

A revision of the New Zealand landsnails referred to *Allodiscus* Pilsbry, 1892 and *Pseudallodiscus* Climo, 1971, with the introduction of three new genera (Mollusca: Gastropoda: Charopidae)

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ABSTRACT: The New Zealand species referred to *Allodiscus* Pilsbry, 1892 during the last 60 years are evaluated. A total of 60 species are recognised, of which 37 are described as new. The taxa are described, they are illustrated by colour photographs and scanning electron microscope images, their distributions are described and mapped, and their biology and conservation are briefly discussed. *Pseudallodiscus tataensis* Climo, 1971 is referred to *Allodiscus* [*s. lat.*]. Three new genera are introduced: *Granallodiscus* (for *Helix granum* L. Pfeiffer, 1857 and two new species), *Costallodiscus* (for three new species) and *Canallodiscus* (for *Allodiscus fectoloides* Dell, 1955, *Phelussa elliottae* Gardner, 1968 and a new species). *Hirsutodiscus* Climo, 1971 is elevated to generic status. Lectotypes are designated for *Helix dimorpha* Reeve, 1852, *Pitys cryptobidens* Suter, 1891, *Helix venulata* L. Pfeiffer, 1857, *Nanina tullia* Gray, 1850 and *Psyra godeti* Suter, 1891. Neotypes are designated for *Helix granum* L. Pfeiffer, 1857 and *Charopa miranda* Hutton, 1883.

KEYWORDS: Mollusca, Gastropoda, Charopidae, *Allodiscus*, *Pseudallodiscus*, *Granallodiscus*, *Costallodiscus*, *Canallodiscus*, *Hirsutodiscus*, revision, taxonomy, distribution, new taxa, new combinations, lectotypes, neotypes.

Introduction

New Zealand has a diverse landsnail fauna. Barker (2005) estimated that at least 450 New Zealand species-level taxa in the family Charopidae are represented in collections, of which only 210 have been formally described. Spencer *et al.* (in press) tabulated 207 described and 167 undescribed charopids in their checklist to New Zealand Mollusca. Many charopids are considered of conservation concern (Hitchmough *et al.* 2007). However, for many groups in the New Zealand Charopidae, proper assessment of conservation status has been hindered by the lack of modern systematic treatment and the absence of formal taxonomy of many

recognised but presently undescribed species. This paper addresses the systematics of New Zealand landsnails, including a number of undescribed species, presently assigned to the charopid genus *Allodiscus* Pilsbry, 1892 (type species *Helix dimorpha* Reeve, 1852).

Allodiscus was founded for New Zealand species, but it has also been applied to New Caledonian and Australian material. Franc (1957) treated the New Caledonian *Platyrhytida* Pilsbry, 1894 (type species *Helix saisseti* Gassies, 1860) as a subgenus of *Allodiscus*. However, Solem (1961) recognised conchological differences between *Allodiscus* and *Platyrhytida*, and accordingly treated the latter at genus level. Suter (1913) suggested a possible close relationship to

Monomphalus Ancey, 1882 from New Caledonia (type species *Helix rossiterianus* Crosse, 1871), based on conchological features, but this genus has subsequently been shown (Schileyko 2001; Starmühlner 1970) to differ anatomically from *Allodiscus*. The Victorian species *Allodiscus cannfluviatilus* Gabriel, 1929 and *A. marysvillensis* Gabriel, 1947 are presently classified in *Oreomava* Kershaw, 1956 and *Pillomena* Iredale, 1937, respectively (see Smith 1992). Thus, *Allodiscus* is evidently a New Zealand endemic genus.

Since the inception of the genus, a total of 29 New Zealand species-group names have hitherto been erected in *Allodiscus* or secondarily assigned to the genus. Over the past 50 years, there has been a gradual evolution in the concept of *Allodiscus*. First, Cumber (1961) transferred *Flammulina* (*Allodiscus*) *tholoides* Suter, 1907 to *Phenacohelix* Suter, 1892 (type species *Helix pilula* Reeve, 1852). Then Climo (1971a) erected the monotypic subgenus *Hirsutodiscus* for *Allodiscus* (*Hirsutodiscus*) *rakiura* Climo, 1971, on the basis of smooth, glossy protoconch and hair-like processes on the axial ribs of the teleoconch. Here, we elevate *Hirsutodiscus* to generic status.

Climo (1971a) introduced *Pseudallodiscus* (type species *Pseudallodiscus ponderi* Climo, 1971) for three small snails with *Allodiscus* characters but differing in the reproductive system and radular dentition. However, Climo (1981) subsequently transferred *Pseudallodiscus spelaeus* Climo, 1971 to *Mocella* Iredale, 1915 (type species *Helix corniculum* Reeve, 1852). In the present contribution, we assign *Pseudallodiscus tataensis* Climo, 1971 to *Allodiscus*. With these transfers, *Pseudallodiscus* is secondarily monotypic and we have taken the opportunity to redefine the genus.

Most recently, Climo & Mahlfeld (1998) reassigned four species formerly referred to *Allodiscus*. *Charopa planulata* Hutton, 1883 (misapplied to a number of species of *Allodiscus s. lat.*), *Allodiscus rusticus* Suter, 1894, and *Flammulina* (*Allodiscus*) *mossi* Murdoch, 1897 were assigned to *Chaureopa* Climo, 1985 (type species *Chaureopa depressa* Climo, 1985). *Allodiscus stewartensis* David, 1934 was assigned to *Phacussa* Hutton, 1883 (type species *Zonites helmsi* Hutton, 1883).

Materials and methods

In the absence of preserved animal material, we have necessarily based this revision primarily on conchological features. In the descriptions we refer, where available, to anatomical information provided by previous authors, including Hutton

(1884a), Suter (1913), Gardner (1968), Climo (1969b, 1971a) and Schileyko (2001). We erect several conchological form groups in *Allodiscus*, corresponding to *Allodiscus s. str.* and several groupings in *Allodiscus s. lat.* Diagnoses are provided for each as an aid to any subsequent revision, but demonstration that these form groups represent monophyletic clades must await molecular genetic studies. Full synonymies are provided for all taxa recognised, inclusive of all literature records in unrefereed checklists, shell club articles and unpublished handouts.

All measurements were performed with a microscope eyepiece graticule. In cited dimensions in plate captions, height dimension precedes width. The method for counting the number of protoconch whorls follows Warén (e.g. 1992) (Fig. 2A). Selected specimens were photographed in colour using automontage software, and some of these and others were subsequently prepared and mounted, then carbon and gold/palladium coated and illustrated by scanning electron microscopy.

Unless preceded by the acronyms AIM, BMNH or CM, all material examined (2962 lots, which includes material additional to that recorded herein) is at NMNZ (registration numbers preceded by 'M.'). All examined material is plotted on distribution maps. Full locality information is provided for primary type material only. All locality information for examined material is stored with full data in Te Papa's database (KE EMu) and is also available on the Global Biodiversity Information Facility (GBIF) website. The bulk of the material was collected by Pauline Mayhill (845 lots), David Roscoe (660 lots), Frank Climo (318 lots) and Bruce Hazelwood (203 lots).

Information about biology and macroecology was derived from specimen labels, geographic information systems (GIS) databases and expert knowledge. We have provided comments on the conservation status of all species, with reference to previous assessments by McGuinness (2001), Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007), the latter three based on the nationally agreed standard classification criteria of Molloy *et al.* (2002). For all taxa, including those recognised for the first time, we have provided our own assessments of conservation status using the Molloy *et al.* (2002) criteria.

Abbreviations used in the text

AIM – Auckland Institute and Museum, Auckland
 BMNH – The Natural History Museum, London
 CM – Canterbury Museum, Christchurch

NMNZ – Museum of New Zealand Te Papa Tongarewa,
Wellington

NZMS 260 – New Zealand Map Series metric grid reference
(Infomap: New Zealand Department of Survey and Land
Information)

HWR – Shell height/width ratio

SH – Shell height

SW – Shell width

Index to taxa

<i>abaxoides</i> 141	<i>maybillae</i> 147
<i>absidatus</i> 125	<i>miranda</i> 145
<i>adriana</i> 80	<i>mirificus</i> 108
<i>albinus</i> 85	<i>morioria</i> 119
<i>Allodiscus</i> 59	<i>negiae</i> 103
<i>alloia</i> 132	<i>occidaneus</i> 129
<i>aurora</i> 109	<i>pallidus</i> 135
<i>austrorodimorphus</i> 110	<i>parrishi</i> 153
<i>basiliratus</i> 126	<i>patulus</i> 108
<i>brooki</i> 127	<i>pegasus</i> 153
<i>camelinus</i> 61	<i>planulatus</i> 58
<i>Canallodiscus</i> 155	<i>ponderi</i> 150
<i>cassandra</i> 64	<i>Pseudallodiscus</i> 149
Charopidae 59	<i>pumilus</i> 73
<i>chion</i> 111	<i>punakaiki</i> 104
<i>climoi</i> 96	<i>pygmaeus</i> 120
<i>conopeus</i> 66	<i>rakiura</i> 149
<i>cooperi</i> 67	Rotadiscinae 136
<i>Costallodiscus</i> 152	<i>smithi</i> 80
<i>cryptobidens</i> 106	<i>southlandicus</i> 84
<i>dimorphus</i> 70	<i>spiritus</i> 74
<i>elliottae</i> 156	<i>tataensis</i> 104
<i>ergodes</i> 101	<i>tawhiti</i> 121
<i>erua</i> 136	<i>tessellatus</i> 122
<i>fallax</i> 72	<i>tongariro</i> 105
<i>fectoloides</i> 156	<i>tullia</i> 85
<i>godeti</i> 107	<i>turbotti</i> 77
<i>goulstonei</i> 114	<i>undulatus</i> 137
<i>Granallodiscus</i> 140	<i>urquharti</i> 132
<i>granum</i> 145	<i>venulatus</i> 75
<i>hazelwoodi</i> 127	<i>wairarapa</i> 91
<i>Hirsutodiscus</i> 148	<i>wairoaensis</i> 92
<i>kaikoura</i> 152	<i>wairua</i> 134
<i>kakano</i> 115	<i>waitomo</i> 93
<i>karamea</i> 157	<i>waitutu</i> 137
<i>laganus</i> 101	<i>worthyi</i> 123
<i>mahlfeldae</i> 83	<i>yaldwyni</i> 94

Systematics

Superfamily PUNCTOIDEA Morse, 1864

Family CHAROPIDAE Hutton, 1884

Genus *Allodiscus* Pilsbry, 1892

Psyra Hutton, 1883b: 532. Type species *Helix venulata* L. Pfeiffer, 1857, by original designation and monotypy. (Not *Psyra* Stal, 1876 in Orthoptera.)

Allodiscus Pilsbry, 1892a: 56. Type species *Helix dimorpha* Reeve, 1852, by original designation; Recent, New Zealand.

Charopa as applied by various authors. (Not *Charopa* Albers & Martens, 1860: 87. Type species *Helix coma* Gray, 1843, by original designation; Charopidae.)

Endodonta as applied by various authors to New Zealand material. (Not *Endodonta* Albers, 1850. Type species *Helix lamellosa* Férussac, 1824, by subsequent designation of Albers & Martens, 1860; Endodontidae.)

Flammulina as applied by various authors. (Not *Flammulina* Martens, 1873: 12. Type species *Vitrina zebra* Le Guillou, 1842, by subsequent designation of Pilsbry, 1893; Charopidae.)

Fruticicola as applied by various authors to New Zealand material. (Not *Fruticicola* Held, 1838: 914. Type species *Helix fruticum* Müller, 1774, by subsequent designation of Herrmannsen, 1846; Bradybaenidae.)

Gerontia as applied by various authors. (Not *Gerontia* Hutton, 1882: 281. Type species *Gerontia pantherina* Hutton, 1882, by monotypy; Charopidae.)

Helix as applied by various authors to New Zealand material. (Not *Helix* Linnaeus, 1758: 768. Type species *Helix pomatia* Linnaeus, 1758, ICZN Opinion 94, 1926; Helicidae.)

Nanina as applied by various authors to New Zealand material. (Not *Nanina* Gray, 1834: 58. Type species *Helix citrina* Linnaeus, 1758, by subsequent designation of Herrmannsen, 1847. Synonym of *Xesta* Albers, 1850; Ariophantidae.) (Not *Nanina* Risso, 1826.)

Patula as applied by various authors to New Zealand material. (Not *Patula* Held, 1838: 918. Type species *Helix rotundata* Müller, 1774, by subsequent designation of Herrmannsen, 1847. Synonym of *Discus* Fitzinger, 1833; Discidae.)

Pityis as applied by various authors to New Zealand material. (Not *Pityis* Beck, 1837: 9 (nude name). Type species *Pityis oparana* Beck, 1837 (nude name).) (Not *Pityis* Pease, 1871.)



Fig. 1 Shells of *Allodiscus* species. A, *Allodiscus camelinus* n.sp., Mt Camel, holotype, M.88458 (3.10 × 5.05 mm); B, *Allodiscus cassandra* (Hutton, 1883), Three Kings Islands, Great Island, M.29280 (8.70 × 13.3 mm); C, *Allodiscus conopeus* n.sp., NW of Napier, Blowhard Bush, holotype, M.180092 (4.85 × 8.10 mm); D, *Allodiscus cooperi* (Suter, 1907), Poor Knights Islands, M.99811 (2.85 × 4.40 mm); E, *Allodiscus dimorphus* (Reeve, 1852), Auckland, Birkdale, M.156778 (5.30 × 7.90 mm); F, *Allodiscus fallax* Powell, 1952, Karikari Peninsula, M.180010 (5.80 × 9.10 mm); G, *Allodiscus pumilus* n.sp., Spirits Bay, Waitapu Stream, above waterfall, holotype, M.180017 (3.90 × 6.00 mm); H, *Allodiscus spiritus* Powell, 1952, SE of Cape Reinga, Radar Bush, M.161069 (5.40 × 7.95 mm); I, *Allodiscus venulatus* (L. Pfeiffer, 1857), Maunganui Bluff, M.124977 (4.20 × 6.50 mm); J, *Allodiscus adriana* (Hutton, 1883), Christchurch, Sumner Cliffs, M.72505 (2.40 × 4.35 mm); K, *Allodiscus turbotti* Powell, 1948, Three Kings Islands, Great Island, M.155678 (4.00 × 5.45 mm); L, *Allodiscus mahlfeldae* n.sp., Wellington, Lowry Bay, holotype, M.180015 (2.18 × 3.90 mm); M, *Allodiscus southlandicus* n.sp., NE of Bluff, Seaward Downs Reserve, paratype, M.21445 (2.40 × 4.15 mm); N, *Allodiscus tullia* (Gray, 1850), E of Waipara, Crofts Road, M.124054 (2.30 × 3.85 mm); O, *Allodiscus wairarapa* n.sp., N of Masterton, Mt Bruce, holotype, M.180064 (3.10 × 5.20 mm).

Ptychodon as applied by various authors. (Not *Ptychodon* Ancey, 1888: 372. Type species *Strobila leiodon* Hutton, 1883, by original designation; Charopidae.)

Thalassia as applied by various authors to New Zealand material. (Not *Thalassia* Albers & Martens, 1860: 59. Type species *Helix subrugata* Reeve, 1852, by original designation. Synonym of *Nitor* Gude, 1911; Helicarionidae.) (Not *Thalassia* Chevrolat, 1834 in Coleoptera.)

Thaumatodon as applied by various authors to New Zealand material. (Not *Thaumatodon* Pilsbry, 1893: 26. Type species *Pityis multilamellata* Garrett, 1872, by original designation; Endodontidae.)

DIAGNOSIS: Shell of medium to large size (maximum width 5–16 mm), discoidal to globose (HWR 0.56–0.70), tight whorl increment, spire moderately elevated (13–32% SH). Anomphalous or very narrowly to widely umbilicate. Protoconch of medium to large size (width 900–1700 µm), sculptured throughout or on last quarter-whorl with numerous (≤25) very fine spiral threads, with or without addition of very fine, irregular flocculant sculpture (e.g. Fig. 5B). Teleoconch tightly coiled, with prominent primary axial ribs, interspersed with secondary axial riblets, overlain by fine spiral threads.

Aulacopod, able to withdraw completely into the shell. Foot long, narrow, projecting behind shell in crawling animal; with distinct pedal grooves; truncated posteriorly, with a caudal pit below a short horn. Jaw stegognathic. Radula with central tooth well developed, with elongate mesocone flanked either side by prominent ectocones, or moderately reduced, with mesocone shortened and accessory cusps reduced or absent; lateral teeth tricuspid, or bicuspid by suppression of the endocone; latero-marginal transitional teeth often with mesocone elongated; marginal teeth generally multicuspid. Reproductive system hermaphroditic, gonad with two clusters of acini; female and male pallial gonoducts fused to spermooviduct condition; bursa copulatrix on a long duct, which is dilated at origin from oviduct; epiphallus not externally differentiated from vas deferens but spermatophores produced; entry of vas deferens into penis a simple opening; penis generally differentiated into proximal and distal sections, the former often with one or two appendices; penis invested with a thin muscular sheath.

