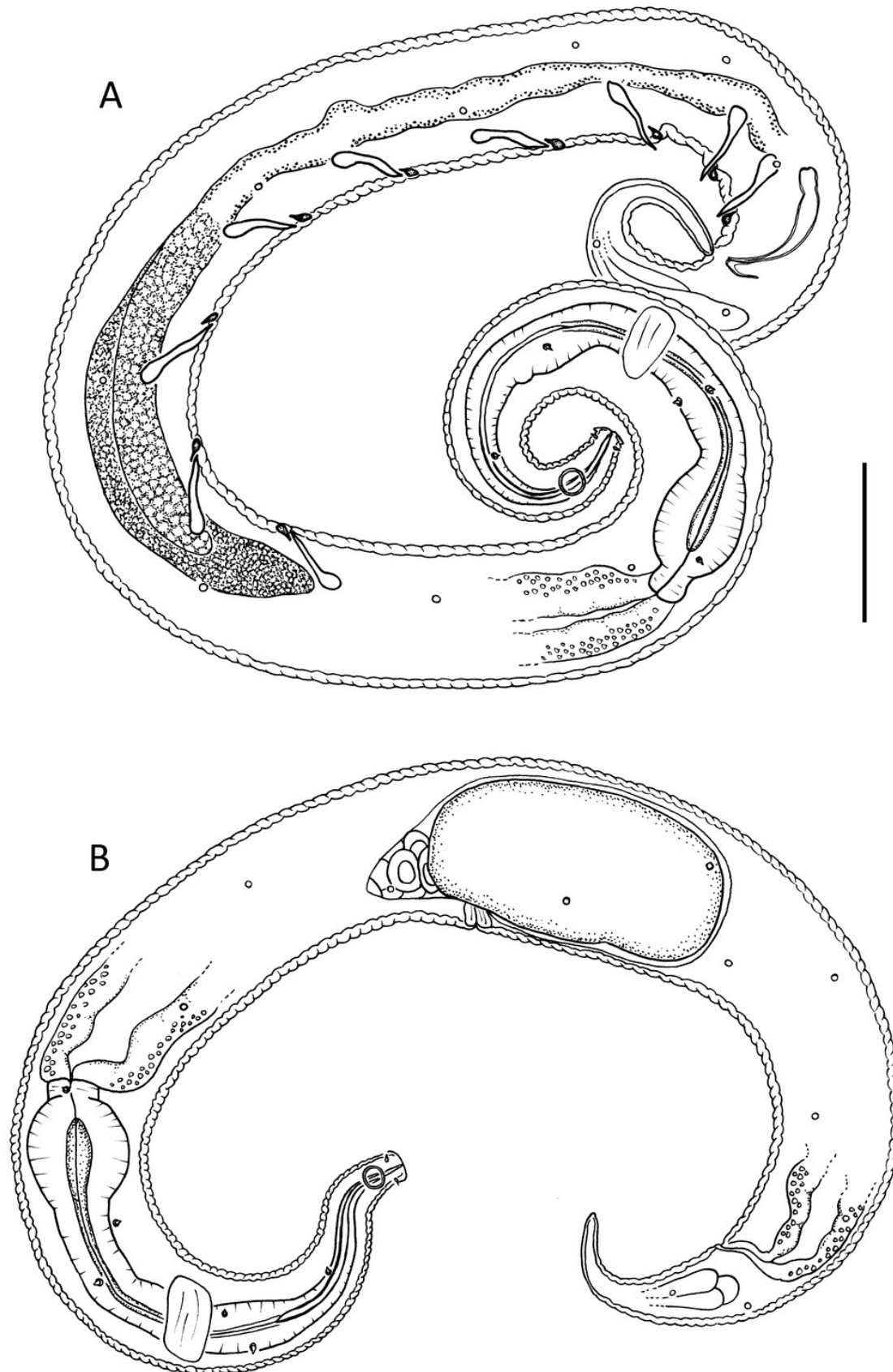
Figure 3

Leptolaimus dififtinus sp. nov. light micrographs.