REMARKS: The type species of *Phenacohelix* Suter, 1892 (*Helix pilula* Reeve, 1852) resembles some of the high-spired *Allodiscus* species in gross shell morphology, including the

presence of fine spiral lirae on the protoconch, but differs from all of them in having a distinctively subangulate periphery. The anatomy of *Phenacohelix pilula*, as illustrated by Goulstone (2001), resembles that of some *Allodiscus* species in lacking an obvious epiphallus and having a penial appendix. Further anatomical study of *Phenacohelix pilula* is needed to differentiate *Allodiscus* and *Phenacohelix* properly. The anatomy of *Phenacohelix pilula* illustrated by Solem (1982) (reproduced by Schileyko 2001) evidently pertains to material not conspecific with Reeve's (1852) species and thus is not informative about relationships between *Allodiscus* and *Phenacohelix*. We suspect that *Phenacohelix sensu* Goulstone (2001) is a generic complex, of which part may relate to *Allodiscus s. lat.*

Species of *Granallodiscus* are somewhat similar in shell shape, including the presence of a more or less distinctly exsert protoconch, but differ markedly in having microscopic spines on the spiral threads on the protoconch, and in details of teleoconch sculpture.

Allodiscus sensu stricto

DIAGNOSIS: Shell of medium to moderately large size (maximum width 5–16 mm), high (HWR 0.57–0.70), spire moderately elevated (13–32% SH). Adult shell very narrowly umbilicate to anomphalous. Protoconch medium to rather large-sized (width 970–1700 µm), sculptured with 25–60 fine spiral threads, with addition of axial riblets on last quarter-whorl.

REMARKS: The following species are referred to *Allodiscus (s. str.)*: *Allodiscus camelinus* n.sp.; *A. cassandra* (Hutton, 1883); *A. conopeus* n.sp.; *A. cooperi* (Suter, 1907); *A. dimorphus* (Reeve, 1852); *A. fallax* Powell, 1952; *A. pumilus* n.sp.; *A. spiritus* Powell, 1952; and *A. venulatus* (L. Pfeiffer, 1857).

Allodiscus camelinus new species

(Figs 1A, 2A–E, 3C)

Allodiscus sp. 'Houhora' McGuinness, 2001: 568.

Charopidae sp. 164 (NMNZ M.88458) Brook, 2002b: 93;

Hitchmough *et al.*, 2007: 34; Spencer *et al.*, in press.

Charopidae sp. 2 (NMNZ M.88458) Hitchmough, 2002: 31.

TYPE MATERIAL: Holotype NMNZ M.88458: North Island, Houhora, near shore SW of Mt Camel (NZMS 260, N03/251088), 12 Jan. 1975, P.R. Jamieson.

MATERIAL EXAMINED: Holotype (see above).

DESCRIPTION: Shell (holotype) 5.00 mm wide, thin, wider

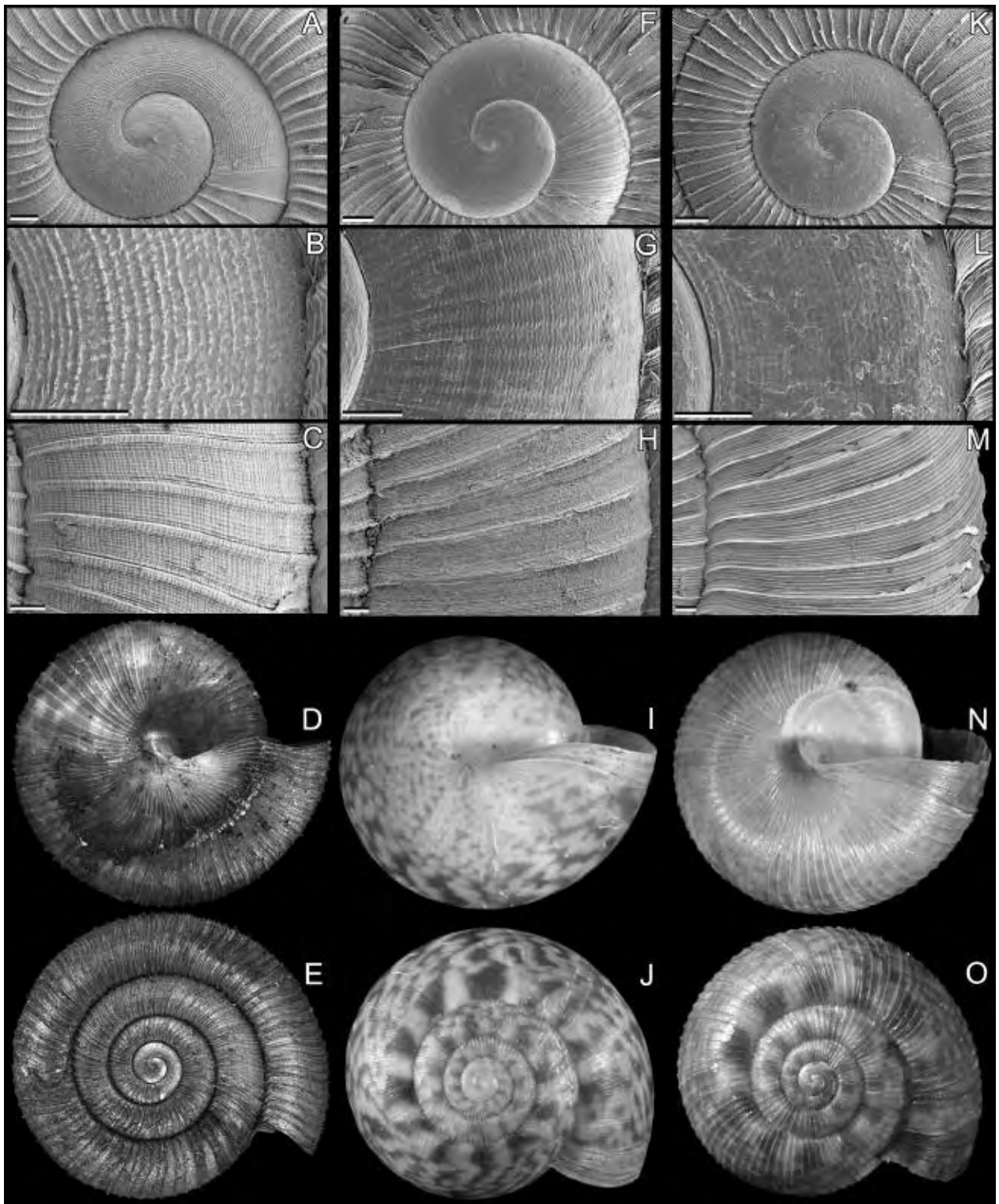


Fig. 2 Shells of *Allodiscus* (*s. str.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus camelinus* n.sp., Mt Camel, holotype, M.88458 (D, E, 3.10 × 5.05 mm) (oblique line denotes approximate boundary of first half protoconch whorl); F–J, *Allodiscus cassandra* (Hutton, 1883), Great Island, Three Kings Islands, M.155556 (F, G), M.180012 (H), M.29280 (I, J, 8.70 × 13.3 mm); K–O, *Allodiscus conopeus* n.sp., NW of Napier, Blowhard Bush, paratypes, M.175042 (K), M.46890 (L, M), and holotype, M.180092 (N, O, 4.85 × 8.10 mm). Scale bars 100 μm (A–C, G, H, L), 200 μm (F, K, M).

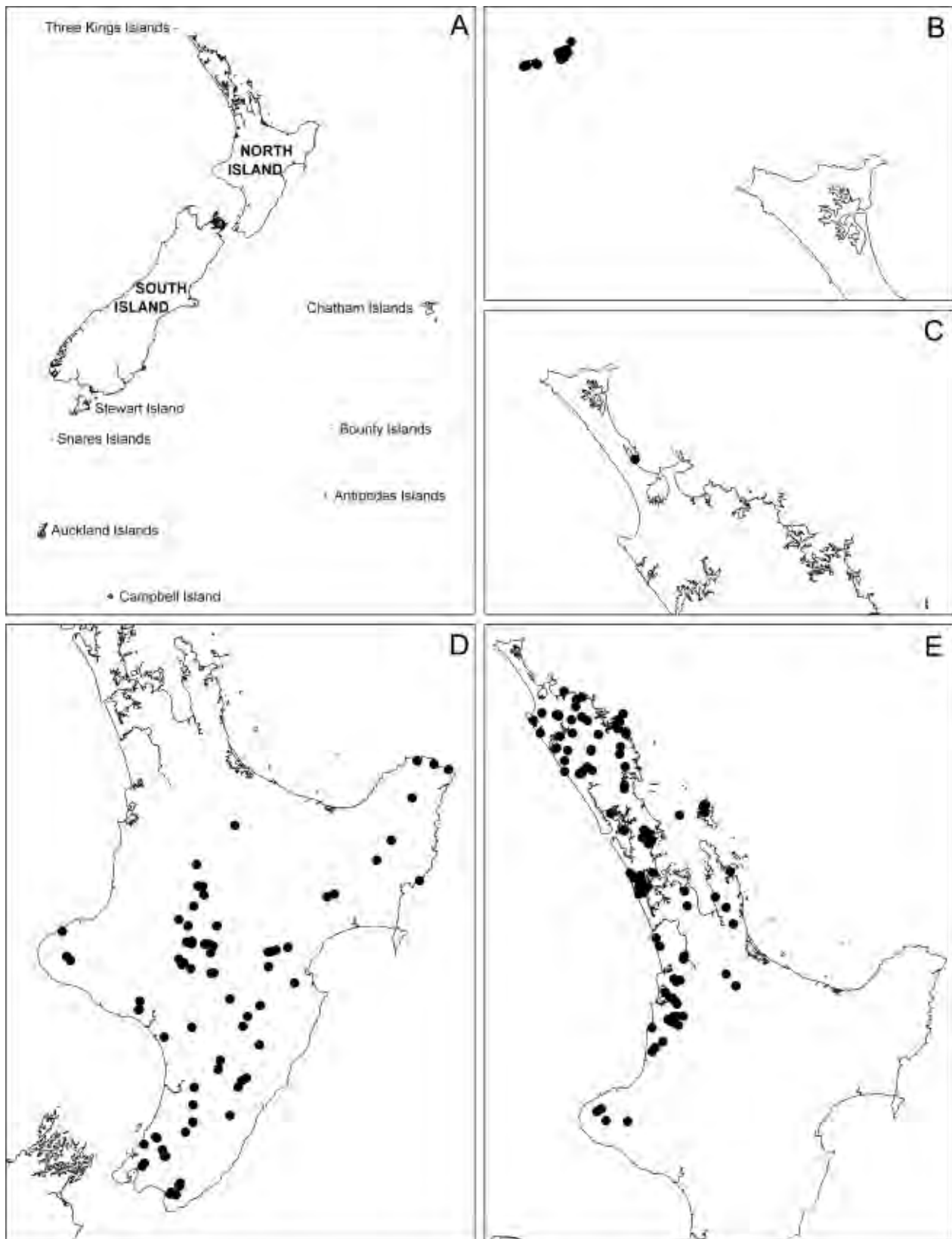


Fig. 3 Distributions of *Allodiscus* (*s. str.*) species within New Zealand. A, location key; B, *Allodiscus cassandra* (Hutton, 1883); C, *Allodiscus camelinus* n.sp.; D, *Allodiscus conopeus* n.sp.; E, *Allodiscus dimorphus* (Reeve, 1852).

than high (HWR 0.61), spire moderately elevated (22.5% SH), anomphalous. Protoconch translucent, pale reddish brown; teleoconch translucent white with large, irregular reddish-brown maculations on spire, these transforming near insertion and extending around periphery and over base as anastomosing zigzag axial bands that are strongly stretched in direction of growth.

Protoconch of 1.25 convex whorls, 930 μm wide, sculptured with about 25 fine, crisp spiral threads surmounted by fine but distinct granules at intersections with weak, anastomosing radial threads.

Teleoconch of 2.80 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp, spiral and axial threads of similar width and spacing, weakly beaded at intersections; axial threads surmounted by periostracal lamellae, strong at summit of primary axial ribs (most broken off), low elsewhere. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker, its thin rim strongly projected to overhang umbilical depression.

DISTRIBUTION: Northern North Island, Mt Camel (Fig. 3C).

BIOLOGY: A litter-dwelling detritivore of coastal broadleaved forest.

CONSERVATION STATUS: In recognition that the only extant population is restricted to a remnant patch of native forest <1 ha in total area, *Allodiscus camelinus* has been afforded the ranks of 'endangered' (McGuinness 2001) and 'nationally critical (one location)' (Brook 2002b; Hitchmough 2002; Hitchmough *et al.* 2007). We concur with this high conservation status.

The former range of *Allodiscus camelinus* is not known, but the species may be endemic to Mt Camel, which was an island during the Pliocene (Isaac *et al.*, 1994). Brook (2002b) summarised the current understanding of the status of this population. While historical population trends are not known, Brook noted that 'clearance of most of the original native forest on Mt Camel for pastoral farming has presumably resulted in a marked population decline. ... Continued modification and destruction of habitat (i.e. from damage by possums, pigs and live stock); predation by rats and mice is probably also a threat. This population is highly threatened, with its survival contingent on preservation of its remaining native forest habitat.'

REMARKS: Among previously described species, *Allodiscus camelinus* most closely resembles *A. venulatus* (L. Pfeiffer, 1857) and *A. cooperi* (Suter, 1907) in gross facies, differing

from both in being smaller relative to the number of whorls, and in having coarser, more widely spaced spiral threads on the teleoconch, and in having a smaller protoconch than *A. cooperi* (width 930 μm versus 1230–1300 μm). Closer relationship to *Allodiscus venulatus* than to other *Allodiscus* species is suggested both by the strong, granular spiral threads on the protoconch and the coastal northern habitat. Other superficially similar species are *Allodiscus pumilus* n.sp., described below, and Charopidae sp. 115 from a midden northwest of Helensville (Fig. 38D–F, see below). *Allodiscus camelinus*, *A. cooperi* and *A. pumilus* n.sp. are strongly allopatric, being restricted to Mt Camel, the Poor Knights Islands, and northernmost Northland, between Cape Reinga and North Cape, respectively, whereas *A. venulatus* appears to be restricted to western Northland.

The anatomy of *Allodiscus camelinus* is not presently known.

ETYMOLOGY: Pertaining to camels (Latin), alluding to the type locality. Noun in apposition.

Allodiscus cassandra (Hutton, 1883)

(Figs 1B, 2F–J, 3B)

Charopa cassandra Hutton, 1883a: 476; Freeman *et al.*, 1996: 36.

Charopa (?) *cassandra*.—Hutton, 1884a: 181.

Psyra cassandra.—Hutton, 1884b: 201.

Gerontia (*Allodiscus*) *cassandra*.—Pilsbry, 1892b: 66, pl. 22, figs 37–39.

Allodiscus cassandra.—Hedley & Suter, 1893: 638; Suter, 1913: 637, pl. 9, figs 2, 2a–b; Powell, 1935: 245; Powell, 1937: 88; Powell, 1946: 92; Powell, 1948: 275, text fig. B; Powell, 1951: 130; Powell, 1957: 117; Powell, 1962: 109; Price, 1963: 63; Powell, 1976: 117; Powell, 1979: 318, pl. 65, fig. 7; Spencer & Willan, 1996: 40; Brook, 1999a: 10; McGuinness, 2001: 576; Brook, 2002a: 71, 85; Brook, 2002b: 65; Hitchmough, 2002: 114; Hitchmough *et al.*, 2007: 76.

Flammulina (*Allodiscus*) *cassandra*.—Suter, 1894b: 146; Suter, 1894d: 251; Pilsbry, 1893: 15.

Allodiscus (*Allodiscus*) *cassandra*.—Climo, 1969b: 17, figs 13a, 14f–g, 22a, 25a; Climo, 1973: 596, figs 5F, 14A, 15E, 23C.

TYPE MATERIAL: Apparently no longer extant (Freeman *et al.* 1996; Marshall 1996): 'Napier' [error] = Three Kings Islands, Great Island (Suter 1913: 638).

MATERIAL EXAMINED (84 lots): M.29267 (3), M.29268 (4), M.29269 (3), M.29270 (3), M.29271 (4), M.29272 (many), M.29273 (2), M.29275 (2), M.29276 (1), M.29277 (3),

M.29278 (many), M.29279 (2), M.29280 (many), M.29281 (3), M.29282 (1), M.29283 (many), M.29285 (3), M.29286 (1), M.29287 (3), M.29288 (10), M.29289 (7), M.29290 (3), M.29291 (1), M.29292 (3), M.29293 (1), M.29294 (6), M.30199 (12), M.30200 (4), M.30201 (1), M.32761 (5), M.32940 (1), M.32941 (many), M.37755 (2), M.38731 (2), M.47284 (5), M.54233 (1), M.84536 (3), M.84586 (1), M.84587 (1), M.102420 (4), M.107635 (3), M.114922 (5), M.155484 (2), M.155492 (1), M.155520 (4), M.155529 (1), M.155539 (1), M.155556 (6), M.155570 (1), M.155576 (1), M.155588 (3), M.155598 (2), M.155620 (3), M.155628 (1), M.155637 (1), M.155642 (3), M.155651 (7), M.155671 (1), M.155677 (4), M.155686 (3), M.155696 (5), M.155724 (1), M.155736 (7), M.155747 (2), M.155769 (1), M.155777 (3), M.155798 (3), M.155812 (9), M.155831 (1), M.155844 (2), M.155865 (2), M.155870 (5), M.170136 (5), M.170137 (2), M.174439 (1), M.174464 (1), M.174457 (1), M.174489 (1), M.174517 (1), M.174533 (1), M.174687 (1), M.174709 (6), M.174720 (2), M.180012 (4).

REDESCRIPTION: Shell up to 16.0 mm wide, thin, wider than high (HWR 0.63–0.67), spire moderately elevated (23–32% SH), anomphalous, newly metamorphosed juveniles with very small umbilicus. Protoconch and teleoconch ground yellowish brown. Teleoconch with irregular reddish-purplish-brown subsutural maculations that transform about midway to insertion to more numerous, irregular, anastomosing, wavy or zigzag axial bands.

Protoconch of about 1.25 convex whorls, 1400–1700 µm wide, sculptured initially with irregular, distinctly wavy spiral cords, resolving rapidly to *c.* 60 very fine, more or less regularly spaced, slightly wavy spiral threads that traverse low, rounded primary axial ribs.

Teleoconch of up to 4.10 broadly convex whorls, first approximately 2.5 whorls sculptured with prominent, regularly spaced primary axial ribs, weaker and almost obsolete thereafter; and exceedingly fine, overlying, densely crowded spiral threads and axial periostracal lamellae of similar width and spacing. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker, edge spreading over parietal area.

DISTRIBUTION: Great, North East, South West and West islands, Three Kings Islands group (Fig. 3B).

BIOLOGY: Litter-dwelling species of broadleaved and kānuka forests and shrubland-herbfields. Common in litter, but

also not uncommonly associated with rotten logs in kānuka-dominant forest and rocky screes.

CONSERVATION STATUS: *Allodiscus cassandra* was listed as ‘range restricted’ by McGuinness (2001), Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007). This species is known from all four main islands of the Three Kings Islands group. While population trends are not precisely known, information from Great King Island suggests the species is widely distributed and not uncommon (Brook 2002b; Price 1963).

REMARKS: Apart from being by far the largest *Allodiscus* species (width up to 16.0 mm) with the largest protoconch (width 1400–1700 µm), *Allodiscus cassandra* is characterised by the finely spirally and axially sculptured protoconch, by the lack of umbilicus on all but the smallest postlarval juveniles, the strong colour pattern, and in that the teleoconch sculpture is so fine and dense that the last adult whorl has a silken texture.

Although the original type material appears to be no longer extant (Freeman *et al.* 1996), the original description is reasonably accordant with the present material. The given dimension is ‘.5 inch’ (12.7 mm), yet statements that the umbilicus is ‘narrowly perforate’ or ‘very narrow, almost covered’ (Hutton 1883a, 1884a), and indication that there was more than one specimen (Hutton 1884a), suggest that the type material included a juvenile, since even etched specimens more than 5 mm wide have absolutely no trace of an umbilicus. Suter (1913: 638) evidently saw original material at the Canterbury Museum, and confirmed that the type locality was not Napier as originally indicated, but the Three Kings Islands, to where the species is restricted.

Powell (1935, 1948) and Climo (1969b, 1973) described and illustrated the radular dentition of *Allodiscus cassandra*. The central tooth is tricuspid, with the mesocone extending about two-thirds the length of the basal plate, and with a subobsolete cusp on each side; the basal plate is slightly narrower than that of the lateral teeth. Laterals towards the centre of the radula are bicuspid, more laterally sited teeth are tricuspid. Marginal teeth are multicuspid, with elongate endocone and mesocone, and small ectocone that is variously subdivided into accessory cusps.

The reproductive anatomy of *Allodiscus cassandra* (Climo 1969b, 1973) is characterised by the bursa copulatrix duct being narrow at its origin from the free oviduct but rapidly enlarging to a spindle-shaped basal section before then tapering gradually to the bursa sac; vagina elongate, slender; penis elongate, divided into bulkier proximal and slender distal

sections of similar length, the vas deferens inserted in the lower part and the penial retractor attaching to the apex of the proximal section.

Climo (1969b, 1973) recognised the relationship to *Allodiscus dimorphus* (Reeve, 1852).

Allodiscus conopeus new species

(Figs 1C, 2K–O, 3D)

Helix dimorpha. – Reeve, 1852: pl. 128, species 775 (in part); Pfeiffer, 1853: 68 (in part of Reeve, 1852); Pfeiffer, 1854: 148 (in part).

Psyra dimorpha. – Hutton, 1884b: 201 (in part of Reeve, 1852); Suter, 1892a: 272 (not of Reeve, 1852).

Allodiscus dimorphus. – Hedley & Suter, 1893: 638 (in part of Reeve); Suter, 1913: 639 (in part of Reeve); Milligan, 1956: 56 (not of Reeve); Powell, 1979: 319 (in part of Reeve); Goulstone, 1976: 5, text fig. (not of Pfeiffer); Goulstone, 1977a: 10 (not of Pfeiffer); Mayhill, 1994: 57 (not of Reeve); Barker & Mayhill, 1999: 238 (not of Reeve).

Flammulina (Allodiscus) dimorpha. – Suter, 1894d: 250 (in part of Reeve).

Psyra dimorpha. – Suter, 1892a: 272 (not of Reeve).

Allodiscus dimorphous [sic]. – Mayhill, 1982: 12, text fig. (not of Reeve); Mayhill, 1994: 31, 58, text fig. (not of Reeve).

TYPE MATERIAL: Holotype NMNZ M.180092 and paratypes M.175042 (5), AIM AK 73265 (1): North Island, NW of Napier, SE of Kuripapango, Blowhard Bush, Napier–Taihape Road (NZMS 260 U20/038931), 2 Jun. 1968, D.J. Roscoe. Additional paratypes: SW of Hastings, Ruahine Forest Park, 11 Aug. 1968, D.J. Roscoe, M.46796 (2); Blowhard Bush, 2 Jun. 1968, D.J. Roscoe, M.46797 (4) and M.46890 (3), Sep. 1987, P.C. Mayhill, M.101495 (5); SW of Hastings, Gwavas Forest, 29 Mar. 1969, D.J. Roscoe, M.46955 (1) and M.92609 (2); 20 Apr. 1968, D.J. Roscoe, M.46977 (1); NW of Napier, Kaweka Road, Feb. 1982, P.C. Mayhill, M.75908 (4); NW of Napier, Boulder Creek, end of Kaweka Road, Feb. 1982, P.C. Mayhill, M.75918 (1); N of Dannevirke, Ruahine Forest Park, Pohangina Saddle, 22 Sep. 1968, D.J. Roscoe, M.128670 (1).

MATERIAL EXAMINED (110 lots): Type material (see above), paralectotype of *H. dimorpha* BMNH 1962729/3 (1), M.4040 (1), M.4047 (1), M.13352 (1), M.13412 (4), M.13451 (4), M.14207 (6), M.22319 (3), M.23066 (6), M.23427 (1), M.23429 (1), M.25388 (2), M.29532 (1), M.29538 (1), M.30229 (many), M.30230 (4), M.30231 (3), M.30233 (1), M.30236 (1), M.30237 (1), M.30238 (3),

M.31095 (many), M.31138 (1), M.31183 (1), M.32880 (1), M.37205 (1), M.37676 (1), M.38425 (3), M.46943 (1), M.46952 (3), M.46953 (1), M.46954 (1), M.47188 (3), M.47640 (1), M.47642 (2), M.47652 (5), M.47665 (5), M.47668 (1), M.47703 (15), M.47717 (6), M.51764 (4), M.55242 (5), M.56367 (1), M.62588 (1), M.68200 (1), M.68589 (2), M.75507 (1), M.75523 (1), M.76210 (3), M.76221 (2), M.76808 (6), M.76847 (2), M.76910 (4), M.78160 (7), M.78337 (4), M.81670 (1), M.82333 (1), M.82365 (1), M.85211 (1), M.85301 (2), M.85335 (2), M.85621 (1), M.89510 (1), M.92876 (2), M.96849 (1), M.101540 (1), M.101551 (2), M.101711 (2), M.102653 (1), M.103576 (1), M.103857 (2), M.103877 (2), M.104036 (3), M.104135 (1), M.104189 (2), M.104459 (1), M.115931 (2), M.115938 (1), M.120335 (1), M.124775 (6), M.125571 (1), M.125590 (1), M.156606 (1), M.156904 (1), M.170130 (4), M.170132 (1), M.176156 (1), M.176157 (1), M.176158 (1), M.176159 (5), M.176160 (1), M.176161 (1), M.176162 (1), M.176163 (1), M.176164 (1), M.176165 (1), M.176166 (1).

DESCRIPTION: Shell up to 8.90 mm wide, thin, wider than high (HWR 0.57–0.65), spire moderately elevated (13–19% SH), juveniles narrowly umbilicate, adults anomphalous. Protoconch translucent buff; teleoconch translucent buff with irregular reddish-brown maculations, maculations strongest and darkest on spire, transforming near insertion and extending around periphery and over base as a finer zigzag pattern of variable spacing and regularity.

Protoconch of 1.20–1.25 convex whorls, 1100–1270 µm wide; very fine, short radial threads and flocculant sculpture on first whorl, after which numerous (*c.* 35–40) weak spiral threads gradually resolve; last eighth-whorl with or without a few axial riblets, which are finer and more closely spaced than those on adjacent teleoconch.

Teleoconch of up to 3.00 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp, spiral threads and much weaker axial threads, no beading at intersections; spiral threads strongest and about as widely spaced as axial threads in narrow subsutural band, much finer and more closely spaced than axial threads elsewhere; axials surmounted by low periostracal lamellae, lamella at summit of each primary axial rib strongly elevated. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker, its thin rim overhanging umbilical depression.

DISTRIBUTION: Southern North Island (Fig. 3D). Within this range, *Allodiscus conopeus* is also known as fossils from

below Quaternary Taupo Ignimbrite (M.156904) and in Holocene cave deposits (e.g. M.31095, M.47640, M.47642).

BIOLOGY: *Allodiscus conopeus* occurs from sea-level to elevations above 1400 m in a range of ecosystems that include lowland broadleaved shrublands and forests, and mixed broadleaved/podocarp forests; montane *Nothofagus* forests; and subalpine shrublands. The species is predominately a litter-dweller on the ground, but is also found associated with woody debris, and with rock escarpments and rubble.

CONSERVATION STATUS: *Allodiscus conopeus* is widely distributed and not uncommon. Our assessment is that the species is of no immediate conservation concern.

REMARKS: Compared with *Allodiscus dimorphus* (Reeve, 1852), which it most closely resembles, *A. conopeus* differs principally in having much finer and more closely spaced spiral threads everywhere on the teleoconch apart from those in a narrow subsutural band. The two species are allopatric and both are widely distributed without evidence of morphological intergradation near the boundaries. Although the two species are allopatric, they are closely adjacent over several hundred kilometres and are quite possibly locally sympatric. *Allodiscus conopeus* differs from *A. cooperi* (Suter, 1907) in attaining larger size, in being larger relative to the number of whorls, and in having coarser, less crowded spiral threads on the teleoconch: the two species are strongly allopatric, *A. cooperi* being restricted to the Poor Knights Islands. The status of extremely similar forms from Mayor Island (e.g. M.114301, M.114394) and Mercury Island (M.181386) remains to be established.

The anatomy of *Allodiscus conopeus* is not presently known.

ETYMOLOGY: Mosquito-net (Latin), alluding to the distinctive fine sculpture. Noun in apposition.

***Allodiscus cooperi* (Suter, 1907)**

(Figs 1D, 4A–E, 6A)

Flammulina (Allodiscus) cooperi Suter, 1907: 237, pl. 22, figs 5–7; Marshall, 1996: 36.

Allodiscus cooperi.— Suter, 1913: 638, pl. 11, figs 5–7; Powell, 1937: 88; Powell, 1946: 92; Powell, 1957: 117; Powell, 1962: 110; Climo, 1971b: 68; Powell, 1976: 117; Powell, 1979: 319; Spencer & Willan, 1996: 40; McGuinness, 2001: 576; Brook, 2002b: 66; Hitchmough, 2002: 114; Hitchmough *et al.*, 2007: 76.

Allodiscus (Allodiscus) cooperi.— Climo, 1969b: 24, figs 1b, 13f, 25a.

NOT *Allodiscus cooperi*.— O'Neill & Gardner, 1975: 114 (= *A. dimorphus* Reeve, 1852).

TYPE MATERIAL: Syntypes (2) NMNZ M.125088: North Island, Poor Knights Islands, C. Cooper.

MATERIAL EXAMINED (14 lots): Syntypes (see above), M.30202 (3), M.31030 (4), M.38458 (1), M.57498 (3), M.57619 (3), M.57630 (6), M.73475 (1), M.73477 (1), M.99799 (3), M.99804 (1), M.99811 (many), M.127647 (2), M.180011 (1).

REDESCRIPTION: Shell 7.05 mm wide, thin, wider than high (HWR 0.56–0.64), spire moderately elevated (17–30% SH), very narrowly umbilicate. Protoconch translucent and teleoconch translucent and colourless; teleoconch with large, irregular reddish-brown maculations on spire, these transforming near insertion and extending around periphery and over base as finer zigzag radial bands or a diagonally reticulate pattern.

Protoconch of about 1.20 convex whorls, 1230–1300 µm wide, first quarter-whorl more or less smooth, thereafter sculptured with *c.* 38–40 fine, rounded, crowded spiral threads; last eighth-whorl additionally with fine axial ribs that are traversed by the spirals.

Teleoconch of up to 3.20 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and with very fine, overlying, crisp, crowded spiral threads, and more widely spaced periostracal lamellae, intersections simple; lamella at summit of each primary axial rib very prominent, interstitial lamellae much lower, yet stronger than spirals. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker, its thin rim overhanging umbilicus.

DISTRIBUTION: Poor Knights Islands (Fig. 6A).

BIOLOGY: *Allodiscus cooperi* occurs on the ground, in litter and under woody debris and ground-layer vegetation, in shrublands and broadleaved forests.

CONSERVATION STATUS: *Allodiscus cooperi* is widely distributed on islands and islets in the Poor Knights Islands group, but information on abundance and population trends are not presently known. The status of the species was not mentioned by McGuinness (2001), but listed as 'range restricted' by Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007).