Leptolaimus dififtinus sp. nov. light micrographs. A: Optical cross section of entire female; B: surface view of female; C: optical cross-section of entire male; D: surface view of entire male. Scale bar = 20 microns.
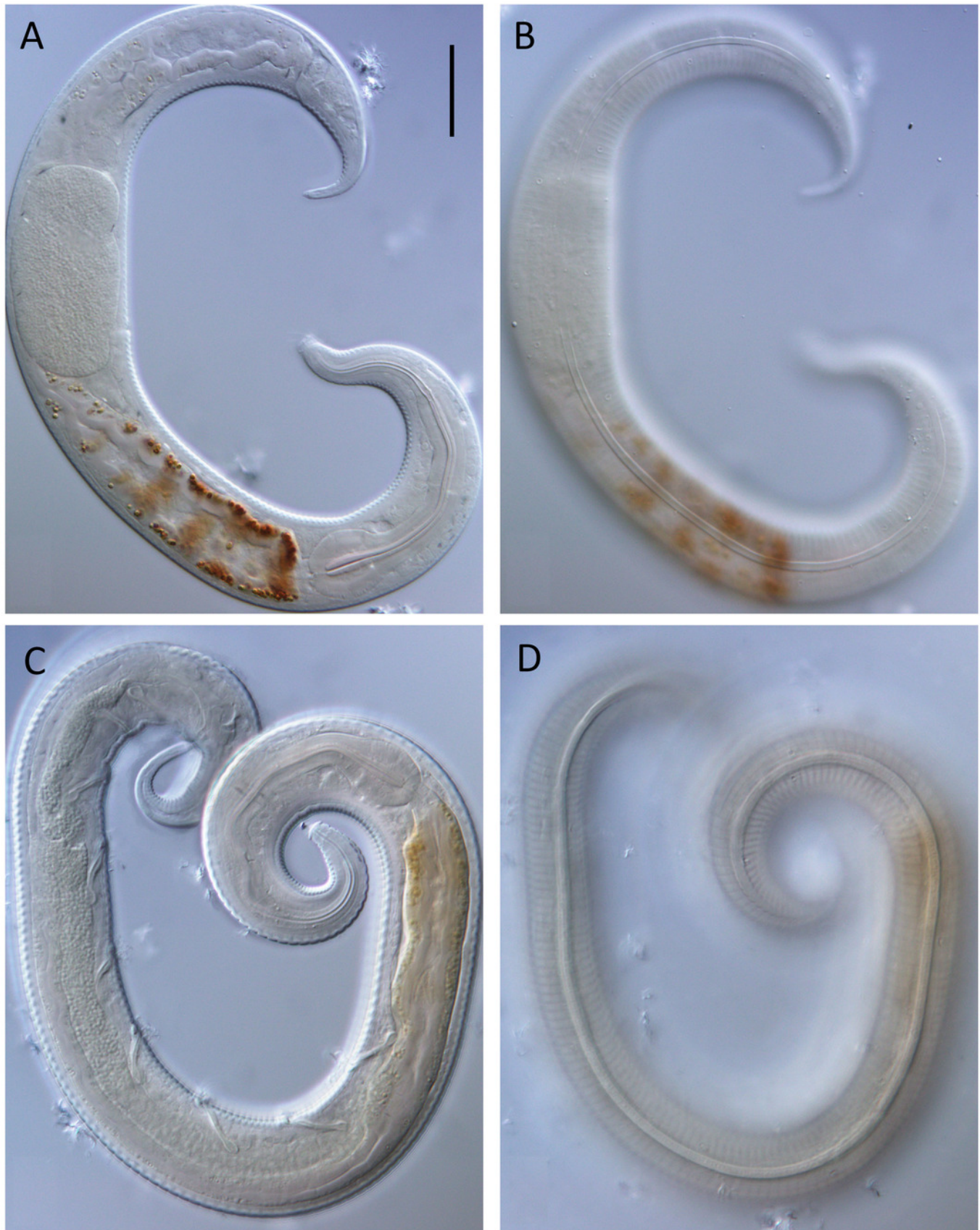
Figure 4

Leptolaimus dififtinus sp. nov. light micrographs.