REMARKS: Compared with *Allodiscus dimorphus* (Reeve, 1852), *A. cooperi* differs in attaining a smaller size, in being smaller relative to the number of whorls, in having fine axial ribs on the last eighth-whorl of the protoconch, and in having much finer, more crowded spiral threads on the teleoconch. *Allodiscus cooperi* attains a similar size to *A. venulatus* (L. Pfeiffer, 1857), but differs in numerous points of detail,

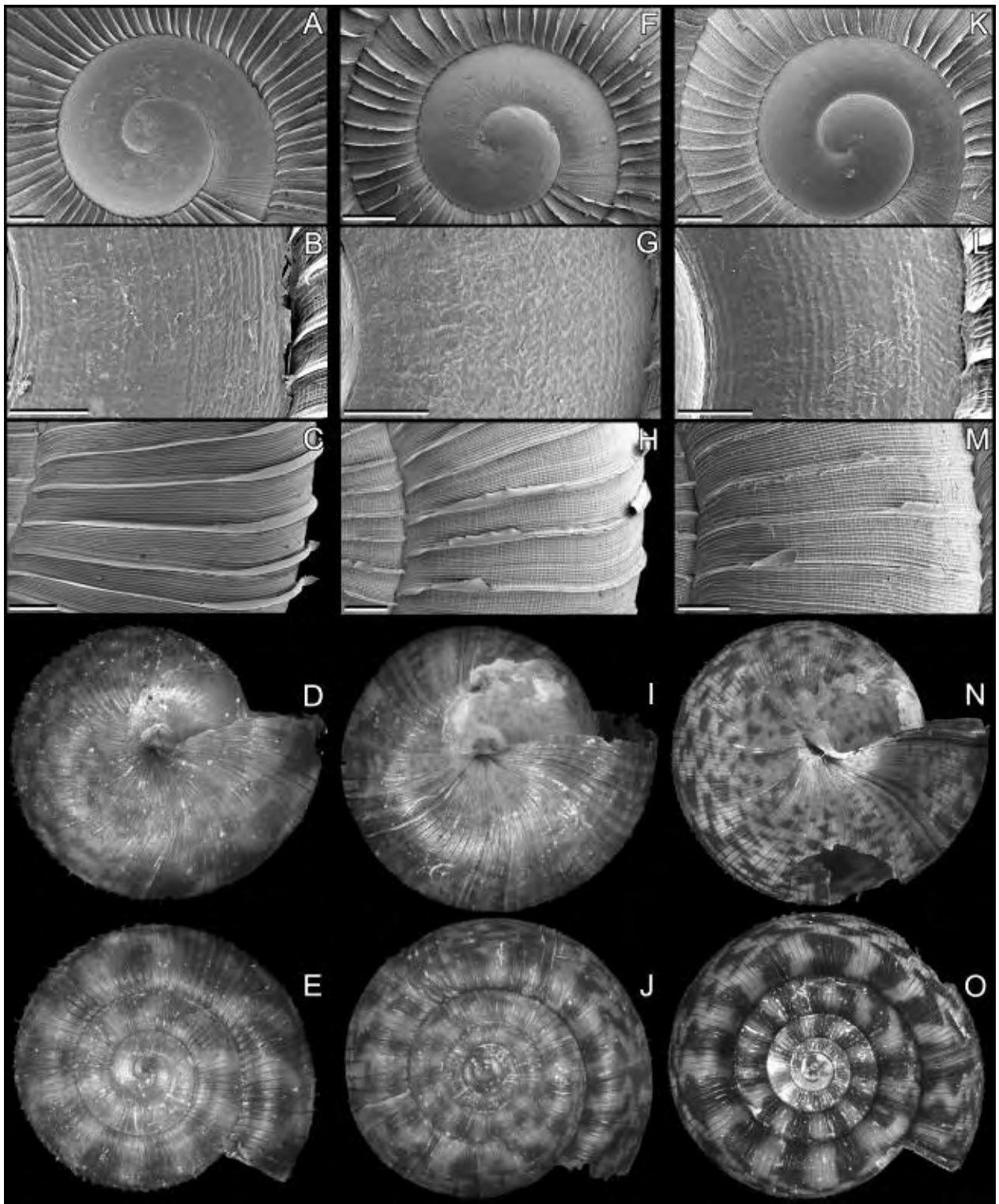


Fig. 4 Shells of *Allodiscus* (*s. str.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus cooperi* (Suter, 1907), Poor Knights Islands, Tawhiti Rahi, M.99799 (A–C), M.99811 (D, E, 2.85 × 4.40 mm); F–J, *Allodiscus dimorphus* (Reeve, 1852), NW of Kaikohe, S of Utakura, M.97954 (F–H), and Auckland, Birkdale, M.156778 (I, J, 5.30 × 7.90 mm); K–O, *Allodiscus fallax* Powell, 1952, Karikari Peninsula, M.30631 (K–M), M.180010 (N, O, 5.80 × 9.10 mm). Scale bars 100 µm (B, G, L), 200 µm (A, C, H, M), 300 µm (F, K).

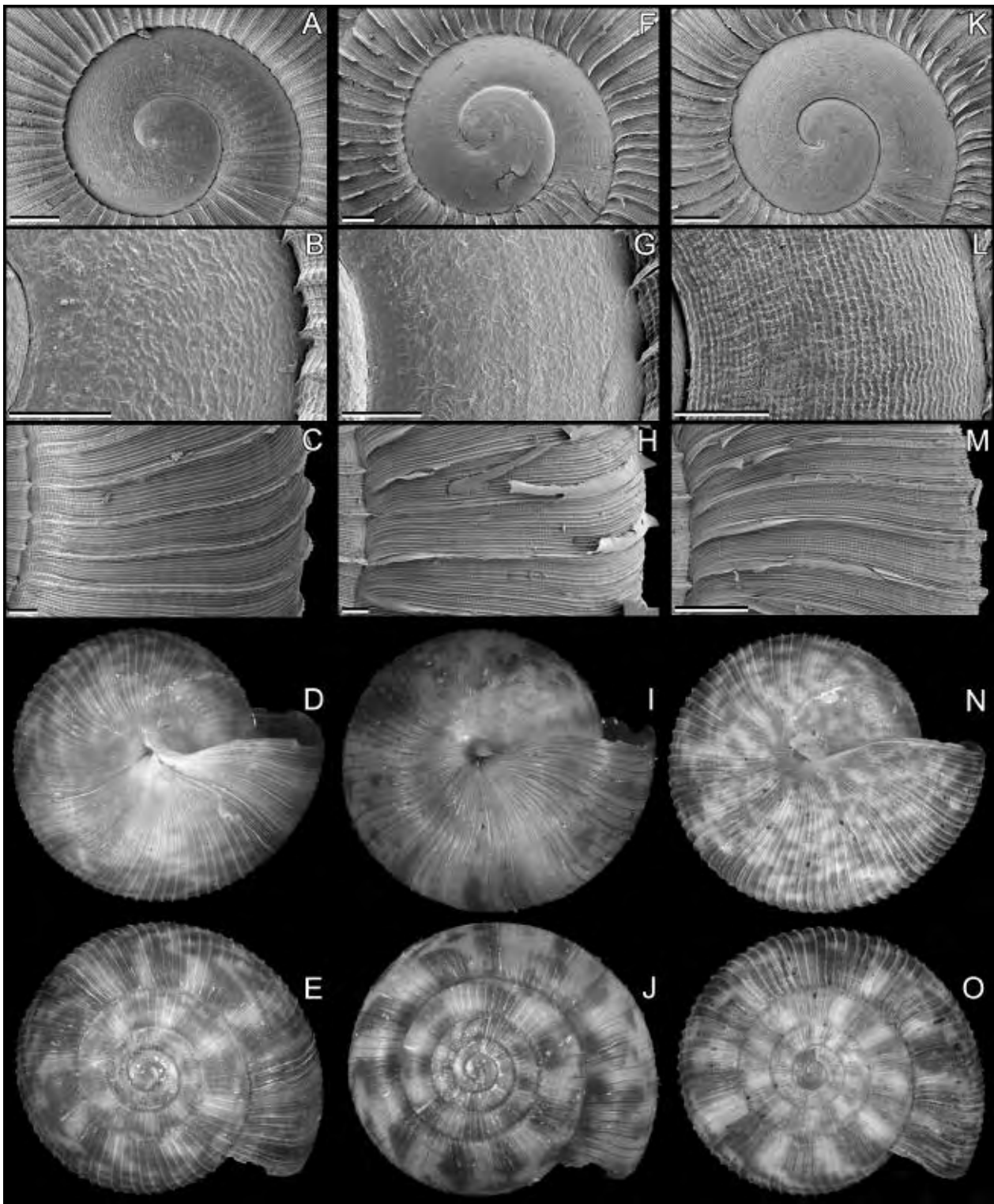


Fig. 5 Shells of *Allodiscus* (*s. str.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus pumilus* n.sp., SE of Cape Reinga, paratype, M.88398 (A–C), and Spirits Bay, Waitapu Stream, above waterfall, holotype, M.180017 (D, E, 3.90 × 6.00 mm); F–J, *Allodiscus spiritus* Powell, 1952, SE of Cape Reinga, Whangakea Stream valley, M.161200 (F–H), and SE of Cape Reinga, Radar Bush, M.161069 (I, J, 5.40 × 7.95 mm); K–O, *Allodiscus venulatus* (L. Pfeiffer, 1857), Maunganui Bluff, M.124982 (K–M), and M.124977 (N, O, 4.20 × 6.50 mm). Scale bars 100 µm (B, C, G, H, L), 200 µm (A, F, K, M).

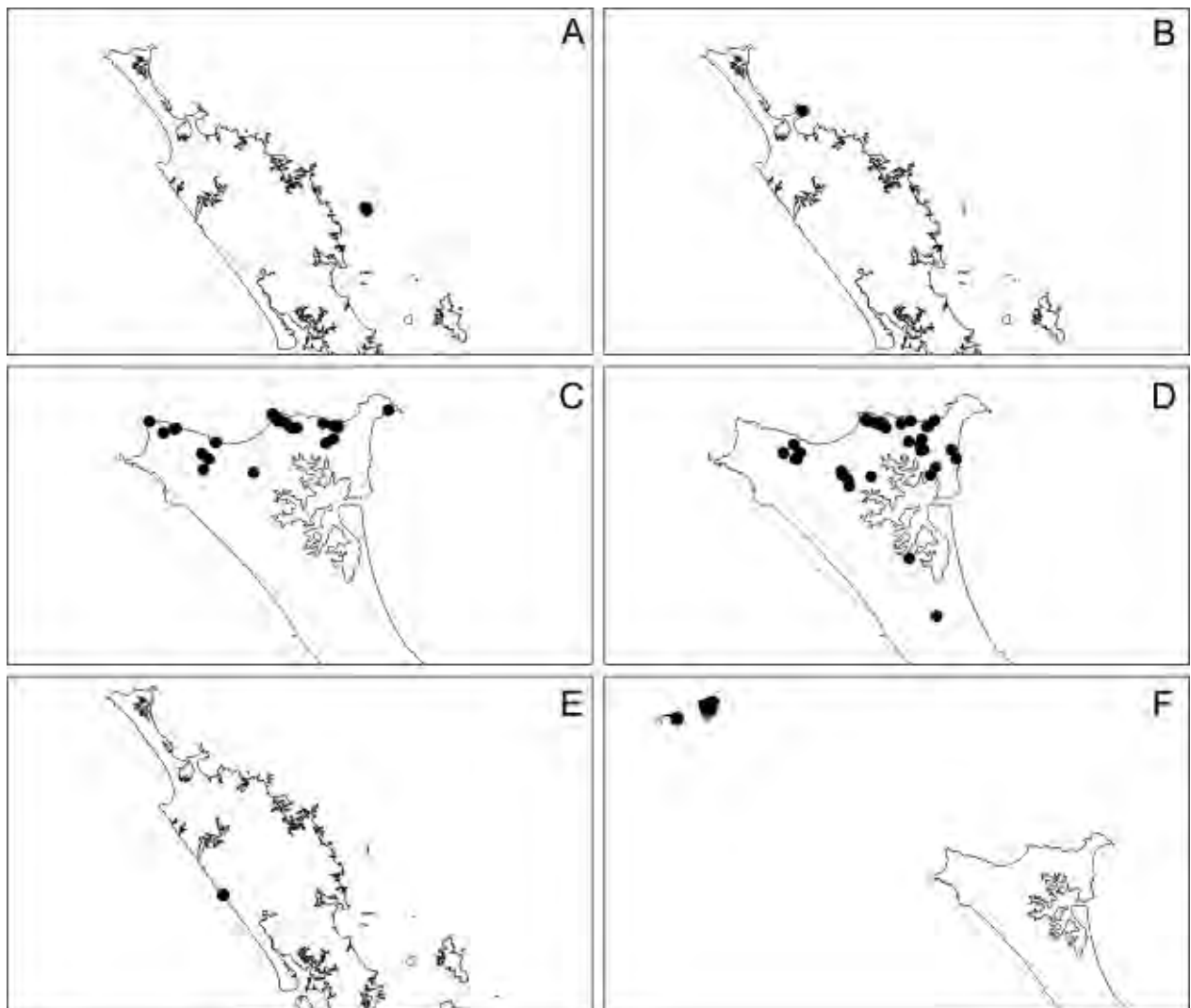


Fig. 6 Distributions of *Allodiscus* species within New Zealand. A, *Allodiscus cooperi* (Suter, 1907); B, *Allodiscus fallax* Powell 1952; C, *Allodiscus pumilus* n.sp.; D, *Allodiscus spiritus* Powell, 1952; E, *Allodiscus venulatus* (L. Pfeiffer, 1857); F, *Allodiscus turbotti* Powell, 1948.

notably less crisply defined spiral threads on the protoconch, and much finer, more closely spaced spiral threads on the teleoconch.

The anatomy of *Allodiscus cooperi* is not presently known.

***Allodiscus dimorphus* (Reeve, 1852)**

(Figs 1E, 3E, 4F–J)

Helix dimorpha Reeve, 1852, pl. 128, species 775 (in part = *A. conopeus* n. sp.).

Helix dimorpha Pfeiffer, 1853: 68 (in part = *A. conopeus* n.sp.); Pfeiffer, 1854: 148 (in part = *A. conopeus*); Martens, 1873: 10.

Helix (Charopa) dimorpha.– Hector, 1873: 8.

Patula dimorpha.– Hutton, 1880: 6; Hutton, 1884a: 161 (in part? – pl. 9, fig. V?).

Charopa (Psyra) dimorpha.– Tryon, 1886: 211 (in part? – pl. 62, fig. 39?).

Psyra dimorpha.– Hutton, 1884b: 201 (in part = *A. conopeus*); Adams, 1886: 180; Cheeseman, 1886: 171; Suter, 1892a: 277.

Allodiscus dimorphus.– Hedley & Suter, 1893: 638 (in part = *A. conopeus*); Suter, 1913: 639, pl. 50, fig. 5 (in part = *A. conopeus*); Powell, 1937: 87 (in part: South Island record erroneous); Powell, 1946: 92 (in part: South Island record erroneous); Milligan, 1954: 119; Milligan, 1955: 8; Warren, 1955: 20; Price, 1956: 8; Powell, 1957: 117 (in

part: South Island record erroneous); Whitten, 1957: 2; Rees, 1959: 21; Powell, 1962: 110 (in part: South Island record erroneous); Gardner, 1967b: 17; Parkinson, 1970: 139; Parkinson, 1974: 174; Climo, 1975: 483, fig. 13A; Goulstone, 1976: 5, text fig. (in part = *A. conopeus*); Powell, 1976: 117; Goulstone, 1977b: 17, text fig.; Spencer, 1977: 7; Goulstone, 1979b: 24, text figs; Powell, 1979: 319, text fig. 76/1 (in part = *A. conopeus*); Goulstone, 1980c: 1; Solem *et al.*, 1981: 477; Goulstone, 1981a: 6; Goulstone, 1983b: 27, text figs; Goulstone, 1990: 5, 31, text figs; Goulstone, 1991b: 6; Goulstone, 1991c: 9; Brook & Goulstone, 1995: 9; Spencer & Willan, 1996: 40; Brook & Goulstone, 1999: 130; Mahlfeld, 2000: appendix 3 & subseq.; Hazelwood *et al.*, 2002: 30; Barker, 2005: 76; Barker, 2006: 133.

Flammulina (Allodiscus) dimorpha.— Suter, 1894b: 146 (in part = *A. conopeus*); Suter, 1894d: 250 (in part = *A. conopeus*); Pilsbry, 1893: 14; Suter, 1901: 207.

Allodiscus (Allodiscus) dimorphus.— Climo, 1969b: 26, figs 1b, 13e, 15d, 17a, 22f, 25a; Schileyko, 2001: 1017, fig. 1334.

Allodiscus cooperi.— O'Neill & Gardner, 1975: 114 (not of Suter, 1907).

NOT *Pyra dimorpha*.— Suter, 1892a: 272 (= *A. conopeus*).

NOT *Allodiscus dimorpha*.— Mayhill, 1982: 12, text fig. (= *A. conopeus*); Mayhill, 1994: 31, 57, text fig. (= *A. conopeus*).

NOT *Allodiscus dimorphus*.— Goulstone, 1976: 5, text fig. (= *A. conopeus*); Goulstone, 1977a: 10 (= *A. conopeus*).

TYPE MATERIAL: Lectotype (here selected) BMNH 1962729/1: 'Nova Seelandia', F. Strange. Type locality here restricted to North Island, W of Auckland, Cornwallis, Kakamatua Valley. Of the two paralectotypes, the smaller (BMNH 1962729/2) is conspecific with the lectotype, while the larger (BMNH 1962729/3) is *Allodiscus conopeus* n.sp. from a locality south of the type locality (see above). Note that *Helix dimorpha* of Reeve (1852) and of Pfeiffer (1853) are based on the same type material.

MATERIAL EXAMINED (147 lots): Type material (see above), M.4005 (1), M.4019 (2), M.8992 (2), M.8993 (2), M.13353 (2), M.13354 (4), M.13428 (3), M.23069 (7), M.24009 (15), M.24441 (2), M.30232 (2), M.30234 (4), M.30235 (1), M.31240 (9), M.31255 (1), M.32191 (1), M.37204 (1), M.39151 (4), M.39277 (4), M.45810 (2), M.46944 (1), M.48080 (1), M.48157 (1), M.48173 (3), M.55184 (1), M.56769 (2), M.57415 (2), M.57612 (3), M.58319 (2), M.63004 (1), M.68404 (3), M.68646 (1), M.70141 (1), M.70542 (1), M.72310 (1), M.72472 (4), M.76656 (1), M.80310 (1), M.80327 (2), M.80406 (1), M.82823 (1), M.82928 (2), M.83082 (3), M.84585 (1),

M.84588 (1), M.84589 (10), M.84590 (2), M.84591 (1), M.84592 (2), M.84717 (1), M.84724 (1), M.84752 (1), M.84757 (1), M.87662 (2), M.88501 (3), M.88557 (3), M.89544 (2), M.97727 (2), M.97896 (1), M.97954 (1), M.98221 (3), M.98249 (1), M.99561 (1), M.100256 (1), M.107844 (1), M.114415 (2), M.114473 (2), M.114673 (1), M.115934 (1), M.116207 (1), M.124523 (1), M.124681 (1), M.124682 (1), M.124987 (1), M.126638 (1), M.127646 (5), M.129285 (2), M.156610 (20), M.156769 (2), M.163376 (3), M.163723 (1), M.163737 (1), M.163932 (3), M.163944 (2), M.164097 (2), M.164125 (1), M.164227 (1), M.164851 (3), M.164990 (1), M.165003 (2), M.165076 (2), M.165105 (1), M.165115 (2), M.165375 (1), M.165390 (1), M.165499 (1), M.165565 (4), M.165595 (1), M.165662 (1), M.165697 (1), M.165723 (1), M.165760 (1), M.165953 (1), M.166190 (1), M.166725 (2), M.166814 (3), M.166984 (3), M.167046 (1), M.167070 (1), M.167123 (3), M.167535 (2), M.168221 (1), M.168313 (1), M.168362 (1), M.168479 (1), M.168638 (4), M.168780 (1), M.169346 (1), M.169351 (7), M.169353 (2), M.169358 (1), M.169410 (1), M.169478 (1), M.169491 (2), M.169495 (1), M.169625 (1), M.169660 (1), M.169729 (1), M.169734 (3), M.169755 (1), M.169794 (2), M.169851 (1), M.169991 (1), M.170126 (7), M.170128 (1), M.170129 (1), M.170131 (4), M.170133 (3), M.170134 (3), M.170135 (2), M.170202 (3), M.176030 (1), M.176153 (1), M.176154 (2), M.180005 (1), M.180006 (1).

REDESCRIPTION: Shell up to 9.70 mm wide, thin, wider than high (HWR 0.62–0.68), spire weakly to moderately elevated (14–24% SH), juveniles narrowly umbilicate, adults anomphalous. Protoconch translucent reddish-brown; teleoconch translucent buff with irregular reddish-brown maculations, maculations strongest and darkest on spire, transforming near insertion and extending around periphery and over base as zigzag pattern of variable spacing and regularity.

Protoconch of 1.20–1.25 convex whorls, 1200–1370 µm wide; very fine flocculant sculpture on first whorl, after which about 25 fine, weakly developed, rounded, spiral threads gradually resolve, only slightly finer than spiral threads on teleoconch. Axial riblets mostly wanting, except on last eighth-whorl, where fine ribs present, traversed by spiral cords.

Teleoconch of up to 3.30 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, weak but crisp, spiral threads and much weaker axial threads, no beading at intersections; axial threads surmounted by periostracal lamellae, lamella at summit of each primary axial rib strongly elevated. Axial

sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker, its thin rim overhanging umbilical depression.

DISTRIBUTION: North and western North Island, from the vicinity of Doubtless Bay to as far south as Mt Taranaki, including several islands off the eastern coast (Fig. 3E).

BIOLOGY: *Allodiscus dimorphus* is usually found in litter, on the ground and suspended in crevices of rock outcrops, cave entrances and in epiphytes. Solem *et al.* (1981) regarded the species as a common associate of the fauna on the underside of large, very rotten logs, especially drier sections of these. Barker (2005) also noted the species' common association with the fallen dead fronds of nikau palm (*Rhopalostylis sapida*). *Allodiscus dimorphus* is known from coastal shrublands and forests, lowland *Agathis* and broadleafed/podocarp forests, through to montane broadleafed forests and shrublands at about 900 m elevation.

CONSERVATION STATUS: *Allodiscus dimorphus* is widely distributed and not uncommon. The species is not of immediate conservation concern.

REMARKS: The specimen chosen as the lectotype is closely similar to specimens from the greater Auckland area, especially specimens from the western side in the Kakamatua Valley near Cornwallis (e.g. M.97727). Our selection of this particular site as type locality is further influenced by the fact that it is a protected area where the species is still living. Whereas the smaller paralectotype may well have been collected with the lectotype, the larger one is an example of *Allodiscus conopeus* n.sp., probably from the Wellington area (see above).

The radula was described by Hutton (1884a), but the identity of the material dissected by him is not known with certainty. Pilsbry (1893) based his description of the radula on that of Hutton (1884a). Climo's (1969b) description indicates the radula, with a formula 12–17 + 10–18 + 1 + 10–18 + 12–17, is characterised by a central tooth that is tricuspid, with the mesocone extending about two-thirds the length of the basal plate. The lateral teeth are either tricuspid, or bicuspid via fusion of endocone and mesocone, in which the length of the mesocone at most barely exceeds the length of the basal plate. The marginal teeth are initially tricuspid on an elongate basal plate but become multicuspid on a very short, broad basal plate towards the margin of the radular ribbon.

The reproductive anatomy of *Allodiscus dimorphus*, described by Climo (1969b), may be characterised by the bursal duct being bulbous in its basal section, opening

broadly to the oviduct and tapering gradually to its sac; the vagina moderately short and slender; the penis moderately short, bulbous, internally differentiated into a proximal section with apical attachment of the penial retractor muscle and mid-lateral insertion of the vas deferens, and a distal section with low, longitudinal folds.

Allodiscus fallax Powell, 1952

(Figs 1F, 4K–O, 6B)

Allodiscus fallax Powell, 1952: 163, fig. 2; Powell, 1957: 117; Powell, 1962: 110; Powell, 1976: 117; Powell, 1979: 319, fig. 76/2; Spencer & Willan, 1996: 40; McGuinness, 2001: 588; Brook, 2002b: 67; Hitchmough 2002: 43; Hitchmough *et al.*, 2007: 40.

Allodiscus (Allodiscus) fallax.—Climo, 1969b: 28, figs 1b, 25a.

TYPE MATERIAL: Holotype AIM AK 71179: North Island, Karikari Peninsula, forest remnant at N end of Whangapupere (Oruru) Bay, A.W.B. Powell, 29 Jan. 1950. Note that specimens other than the holotype referred to in the original description (i.e. AIM AM 83323 (5), AM 83324 (2)) are not paratypes, being so designated neither there nor on the original labels.

MATERIAL EXAMINED (6 lots): Type material (see above), M.30631 (5), M.180010 (3), M.183023 (1).

REDESCRIPTION: Shell up to 8.40 mm wide, thin, wider than high (HWR 0.64–0.67), spire moderately elevated (21–25% SH), juveniles narrowly umbilicate, adult umbilicus narrower and overhung by inner lip. Protoconch translucent yellowish brown; teleoconch translucent pale buff with irregular reddish-brown maculations, maculations strongest and darkest on spire, transforming near insertion and extending around periphery and over base as either anastomosing zigzag lines that form irregular diagonal reticulation, or sparse, irregular maculations.

Protoconch of 1.25 convex whorls, 1270–1470 µm wide; very fine flocculant sculpture with indistinct spiral cords on first whorl, after which about 25 fine, rounded, moderately developed spiral threads gradually resolve, similar in spacing to threads on teleoconch. Axial riblets mostly wanting, except on last eighth-whorl, where fine ribs are present, traversed by spiral cords.

Teleoconch of up to 3.20 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs, 52–77 (mean 63.09, SD 9.28, n = 11) on second whorl; and overlying fine, crisp, spiral threads and much weaker axial threads, no beading at intersections; axial threads surmounted by periostracal lamellae, lamella at summit of

each primary axial rib strongly elevated. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker, its thin rim free and overhanging umbilical depression.

DISTRIBUTION: Northeastern North Island, Karikari Peninsula (Fig. 6B).

BIOLOGY: *Allodiscus fallax* has been collected from leaf litter in remnant coastal forest.

CONSERVATION STATUS: McGuinness (2001) listed *Allodiscus fallax* as of potential conservation concern. Subsequent recognition that *Allodiscus fallax* comprised a single population occupying an area probably no larger than 10 ha led to its listing as 'nationally endangered' by Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007). We concur with these latter assessments.

REMARKS: Powell (1952) distinguished *Allodiscus fallax* from *A. dimorphus* (Reeve, 1852) on the basis of 'darker and more clear cut tessellated pattern ... more numerous axials ... and 8–10 versus 10–12 secondary radials in each interspace'. In fact, colour and colour pattern are similar and variable in both taxa, and both have similar numbers of axial ribs on the second teleoconch whorl (52–77, mean 63.09, SD 9.28, $n=11$; versus 45–85, mean 54.07, SD 7.15, $n=41$ for *Allodiscus dimorphus* from populations north of Hamilton), and we are unable to detect any significant differences in the interstitial sculpture, axial or spiral. The adult umbilical chink is distinctly wider in *Allodiscus fallax* than in the majority of *A. dimorphus*, although the degree of umbilical occlusion in the latter is variable.

Despite lack of consistent differences in shell attributes other than the trend in adult umbilicus width, genetic distances (unpublished sequence data) between topotypes of *Allodiscus fallax* and specimens here interpreted as *A. dimorphus* (from Coromandel Peninsula and Great Barrier Island) suggest distinct species. *Allodiscus fallax* and *A. dimorphus* are strongly allopatric, *A. fallax* being restricted to Karikari Peninsula, whereas *A. dimorphus* is widely distributed to the southwest and south (Fig. 3E). Like Powell (1952), we presume that *Allodiscus fallax* diverged from *A. dimorphus* stock during the Pliocene, when Karikari Peninsula was an island (Isaac *et al.* 1994).

The anatomy of *Allodiscus fallax* is not presently known.

Allodiscus pumilus new species

(Figs 1G, 5A–E, 6C)

Allodiscus (Allodiscus) spiritus.—Climo, 1969b: 44, figs 1b, 13g, 18a–e, 22e, 25a (not of Powell, 1952).

Allodiscus spiritus 'small' Goulstone *et al.*, 1993: 16, text figs (not of Powell).

Allodiscus sp. aff. *spiritus*.—McGuinness, 2001: 637.

Allodiscus spiritus.—Brook, 2002b: 68 (in part).

Charopidae sp. 1 (NMNZ M.89841) Hitchmough, 2002: 122.

Charopidae sp. 177 (NMNZ M.89841) Hitchmough *et al.*, 2007: 84.

TYPE MATERIAL: Holotype NMNZ M.180017: North Island, Spirits Bay, Waitanoni Stream, above waterfall, 60 m (NZMS 260 N02/991524), Jan. 1984, W.M. Mathews. Paratypes: SE of Cape Reinga, 2 Jan. 1975, P.R. Jamieson, M.88398 (7), AIM AK 73266 (2); NE of Te Pahi, May 1985, P.C. Mayhill, M.161925 (1); Waterfall Gully, Kapowairua, 3 Jan. 1975, P.R. Jamieson, M.88472 (2), 3 Jan. 1975, B.F. Hazelwood, M.177465 (2); SE of Unuwahao Trig, May 1982, P.C. Mayhill, M.161831 (3).

MATERIAL EXAMINED (34 lots): Type material (see above), M.29689 (1), M.30180 (1), M.30182 (3), M.37725 (5), M.37779 (1), M.38228 (4), M.38249 (2), M.87845 (1), M.87906 (1), M.87926 (1), M.87934 (2), M.88398 (7), M.88416 (1), M.89841 (1), M.103944 (3), M.104003 (3), M.129293 (1), M.156732 (2), M.156733 (3), M.156734 (3), M.156735 (3), M.156737 (2), M.161090 (1), M.161978 (1), M.162092 (8), M.162158 (4), M.162198 (1).

DESCRIPTION: Shell up to 7.45 mm wide, thin, wider than high (HWR 0.60–0.65), spire moderately elevated (21–28% SH), anomphalous. Protoconch translucent yellowish brown; teleoconch translucent white with large, irregular reddish-brown maculations on spire, these transforming near insertion and extending around periphery and over base as strongly zigzag axial bands.

Protoconch of about 1.10 convex whorls, 1000–1070 μm wide, merging almost imperceptibly into teleoconch; very fine flocculant sculpture and indistinct spiral threads on first three-quarter whorl, after which numerous (*c.* 35–40) fine, crisp spiral threads gradually resolve, only slightly finer than spiral threads on teleoconch; prominent, rounded axial ribs commencing after first half- to three-quarter-whorl, generally closer and less regularly spaced than primary axial ribs on teleoconch.

Teleoconch of up to 3.50 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, crisp, spiral threads and weaker axial threads; spiral threads stronger and more widely spaced than elsewhere in narrow subsutural band, spirals otherwise very fine and considerably more closely spaced

than axial threads, no beading at intersections; axial threads surmounted by periostracal lamellae, lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip considerably thicker, its thin rim overhanging umbilical depression.

DISTRIBUTION: North Island, northern tip of Aupouri Peninsula (Fig. 6C). Recorded as fossil in Holocene dune-fields at Te Werahi (Brook 1999b).

BIOLOGY: *Allodiscus pumilus* is a litter-dweller of lowland broadleaved shrublands and forests.

CONSERVATION STATUS: McGuinness (2001) considered this species as potentially of conservation concern, but 'insufficiently known' to make an assessment. Brook (2002b) treated this species as a synonym of *Allodiscus spiritus* Powell, 1952, which was listed as 'range restricted'. In the assessments reported by Hitchmough (2002) and Hitchmough *et al.* (2007), this species was recognised as distinct from *Allodiscus spiritus* and ranked as 'range restricted'.

The comments on the historical population trends in *Allodiscus spiritus* and *A. basiliratus* Gardner, 1967 provided by Brook (2002b; see below) in relation to habitat degradation on the northern Aupouri Peninsula equally apply to *A. pumilus*. Our assessment is that, while some habitat degradation continues over part of the range, the wide distribution of *Allodiscus pumilus* in the far north of Aupouri Peninsula provides some buffering against stochastic population disturbances. A rank of 'range restricted' according to the criteria of Molloy *et al.* (2002) is appropriate.

REMARKS: *Allodiscus pumilus* most closely resembles *A. cooperi* (Suter, 1907) (allopatric) in gross facies, but differs principally in having a smaller protoconch (width 1000–1070 µm, versus 1230–1300 µm). Compared with the sympatric species *Allodiscus spiritus* Powell, 1952, *A. pumilus* differs principally in attaining a smaller size (7.45 mm, versus 8.25 mm), in having a smaller protoconch (width 1000–1070 µm, versus 1180–1300 µm), and in having more crowded spiral threads on the teleoconch. It has weaker spiral sculpture on the protoconch than in *Allodiscus venulatus* (L. Pfeiffer, 1857) and *A. camelinus* n.sp.

Climo's (1969b) dissection of material from Tapotupotu Bay, southeast of Cape Reinga (M.37725), indicates a distinctive reproductive anatomy, characterised by a penis lacking a diverticulum but equipped internally with a long, curved, tapering stimulator; a long, slender vagina; and the basal part of the duct to the bursa copulatrix ovoid and

swollen. Climo gave the formula for the radular dentition as 14 + 11 + 1 + 11 + 14, indicating a relatively high number of lateral teeth. The central tooth is tricuspid, the lateral teeth are bicuspid by suppression of the endocone, and the marginal teeth are multicuspid.

ETYMOLOGY: Dwarf (Latin), alluding to its small size. Adjective in the nominative case.

Allodiscus spiritus Powell, 1952

(Figs 1H, 5F–J, 6D)

Allodiscus spiritus Powell, 1952: 164; Powell, 1957: 117; Powell, 1962: 110; Walker, 1971: 26; Powell, 1976: 117; Powell, 1979: 319, fig. 76/3; Goulstone *et al.*, 1993: 16, text figs; Spencer & Willan, 1996: 40; Brook, 1999b: 389; McGuinness, 2001: 568; Brook, 2002b: 68 (in part = *A. pumilus* n.sp.); Hitchmough, 2002: 114; Hitchmough *et al.*, 2007: 76.

NOT *Allodiscus* (*Allodiscus*) *spiritus*.– Climo, 1969b: 44, figs 1b, 13g, 18a–e, 22e, 25a (= *A. pumilus* n.sp.).

TYPE MATERIAL: Holotype AIM AK 71180: North Island, Spirits Bay, Kapo Wairua, Waterfall Gully, in *Astelia*, Jan. 1950, A.W.B. Powell.