Leptolaimus dififtinus sp. nov. light micrographs of male. A: Optical cross-section of pharyngeal region; B: surface view of cephalic region; C: optical cross-section of precloacal supplements; D: tail. Scale bar: A & B = 10 microns , C & D = 11 microns .
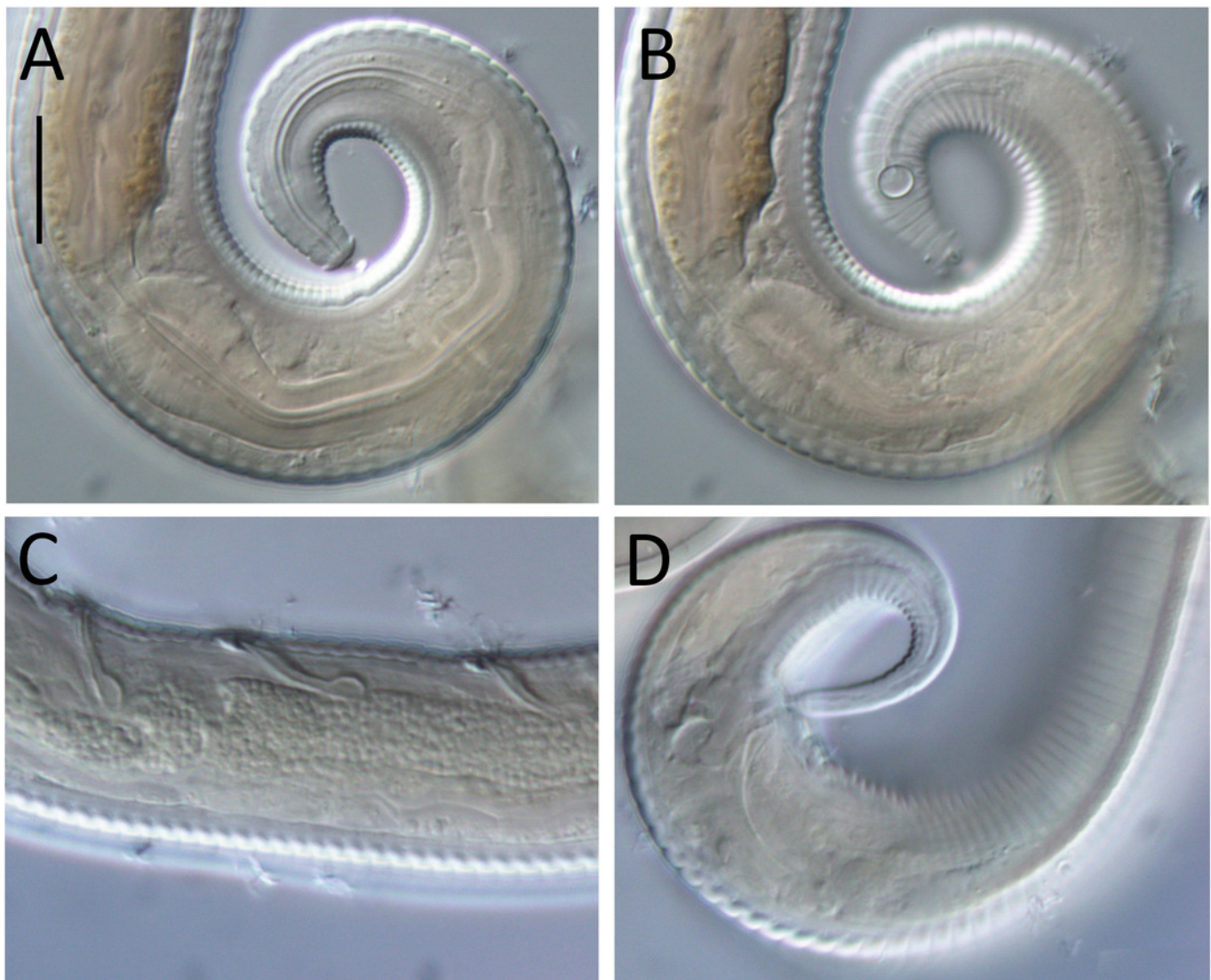
Figure 5

Lavareda iramscotti **sp. nov.** Drawings.