MATERIAL EXAMINED (46 lots): Type material (see above), M.30055 (2), M.30181 (1), M.38235 (3), M.38429 (1), M.38449 (1), M.54253 (2), M.55459 (2), M.70049 (2), M.77011 (1), M.77073 (3), M.77086 (1), M.79034 (3), M.79365 (1), M.79616 (1), M.79634 (1), M.82072 (3), M.87729 (3), M.87748 (3), M.88415 (1), M.88712 (2), M.96566 (1), M.99101 (4), M.107742 (2), M.116611 (1), M.129376 (9), M.156738 (1), M.161069 (2), M.161099 (2), M.161168 (4), M.161200 (5), M.161799 (3), M.161870 (5), M.161935 (2), M.161943 (1), M.161969 (3), M.161992 (1), M.162022 (2), M.162067 (3), M.162169 (1), M.162222 (1), M.162243 (1), M.180009 (1), M.180393 (1), M.180505 (1), M.180818 (1).

REDESCRIPTION: Shell up to 8.25 mm wide, thin, wider than high (HWR 0.61–0.70), spire moderately elevated (17–28% SH), juveniles narrowly umbilicate, adults anophalous. Protoconch translucent yellowish to reddish brown; teleoconch translucent pale buff or white with irregular reddish-brown maculations, maculations strongest and darkest on spire, transforming near insertion and extending around periphery and over base as zigzag pattern of variable spacing and regularity.

Protoconch of 1.15–1.25 convex whorls, 1180–1300 µm wide; very fine flocculant sculpture and indistinct spiral threads on first whorl, after which about 25–30 crisp spiral

threads gradually resolve, similar to threads on teleoconch. Axial ribs mostly wanting, except on last eighth-whorl, where fine ribs present, traversed by spiral cords.

Teleoconch of up to 3.30 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs, 52–97 (mean 71.15, SD 13.53, $n = 52$) on second whorl; and overlying fine, crisp, spiral threads and much weaker axial threads, no beading at intersections; axial threads surmounted by periostracal lamellae, lamella at summit of each primary axial rib strongly elevated. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker, its thin rim overhanging umbilical depression.

DISTRIBUTION: Northern North Island, between Cape Reinga and North Cape and as far south as Te Kao (Fig. 6D). Also known as a fossil in Holocene dunes at Spirits Bay (M.180393), close to the known extant range.

BIOLOGY: *Allodiscus spiritus* occurs in the ground litter of broadleaved and mixed Kānuka/broadleaved shrublands and forests, to about 310 m elevation.

CONSERVATION STATUS: McGuinness (2001) assessed the status of *Allodiscus spiritus* as ‘declining’. This reflected the historical trends in habitat condition in the northern Aupouri Peninsula, as described by Brook (2002b). Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007) listed the species as ‘range restricted’, with which we concur. Our assessment is that, while some habitat degradation continues over part of the range, the wide distribution of *Allodiscus spiritus* in the northern Aupouri Peninsula provides some buffering against stochastic population disturbances. The collections examined in the present work show that the extant range of the species extends further south than previously recorded, with the southernmost population at Te Kao, southern Parengarenga Harbour.

REMARKS: Powell (1952) separated *Allodiscus spiritus* from *A. dimorphus* (Reeve, 1852) on the basis of ‘darker and more clear-cut tessellated pattern, more than twice as many radials, 100–104 on the penultimate whorl’, with the adult whorls ‘more rounded and not so deep’, and from *A. fallax* Powell, 1952 by having ‘more distinct’ spirals on the proto-conch. As with *Allodiscus fallax* (see above), colour pattern and colour intensity are variable in both taxa, and we are unable to separate them convincingly using any of these criteria. Moreover, there is great variation and strong overlap in the number of axial ribs, with *Allodiscus spiritus* having 52–97 (mean 71.15, SD 13.53, $n = 52$), and *A. dimorphus* 45–85 (mean 54.07, SD 7.15, $n = 41$) rather

than ‘45–48’ as reported by Powell. Climo (1969b) earlier highlighted the difficulty of separating *Allodiscus dimorphus* and *A. spiritus* on the basis of Powell’s diagnoses.

Genetic distances (unpublished data, F.J. Brook) between topotypes of *Allodiscus spiritus* and *A. dimorphus* from Coromandel Peninsula and Great Barrier Island suggest that these taxa are specifically distinct. *Allodiscus spiritus* and *A. dimorphus* are strongly allopatric, *A. spiritus* being restricted to northern Northland, some 60 km northwest of the northernmost known population of *A. dimorphus* (Figs 3E, 6E). Presumably *Allodiscus spiritus* diverged from *A. dimorphus* stock during the Pliocene, when the northern tip of Aupouri Peninsula was an island (Isaac *et al.* 1994).

Powell (1952) described the radular dentition, giving the radular formula as 32 + 1 + 32. Central tooth is tricuspid, mesocone long and flanked on either side by a minute ectocone. Lateral teeth are bicuspid by suppression of the endocone. Marginal teeth have a bifurcating mesocone and smaller ectocone split into 3–6 cusps.

The reproductive anatomy of *Allodiscus spiritus* is not presently known.

Allodiscus venulatus (L. Pfeiffer, 1857)

(Figs 1I, 5K–O, 6E)

Helix venulata Pfeiffer, 1857: 108; Pfeiffer, 1859: 163; Hector, 1873: 18; Martens, 1873: 12.

Patula (Flammulina) venulata.– Hutton, 1880: 10.

Nanina (Microcystis) venulata.– Pfeiffer & Clessin, 1881: 36.

Psyra venulata.– Hutton, 1883b: 532.

Charopa (Psyra) venulata.– Tryon, 1886: 211.

Allodiscus venulata.– Hedley & Suter, 1893: 638 (in part = *A. chion* Sykes, 1896).

Flammulina (Allodiscus) venulata.– Pilsbry, 1893: 15 (in part = *A. chion*); Suter, 1894d: 251 (in part = *A. chion*); Suter, 1901: 208.

Allodiscus cf. spiritus.– Mahlfeld, 2000: appendix 8 (not of Powell, 1952).

NOT *Patula venulata*.– Hutton, 1884a: 165, pl. 11, fig. Y = *Phacussa* sp. (CM M115) + *A. chion* (CM M.116).

NOT *Psyra venulata*.– Hutton, 1884b: 201. Mt Cook record = *Phacussa* sp. (M.170117), Greymouth record = *A. chion* (CM M.116).

NOT *Flammulina (Allodiscus) venulata*.– Suter, 1894b: 146; Hedley & Suter, 1893: 638 – Mt Cook record = *Phacussa* sp. (M.170198), Greymouth record = *A. chion*.

NOT *Allodiscus venulatus*.– Suter, 1913: 647 – Mt Cook record = *Phacussa* sp., Greymouth record = *A. chion*;

Powell, 1937: 88 (= *A. chion* and/or *Phacussa* sp.); Powell, 1946: 92 (= *A. chion* and/or *Phacussa* sp.); Dell, 1955: 1137 (CM M.642 = *Phacussa* sp.); Powell, 1957: 117 (= *A. chion* and/or *Phacussa* sp.); Powell, 1962: 110 (= *A. chion* and/or *Phacussa* sp.); Powell, 1976: 117 (= *A. chion* and/or *Phacussa* sp.); Powell, 1979: 321 (= *A. chion* and/or *Phacussa* sp. and possibly other species); Goulstone, 1985: 7, text fig. 8 (= *A. worthyi*); Goulstone, 1988: 9, text figs. (= *A. worthyi*).

NOT *Allodiscus* (*Allodiscus*) *venulatus*.— Climo, 1969b: 50, figs 1b, 12h–j, 15c, 23c, 25a – Bainham record = *A. worthyi* n.sp. (M.25277, M.30365), Taupata Creek record = *A. worthyi* (M.30360, M.107699), Mt Burnett record = *A. climo* n.sp. (M.30534).

TYPE MATERIAL: Lectotype (here selected) BMNH 1996150/1 and 2 conspecific paralectotypes BMNH 1996150/2–3: ‘New Zealand’, H. Cuming colln.

MATERIAL EXAMINED (8 lots): Type material (see above), M.82883 (1), M.124973 (15), M.124977 (many), M.124982 (8), M.164329 (1), M.164356 (2).

REDESCRIPTION: Shell up to 6.60 mm wide, thin, wider than high (HWR 0.56–0.63), spire moderately elevated (18–27% SH), very narrow umbilicus completely overhung or filled by spreading inner lip. Protoconch translucent buff; teleoconch translucent buff with bold pattern of irregular reddish-brown maculations that transform near insertion and extend around periphery and over base as a finer, diagonally reticulate or zigzag pattern of variable spacing and regularity.

Protoconch of about 1.20 convex whorls, 900–970 µm wide, first quarter-whorl more or less smooth (very fine flocculant sculpture and indistinct wavy spiral threads), thereafter sculptured with numerous (c. 40–45), fine, crisp spiral threads surmounted by minute granules, the granules typically at intersections with irregular, short, weak, inconspicuous radial threads.

Teleoconch of up to 3.10 broadly convex whorls, sculptured with prominent, regularly spaced primary axial ribs; and overlying fine, crisp spiral threads, and much weaker axial threads, intersections finely beaded; axial threads surmounted by periostacal lamellae, lamella at summit of each primary axial rib much more strongly elevated than others. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin at rim, weakly and evenly thickened within; inner lip thicker within, rim overhanging and almost entirely occluding umbilicus.

DISTRIBUTION: Coastal northern North Island, Maunganui Bluff (Fig. 6E).

BIOLOGY: *Allodiscus venulatus* is known from coastal broad-leaved scrub, shrubland and forest, where it occurs in leaf litter and among rocks.

CONSERVATION STATUS: *Allodiscus venulatus* is known presently only from Maunganui Bluff, but the species may be more widely distributed coastally between Kaipara Harbour entrance and Ahipara. The species is thus range restricted. Given the ongoing degradation and loss of the coastal habitat due to development projects, and the vulnerability to fire, our assessment is that *Allodiscus venulatus* should be afforded the status of ‘nationally vulnerable’ according to the criteria of Molloy *et al.* (2002). Additional information from further surveys in western Northland is required to establish the conservation status of the species properly.

Allodiscus venulatus has been overlooked in previous assessments of the conservation status of New Zealand landsnails.

REMARKS: The specimen chosen as lectotype has the best-preserved sculpture and colour pattern, although the shell is somewhat damaged. The only specimens we have seen that approach the type material in gross facies are from Maunganui Bluff, western Northland (M.82883, M.124973, M.124977, M.124982, M.164329, M.164356), and were obtained from *Phormium* (flax) litter and amongst stones under *Astelia*. Maunganui Bluff specimens differ from the type specimens, however, in that the teleoconch whorls expand more rapidly so that the shell is wider relative to the number of whorls (lectotype: 3.85 × 5.60 mm, 3.40 teleoconch whorls). While it seems clear that the type specimens were not from the Maunganui Bluff population, given their close similarity there can be little doubt that they also originated from coastal western Northland.

As indicated by the synonymy, specimens identified as Pfeiffer’s species by Hutton (1884a, 1884b), Hedley & Suter (1893), Suter (1913), Dell (1955), Climo (1969b) and Powell (1979) represent one or more species of *Phacussa*, *Allodiscus chion*, *A. worthyi* n.sp., *A. climo* n.sp. and probably others.

Allodiscus venulatus differs from *A. dimorphus* (Reeve, 1852) in attaining a smaller size (width up to 6.60 mm, versus 9.70 mm), in being smaller relative to the number of whorls, in having a smaller protoconch (width 900–970 µm, versus 1200–1370 µm), and in other details of shell morphology.

The anatomy of *Allodiscus venulatus* is not presently known.

Allodiscus sensu lato
Group A (*turbotti*)

DIAGNOSIS: Shell of medium size (maximum width 5.90 mm), high (HWR 0.67–0.71), spire rather strongly elevated (26–38% SH). Narrowly umbilicate (width 8.0–10.3% SW). Protoconch medium-sized (width 870–930 µm), sculptured throughout with axial riblets and finer spiral threads.

REMARKS: Although similar to species of *Allodiscus* (*s. str.*) in size, shape and teleoconch sculpture, *Allodiscus turbotti* differs markedly in that the protoconch is sculptured with prominent axial riblets and finer spiral threads rather than fine crowded spiral threads alone. Gene sequence data (unpublished, F.J. Brook) suggests that *Allodiscus turbotti* probably belongs to a distinct genus.

***Allodiscus turbotti* Powell, 1948**

(Figs 1K, 6F, 7A–E)

Allodiscus turbotti Powell, 1948: 276, pl. 53, fig. 1; Powell, 1957: 117; Powell, 1962: 110; Price, 1963: 63; Powell, 1976: 117; Powell, 1979: 318, pl. 58, figs 3, 4; Spencer & Willan, 1996: 40; Brook, 1999a: 10; McGuinness, 2001: 576; Brook, 2002a: 71, 85; Brook, 2002b: 69; Hitchmough, 2002: 114; Hitchmough *et al.*, 2007: 76.

Allodiscus (Allodiscus) turbotti.—Climo, 1969b: 48, figs 13b–d, 25a; Climo, 1973: 597, figs 5F, 14C, 23A, B, D–F.

TYPE MATERIAL: Holotype AIM AK 70898: Three Kings Islands, Great Island, NE of Hakupu Point, in sparse pōhutukawa and kānuka forest, 8 May 1946, E.G. Turbott.
MATERIAL EXAMINED (52 lots): Type material (see above), M.16826 (5), M.23067 (3), M.29347 (7), M.29348 (7), M.29349 (2), M.29350 (5), M.29351 (5), M.29353 (1), M.29354 (3), M.29355 (3), M.29356 (1), M.29357 (2), M.29358 (7), M.29359 (11), M.29360 (13), M.47285 (2), M.114925 (1), M.155485 (1), M.155493 (4), M.155509 (8), M.155521 (6), M.155530 (4), M.155540 (7), M.155557 (5), M.155577 (1), M.155589 (1), M.155629 (1), M.155643 (13), M.155672 (1), M.155678 (many), M.155687 (11), M.155697 (15), M.155706 (11), M.155714 (15), M.155725 (4), M.155737 (1), M.155748 (2), M.155756 (7), M.155770 (1), M.155799 (3), M.155822 (7), M.155832 (9), M.155845 (5), M.174544 (20), M.174553 (10), M.174612 (4), M.174622 (4), M.174666 (4), M.174677 (2), M.174721 (1), M.180013 (3).

REDESCRIPTION: Shell up to 5.90 mm wide, thin, wider than high (HWR 0.67–0.71), spire rather strongly elevated

(26–38% SH), umbilicus of moderate width (8.0–10.3% SW). Protoconch translucent buff; teleoconch translucent buff with bold pattern of irregular reddish-brown maculations that transform near insertion and extend around periphery and over base as finer diagonally reticulate or zigzag pattern of variable spacing and regularity.

Protoconch of about 1.25 convex whorls, 870–930 µm wide, sculptured with fine, roundly elevated, crisp axial riblets that are traversed by 38–40 finer, closer spiral threads, finely nodular at intersections; axial interspaces each with 3 or 4 even finer axial threads.

Teleoconch of up to 4.10 broadly convex whorls, sculptured outside narrow subsutural band with prominent, regularly spaced primary axial ribs; and overlying fine, crisp, spiral threads, and much weaker axial threads, intersections finely beaded; axial threads surmounted by periostracal lamellae, lamella at summit of each primary axial rib more strongly elevated than others. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, lips thin, weakly and evenly thickened within; inner lip rim overhanging edge of umbilicus.

DISTRIBUTION: South West, Great and North East islands, Three Kings Islands (Fig. 6F).

BIOLOGY: *Allodiscus turbotti* is a litter-dweller of broadleaved and Kānuka forests (Brook 2002a).

CONSERVATION STATUS: *Allodiscus turbotti* occurs on three islands in the Three Kings Islands group. The species is widely distributed and common on Great Island, but sparsely distributed and less common on South West and North East islands (Brook 1999a, 2002a). The listing as ‘range restricted’ by Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007) is appropriate.

REMARKS: *Allodiscus turbotti* is strongly characterised by the combination of axially ribbed protoconch, relatively strongly elevated spire and bold colour pattern.

Climo (1973) described the radular dentition and reproductive anatomy. The radular formula is given as 11–12 + 7–8 + 1 + 7–8 + 11–12. The central tooth tricuspid with a prominent mesocone that extends about two-thirds the length of the basal plate, flanked on either side by a small cusp; the lateral teeth similarly tricuspid, becoming bicuspid with suppression of the endocone, the mesocone progressively elongate, sabre-like in lateral–marginal transition and in marginal teeth; the marginal teeth with ectocone divided into several small accessory cusps.

The reproductive anatomy of *Allodiscus turbotti* is characterised (Climo 1973) by the bursa duct being initially

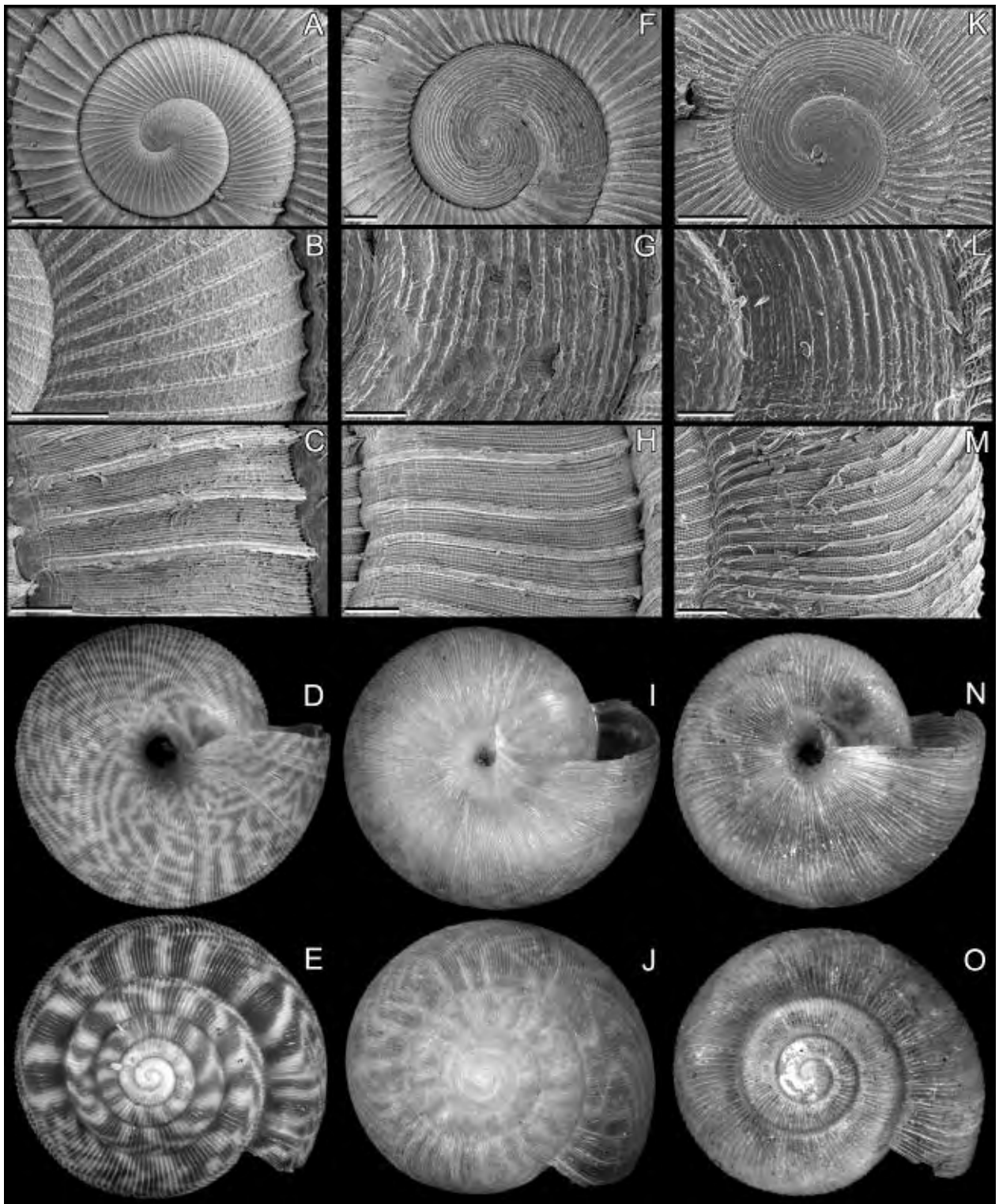


Fig. 7 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus turbotti* Powell, 1948, Three Kings Island, Great Island, M.155678 (D, E, 4.00 × 5.45 mm); F–O, *Allodiscus adriana* (Hutton, 1883), Christchurch, Victoria Park, M.89765 (F–H), Christchurch, Sumner Cliffs, M.72505 (I, J, 2.40 × 4.35 mm), W of Methven, Mt Summers, M.92775 (K–M), and M.125181 (N, O, syntype of *Allodiscus smithi* Suter, 1894, 1.25 × 2.45 mm). Scale bars 50 µm (G, L), 100 µm (B, C, F, H, M), 200 µm (A, K).

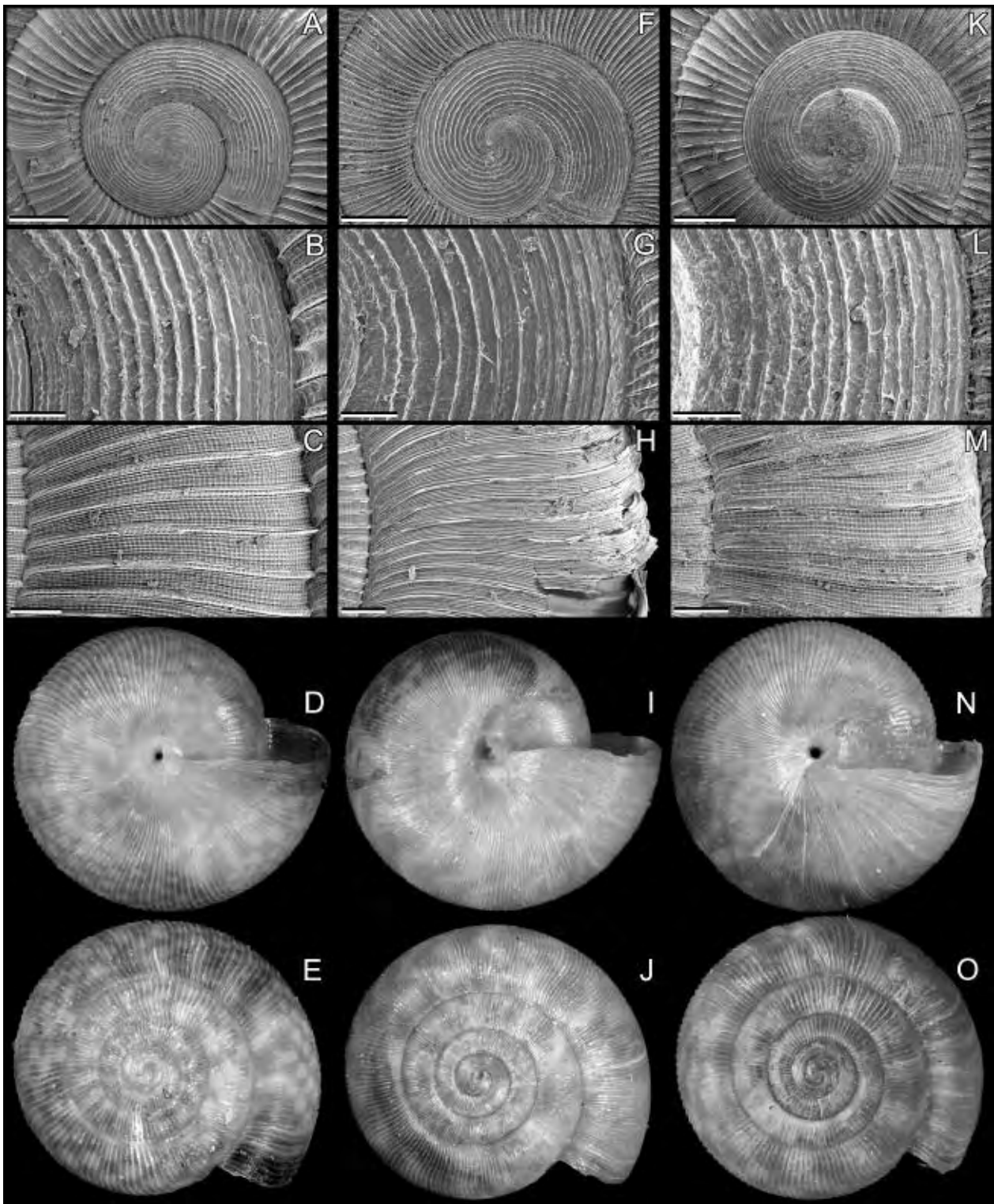


Fig. 8 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus mabfeldae* n.sp., Wellington, Lowry Bay, holotype, M.180015 (2.18 × 3.90 mm); F–J, *Allodiscus southlandicus* n.sp., SE of Mataura, Catlins Forest Park, holotype, M.157472 (F–H), and NE of Bluff, Seaward Downs Reserve, paratype, M.21445 (I, J, 2.40 × 4.15 mm); K–O, *Allodiscus tullia* (Gray, 1850), NE of Kaikoura, Nidd Swamp, M.25067 (K–M), and E of Waipara, Crofts Road, M.124054 (N, O, 2.30 × 3.85 mm). Scale bars 50 µm (B, G, L), 100 µm (C, H, M), 200 µm (A, F, K).

slender, then enlarged to a spindle-shape basal section before then tapering gradually to the bursa sac; vagina elongate, slender; penis elongate, divided into bulkier proximal and slender distal sections of similar length, the vas deferens inserted into the apex of a prominent lateral appendix on the lower part, and the penial retractor attaching to the apex of the proximal section.

Group B (*tullia*)

DIAGNOSIS: Shell of small to medium size (maximum width 4.15–6.05), low relative to width (HWR 0.49–0.63), spire weakly to moderately elevated (15.5–36% SH). Narrowly umbilicate (3.4–9.2% SW) or anomphalous. Protoconch medium sized (width 630–970 μ m), sculptured with 12–18 crisp spiral threads, each surmounted by a low periostacal blade, interspaces wider than each spiral.

REMARKS: Referred species: *Allodiscus adriana* (Hutton, 1883a), *A. mahlfeldae* n.sp., *A. southlandicus* n.sp., *A. tullia* (Gray, 1850), *A. wairarapa* n.sp., *A. wairoaensis* Suter, 1894, *A. waitomo* n.sp. and *A. yaldwyni* n.sp. Group B species differ from members of *Allodiscus* (*s. str.*) principally in having far fewer, stronger and more widely spaced spiral threads on the protoconch (<19 versus >25). Most Group B species also attain a smaller size (maximum width 4.15–6.05 mm, versus 5–16 mm), have smaller protoconchs (width 630–970 μ m, versus 900–1700 μ m), and are lower relative to their width (HWR 0.49–0.63, versus 0.56–0.70), although there is overlap between the two groups.

Allodiscus adriana (Hutton, 1883)

(Figs 1J, 7F–O, 9A)

Fruticicola adriana Hutton, 1883a: 476; Hutton, 1884a: 175; Freeman *et al.*, 1996: 30.

Psyra adriana.– Hutton, 1884b: 201 (in part? – identity of Napier record unknown).

Allodiscus adriana.– Hedley & Suter, 1893: 639 (in part = *Pseudallodiscus ponderi* Climo, 1971); Suter, 1913: 637 (in part = *P. ponderi* + *A. tessellatus* Powell, 1941); Powell, 1937: 87 (in part: North Island record erroneous); Powell, 1946: 92 (in part: North Island record erroneous); Powell, 1957: 117 (in part: North Island record erroneous); Powell, 1962: 109 (in part: North Island record erroneous); Powell, 1976: 117 (in part: North Island record erroneous); Powell, 1979: 319 (in part: ‘Cape Maria van Diemen’ record = *Phenacohelix tholoides* (Suter, 1907)); Spencer & Willan, 1996: 40 (in part = *P. tholoides*).

?*Allodiscus smithi* Suter, 1894a: 134, pl. 20, figs 36–36b; Suter, 1913: 644, pl. 9, figs 5, 5a,b; Powell, 1979: 320; Marshall, 1996: 40; Spencer & Willan, 1996: 40.

Flammulina (*Allodiscus*) *adriana*.– Pilsbry, 1893: 15; Suter, 1894b: 146 (in part = *P. ponderi*); Suter, 1894d: 252 (in part = *P. ponderi*).

Flammulina (*Allodiscus*) *smithi*.– Suter, 1894b: 146; Suter, 1894d: 253.

Allodiscus mossi.– Suter, 1913: 642 (in part) (not of Murdoch, 1897).

Allodiscus planulatus.– Suter, 1913: 643 (in part) (not of Hutton, 1883).

Allodiscus tullia.– Suter, 1913: 646 (in part, i.e. Albury Rocks, M.170211).

Allodiscus (*Allodiscus*) *adriana*.– Climo, 1969b: 11, figs 2c, 6d, 14h, 16a–b, 22d, 24a.

?*Allodiscus* (*Allodiscus*) *smithi*.– Climo, 1969b: 42, figs 2b, 5d–f, 20c, 22b, 24a.

Allodiscus (*Allodiscus*) *wairoaensis*.– Climo, 1969b: 52, figs 1c, 7, 16c–e, 24a,c (in part = *A. wairoaensis* Suter, 1894 + *A. tullia* Gray, 1850).

Charopidae sp. 55 (NMNZM.82255) Spencer *et al.*, in press.

Charopidae sp. 118 (NMNZ M.123272) Spencer *et al.*, in press.

Charopidae sp. 121 (NMNZ M.101337) Spencer *et al.*, in press.

Charopidae sp. 147 (NMNZ M.25228) Spencer *et al.*, in press.

NOT *Psyra adriana*.– Suter, 1892a: 272 (= *P. ponderi*).

TYPE MATERIAL: *Fruticicola adriana* – syntypes CM M162 (4), CM M12774 (1): South Island, Christchurch, R. Brown.

Allodiscus smithi – syntypes (2) NMNZ M.125181: South Island, ‘Mount Somers, W.W. Smith’.

MATERIAL EXAMINED (160 lots): Type material (see above), M.8979 (many), M.12147 (8), M.12148 (2), M.12157 (12), M.21018 (1), M.22466 (3), M.23301 (5), M.25228 (1), M.28724 (1), M.28956 (3), M.29517 (2), M.29981 (5), M.31211 (1), M.36766 (4), M.37046 (1), M.38055 (5), M.48185 (3), M.48189 (2), M.48190 (5), M.48202 (1), M.61899 (3), M.69184 (2), M.72505 (1), M.72980 (2), M.76498 (2), M.76500 (2), M.76515 (1), M.76637 (3), M.76739 (2), M.77388 (5), M.79046 (2), M.79286 (3), M.79667 (many), M.79829 (8), M.81623 (2), M.82255 (4), M.82771 (2), M.84539 (7), M.85238 (3), M.85281 (2), M.85294 (1), M.85648 (1), M.85779 (9), M.85794 (9), M.85797 (7), M.88949 (2), M.88958 (6), M.88991 (1), M.89765 (6), M.92775 (1), M.97484 (many), M.99634 (4),

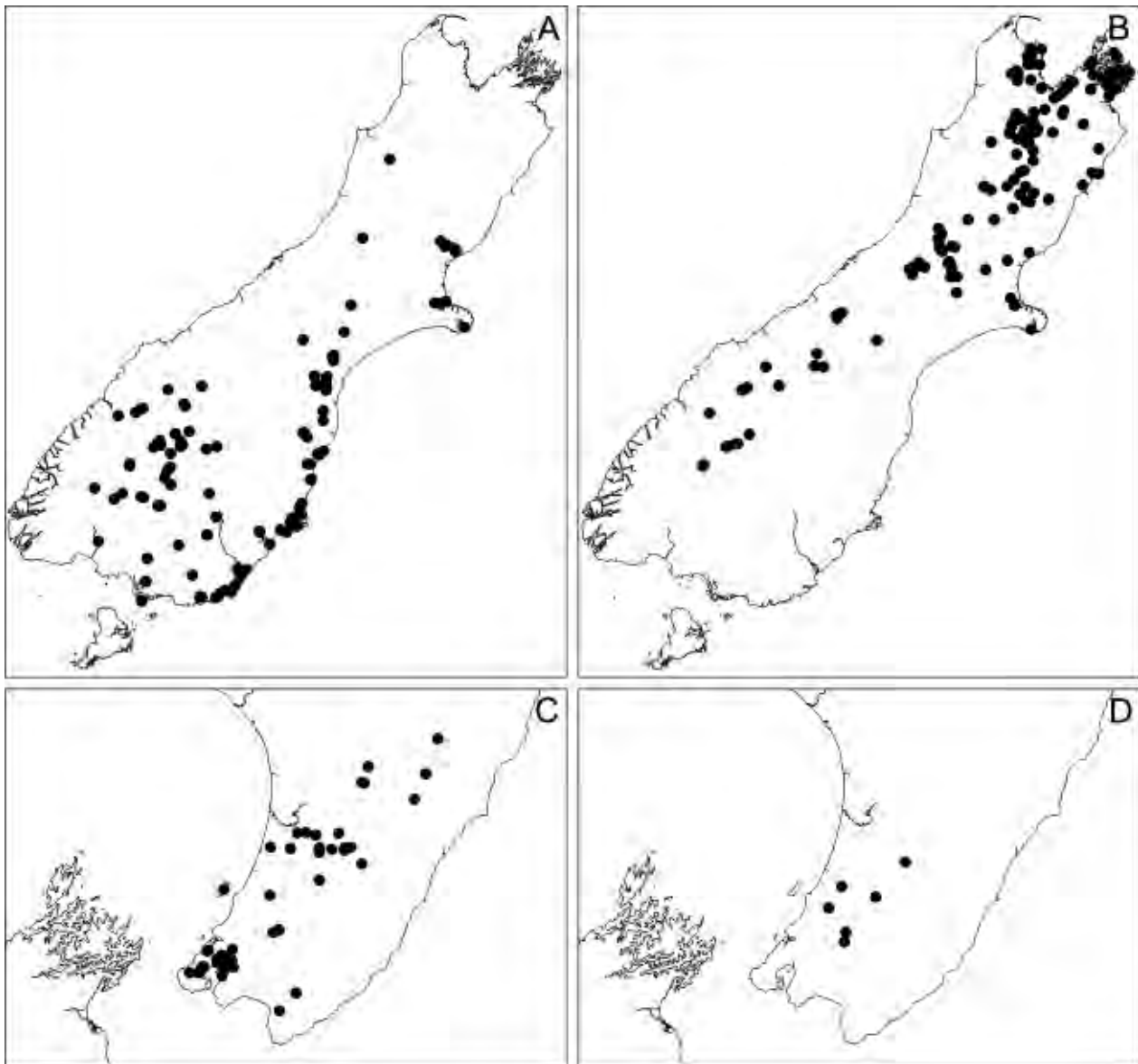


Fig. 9 Distributions of *Allodiscus* (*s. lat.*) species within New Zealand. A, *Allodiscus adriana* (Hutton, 1883); B, *Allodiscus tullia* (Gray, 1850); C, *Allodiscus mahlfeldae* n.sp.; D, *Allodiscus wairarapa* n.sp.