Lavareda iramscotti **sp. nov.** A: Anterior body region of male; B: female cephalic region; C: juvenile cephalic region; D: male cephalic region; E: male posterior body region; F: female anterior body region; G: female posterior body region. Scale bar: A = 50 m m, B, C & D = 20 m m, E = 45 m m, F = 60 m m, G = 40 m m.
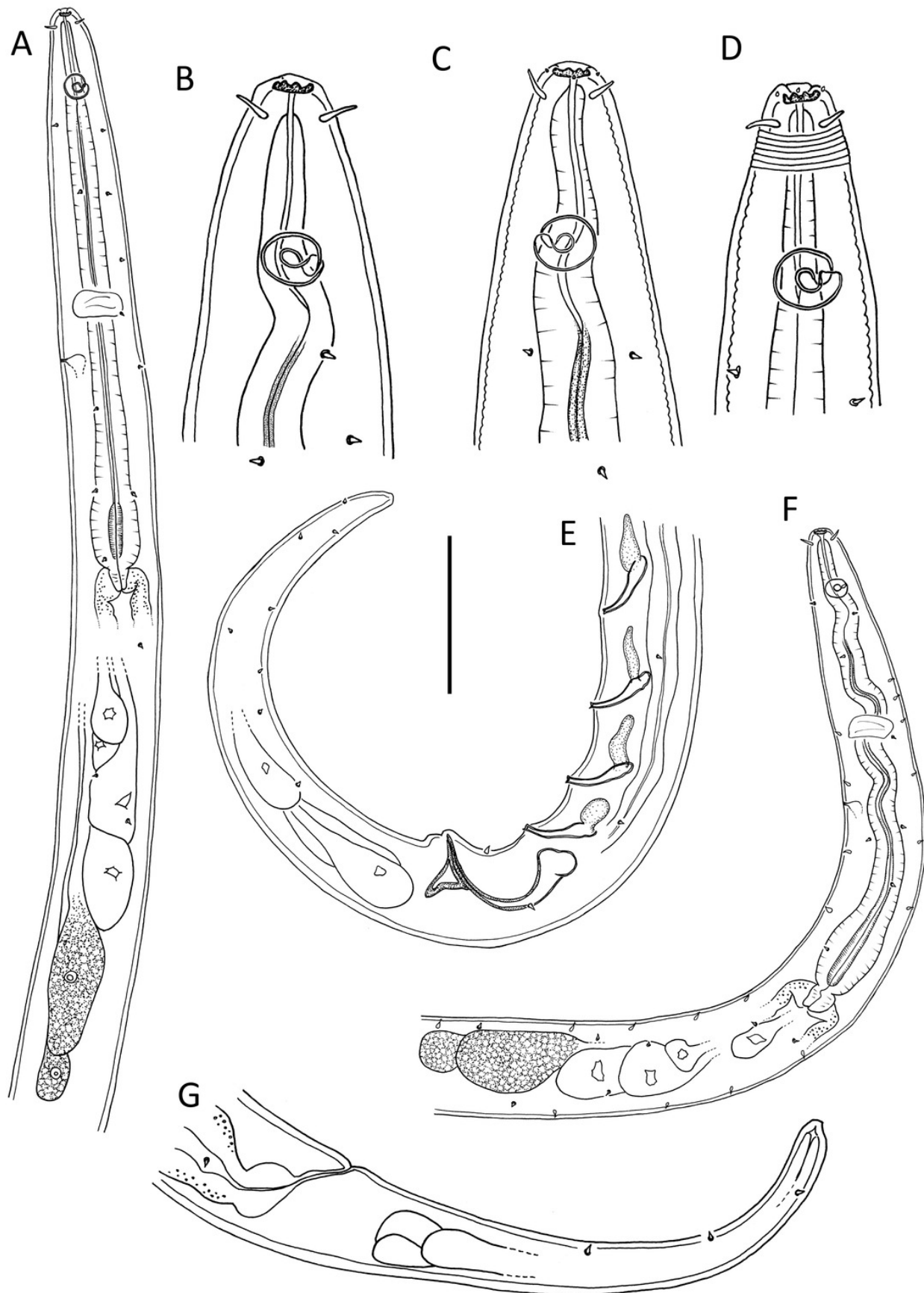
Figure 6

***Lavaredairamscotti* sp. nov.** Drawings.

***Lavareda iramscotti* sp. nov.** A: Entire male; B: female reproductive system. Scale bar: A = 75 m m, B = 185 m m.

A

B
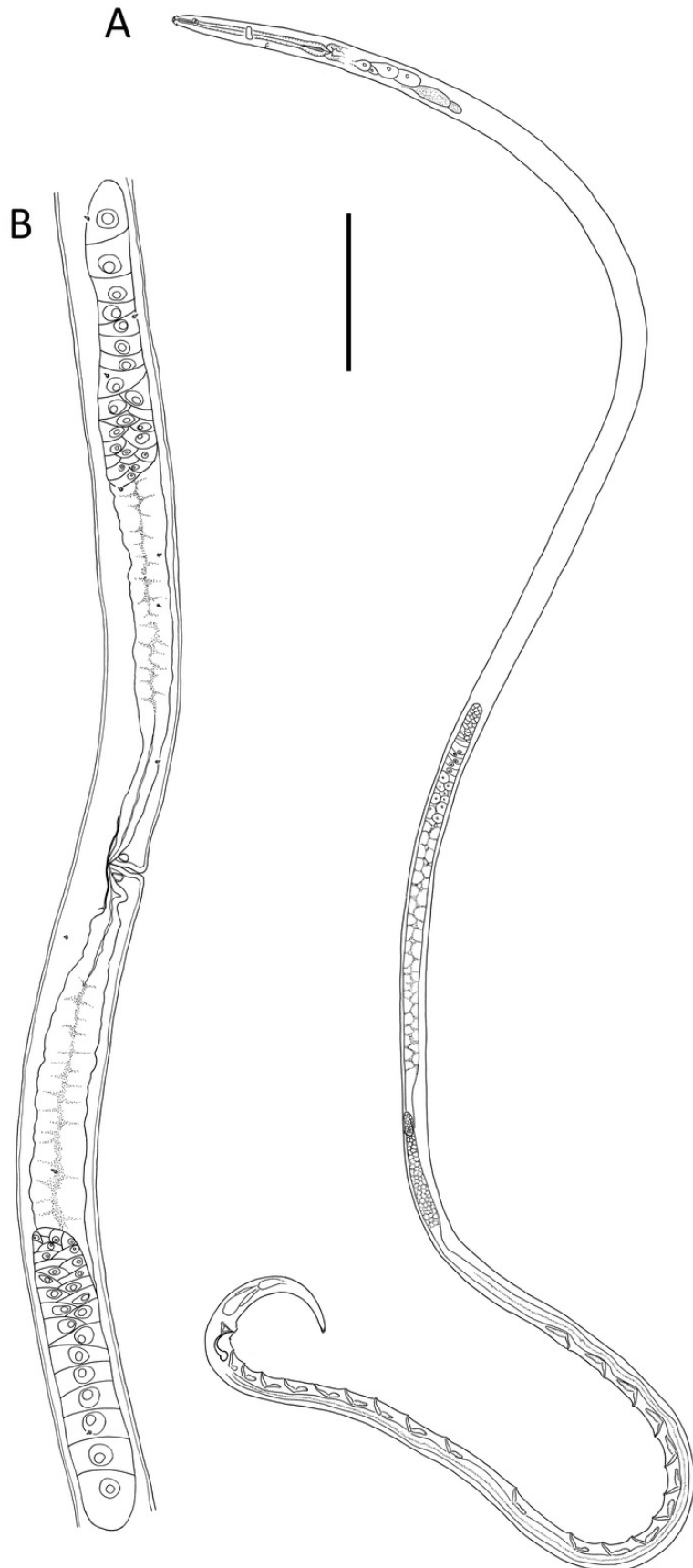
Figure 7

***Lavareda iramscotti* sp. nov. light micrographs ofmale.**

***Lavareda iramscotti* sp. nov. light micrographs of male.** A: Lateral surface view of anterior body region; B: optical cross-section of anterior body region; C: precloacal supplement; D: copulatory apparatus; E: tail tip and spinneret. Scale bar: A & B = 10 m m, C & E = 12 m m, D =14 m m.