M.99656 (3), M.99665 (1), M.99752 (2), M.99763 (3), M.99902 (1), M.99925 (1), M.100158 (14), M.101337 (1), M.103010 (3), M.103047 (1), M.103315 (1), M.103351 (2), M.103413 (10), M.105814 (9), M.114203 (many), M.114214 (many), M.116470 (1), M.121072 (6), M.123183 (1), M.123251 (many), M.123184 (many), M.123202 (7), M.123251 (many), M.123272 (2), M.123293 (7), M.123357 (6), M.123430 (many), M.124065 (5), M.124072 (4), M.124084 (10), M.124102 (3), M.126650 (2), M.126692 (2), M.127644 (1), M.146639 (3), M.146653 (3), M.146716 (1), M.146863 (8), M.146925 (3), M.146940 (2), M.146953 (7),

M.146962 (1), M.146980 (4), M.156239 (1), M.156799 (2), M.157045 (1), M.157379 (1), M.157398 (2), M.157408 (3), M.157433 (1), M.157435 (1), M.157464 (1), M.157577 (1), M.157611 (5), M.157631 (5), M.157634 (9), M.157659 (2), M.157670 (3), M.157901 (6), M.157924 (2), M.157932 (1), M.157983 (many), M.157986 (1), M.159118 (1), M.159153 (2), M.159157 (6), M.159185 (2), M.159194 (15), M.159217 (13), M.159230 (4), M.159235 (many), M.159277 (10), M.159280 (1), M.159286 (4), M.159315 (2), M.159332 (3), M.159333 (2), M.159344 (2), M.159346 (7), M.159362 (2), M.159662 (4), M.170161 (2), M.170184 (1), M.170187 (5),

M.170209 (2), M.170211 (1), M.170213 (6), M.174246 (many), M.175041 (1), M.175072 (4), M.175076 (1), M.175096 (6), M.175099 (3), M.175101 (2), M.175102 (11), M.175104 (1), M.175105 (1), M.175107 (6), M.175122 (1), M.175265 (10), M.175297 (1), M.175298 (1), M.177538 (many), M.177541 (many), M.177664 (10).
REDESCRIPTION: Shell up to 6.05 mm wide, thin, low and broad (HWR 0.49–0.54), spire weakly to moderately elevated (16–26% SH), narrowly umbilicate or partly or fully invaded by inner lip (4.8–9.2% SW). Protoconch and teleoconch ground translucent white; teleoconch with irregular pattern of yellowish-brown zigzag radial lines.

Protoconch of 1.10–1.20 convex whorls, weakly elevated, 670–770 µm wide, sculptured with crisp, widely spaced spiral threads that number 16–20 on spire on last half-whorl, distinctly and irregularly wavy at nucleus, more or less regular thereafter, each surmounted by a low periostacal lamella; interspaces with weak, irregular, prosocline radial lines; additionally 3–10 more or less well-defined collabral riblets beside boundary with teleoconch.

Teleoconch of up to 3.25 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by much finer, crisp, reticulating spiral threads and weaker axial threads, the latter surmounted by periostacal lamellae that are more prominent than spirals, spirals extremely finely nodular at intersections; lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, outer lip thin at rim, slightly thicker within; inner lip thicker than outer, projected abaperturally and partly overhanging or completely invading umbilicus.

DISTRIBUTION: South Island, from vicinity of Christchurch to as far south as Bluff (Fig. 9A). Records over this range include fossils from Holocene deposits on beaches (e.g. M.6979, M.12157), and in caves (M.123430) and cliffs (e.g. M.123202, M.126650, M.177538, M.177541).

BIOLOGY: *Allodiscus adriana* is widely distributed geographically and environmentally in the South Island. The species occurs in broadleaved/podocarp forests and shrublands, and in tussock grasslands, from near sea-level to above 1600 m elevation. It is a ground-dweller, occurring in leaf litter, under woody debris and in crevices of rock rubble and rocky escarpments.

CONSERVATION STATUS: *Allodiscus adriana* is widely distributed and is not rare. Our assessment is that the species is of no immediate conservation concern.

REMARKS: *Allodiscus adriana* may be readily distinguished from the superficially similar species *A. tullia* by the presence of several collabral riblets on the last eighth-whorl of the protoconch, and the more strongly sigmoidal primary axial ribs on the teleoconch.

The type specimens of *Allodiscus smithi* Suter, 1894 and another specimen (M.92775, Figs 7K–M from Mt Summers) (the type locality) resemble specimens of *A. adriana* from the type locality (Christchurch) and further south in protoconch and teleoconch facies, colour and colour pattern, size relative to the number of whorls, and protoconch sculpture, including the presence of axial riblets near the boundary with the teleoconch. However, they are smaller (width up to 2.45 mm, versus 6.05 mm), widely umbilicate (width 8.5–12.0% SW) and have a smaller protoconch (width 570–600 µm, versus typically 570–670 µm). Populations of similarly small forms occur sporadically further south, e.g. at Pareora River Scenic Reserve (M.99656). Specimens from near Lake Hawea are also small (width up to 2.65 mm, protoconch 570–630 µm wide, M.105814) but are narrowly umbilicate (width 5.1–5.6% SW). Specimens from lime-rich sites north of Christchurch (e.g. M.124084) are as widely umbilicate as specimens from Mt Summers (width 6.4–10.4% SW), but their shells and protoconchs are as large as many southern specimens (shell width up to 4.30 mm, protoconch 630–700 µm wide). Differences in protoconch width are directly related to the number of whorls, the smallest protoconchs having up to half a whorl less than the largest ones. There are also considerable differences in the number and spacing of the primary axial ribs. Since there is clearly much variation within and between populations, we consider that the Mt Summers population is possibly a local population of *Allodiscus adriana*.

Climo (1969b), however, recognised *Allodiscus smithi* as distinct from, but closely related to, *A. adriana*. Climo (1969b: 44) stated ‘that *A. smithi* is closely related to *A. adriana* is shown by the similarity in radular morphology and the apparently identical reproductive morphology. However, the two species occur sympatrically at Montgomery Park, Banks Peninsula and the size difference is at once apparent.’ Climo’s (1969b, p. 43) note ‘Reproductive system as described for *adriana*, but mature organs are much smaller’ may not be significant in that the size of the reproductive organs are likely to scale with the size of the animal. Nonetheless, Climo’s (1969b) figures of the reproductive anatomies do suggest that two taxa may be involved, the smaller, possibly

Allodiscus smithi, with a shorter, more rotund penis than *A. adriana*, with the diverticulum oriented apically rather than subapically, and the basal part of the duct to the bursa copulatrix slender rather than bulbous. In addition, while Climo's descriptions indicate that the radular dentition is similar in the two forms, in putative *Allodiscus smithi*, the sabre-like cusp of the primarily unicuspid lateral teeth is distinctly shorter, and the number of marginal teeth is reduced. We have been unable to locate the specimens from Montgomery Park. Moreover, since we have not seen any other examples of sympatry, we tentatively interpret *Allodiscus smithi* as a synonym of *A. adriana*.

Suter (1894a) described the jaw and radula of *Allodiscus smithi*. The radular formula was given as 11 + 4 + 1 + 4 + 11; central tooth tricuspid; lateral teeth broader than the central tooth, tricuspid but endocone rudimentary; marginal teeth mostly tricuspid but some with an additional cusp. Climo (1969b) gave the radular formula of *Allodiscus smithi* as 1–12 + 4–5 + 1 + 4–5 + 11–12, and his description and illustrations indicate a tricuspid central tooth, with the mesocone extending three-quarters the length of the basal plate and the basal plate slightly narrower than that of the lateral teeth; lateral teeth bicuspid via suppression of the endocone, with the mesocone progressively elongate, sabre-like towards the lateral–marginal transition; marginal teeth tricuspid to multicuspid, with bifurcation of the mesocone and subdivision of the ectocone.

Climo (1969b) gave the radular formula of *Allodiscus adriana* as 11–12 + 4–5 + 1 + 4–5 + 11–12, and his description and illustrations indicate a tricuspid central tooth, with the mesocone extending three-quarters the length of the basal plate and the basal plate broader than that of the lateral teeth; lateral teeth bicuspid via suppression of the endocone, with the mesocone elongate and extending the length of the basal plate, becoming progressively more elongated and sabre-like towards the lateral–marginal transition, the ectocone becoming obsolete; marginal teeth unicuspid with the long mesocone, becoming multicuspid towards the margin of the radular ribbon due to bifurcation of the mesocone and with subdivision of the ectocone.

Climo (1969b) described the radula and reproductive anatomy of *Allodiscus adriana* based on dissected material from Canterbury and Otago, and that of *A. smithi* from Banks Peninsula, Canterbury, and Waimate, Otago. Climo (1969b: 13) observed that the 'diagnostic tooth structure [of *Allodiscus adriana*] is shared by Otago and Canterbury specimens'.

Allodiscus mahlfeldae new species

(Figs 1L, 8A–E, 9C)

Psyra tullia.– Suter, 1892a: 272 (not Gray, 1850).

Allodiscus tullia.– Hedley & Suter, 1893: 638 (in part of Gray); Suter, 1913: 646 (in part of Gray).

Allodiscus planulatus.– Hedley & Suter, 1893: 638 (in part of Hutton, 1883); Suter, 1913: 643 (in part of Hutton); ?Climo, 1968: 46.

Flammulina (Allodiscus) tullia.– Suter, 1894b: 146 (in part of Gray); Suter, 1894d: 251 (in part of Gray).

Flammulina (Allodiscus) planulata.– Suter, 1894b: 146 (in part of Hutton); Suter, 1894d: 252 (in part of Hutton).

Allodiscus (Allodiscus) tessellatus.– Climo, 1969b: 46, figs 1a, 8, 20a–b, 24a,b (in part of Powell, 1941 + *A. wairoensis* Suter, 1894 + *A. worthyi* n.sp.).

Allodiscus aff. *tessellatus*.– Solem *et al.*, 1981: 480.

TYPE MATERIAL: Holotype NMNZ M.180015 and paratypes M.30525 (7), AIM AK 73273 (1): Lower Hutt, Lowry Bay, (NZMS 260, R27/705924), 6 Jun. 1938, R.A. Cumber. Additional paratypes: Wellington, Khandallah Park, 11 Oct. 1981, F.M. Climo, M.79063 (8), 7 Jun. 1992, F.M. Climo, M.113789 (2); Wellington, Mt Kaukau, 3 Feb. 1993, K. Mahlfeld, M.116488 (2); Wellington, Ngaio, 17 May 1969, F.M. Climo, M.22198 (2); Lower Hutt, Jubilee Park, 1957, A.G. Beu, M.23362 (2); Lower Hutt, Korokoro Dam, 30 Jun. 1993, F.M. Climo, M.115758 (1); Hutt Valley, opposite Haywards Hill substation, 2 Aug. 1982, B.F. Hazelwood, M.72805 (1); NE of Wellington, Wainuiomata Hill, 6 Apr. 1948, R.K. Dell, M.30560 (2), 7 Jul. 1956, W.F. Ponder, M.127858 (11).

MATERIAL EXAMINED (72 lots): Type material (see above), M.14154 (1), M.22325 (1), M.23077 (2), M.23352 (1), M.23357 (1), M.23359 (1), M.23360 (1), M.23361 (2), M.23424 (2), M.23426 (1), M.24802 (1), M.24855 (2), M.25268 (9), M.30022 (1), M.30553 (5), M.30556 (1), M.30562 (1), M.30564 (1), M.30566 (1), M.31094 (1), M.32912 (2), M.38690 (3), M.46878 (2), M.46992 (1), M.46993 (1), M.46994 (1), M.47137 (1), M.47997 (1), M.48702 (1), M.55247 (3), M.68612 (1), M.69405 (3), M.69483 (1), M.70463 (1), M.70598 (1), M.77245 (6), M.78839 (5), M.79686 (1), M.85298 (1), M.92756 (1), M.98062 (1), M.98366 (2), M.98444 (1), M.102945 (7), M.104201 (4), M.104276 (21), M.115688 (1), M.115801 (1), M.115836 (2), M.120346 (3), M.127972 (1), M.128653 (1), M.128667 (1), M.128668 (1), M.156790 (1), M.170147 (2), M.170192 (2), M.170196 (3), M.170217 (3), M.170221 (1).

DESCRIPTION: Shell up to 4.50 mm wide, wider than high

(HWR 0.52–0.57), thin, spire moderately elevated (22–34% SH), umbilicus narrow to very narrow and partly overhung by inner lip (<5.5% SW). Protoconch pale translucent buff; teleoconch translucent white with reddish-brown to yellowish-brown pattern of axial maculations of rather irregular width and spacing on spire, which transform abapically into diagonal chequer-board pattern that extends over sides and base; position of pattern transformation at insertion on first 1.5 whorls, climbing adapically thereafter; umbilicus white.

Protoconch weakly elevated, of 1.25–1.50 convex whorls, 700–730 µm wide, sculptured with fine spiral threads that number about 15 on spire on last half-whorl.

Teleoconch of up to 3.50 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by crisp spiral threads and fine axial periostracal lamellae; spiral threads very weakly beaded at intersections with low axial lamellae, periostracal lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture weakly and broadly sigmoidal. Aperture simple; outer lip thin, weakly and evenly thickened within; inner lip thicker and overhanging up to about half of umbilicus.

DISTRIBUTION: Southern North Island and Kapiti Island (Fig. 9C).

BIOLOGY: *Allodiscus mahlfeldae* occurs in the litter and under stones and rotten wood in lowland to montane broadleaved shrublands and forests.

CONSERVATION STATUS: *Allodiscus mahlfeldae* is widely distributed and is not rare. Our assessment is that the species is not of immediate conservation concern.

REMARKS: Compared with *Allodiscus tessellatus* Powell, 1941, which is similar in shape, size and colour pattern, *A. mahlfeldae* differs in having stronger, more widely spaced spiral threads on the protoconch, and in that the primary axial ribs are less flexuous, especially on the spire.

The radula and reproductive anatomy of *Allodiscus mahlfeldae* was described by Climo (1969b) (Naenae, Wellington, specimens, M.30564, as *A. tessellatus*; see synonymy above). The radular formula is 10 + 8 + 1 + 8 + 10; central tooth tricuspid, with mesocone extending to about half the length of the basal plate; lateral teeth bicuspid by suppression of the endocone, mesocone extending to about the length of the basal plate; marginal teeth tricuspid due to bifurcation of mesocone, cusps becoming short, more or less of equal length towards margin of the radular ribbon. In the male genitalia of the reproductive system, the penis is

bipartite, comprising a bulkier, elongate proximal part, internally equipped with several rows of papillae, extended apically to a bulbous region with the penial retractor attachment on its lateral aspect, and basally with the vas deferens opening via a prominent conical outgrowth of the penial wall; and a shorter distal part narrowing to the atrium.

ETYMOLOGY: After Karin Mahlfeld, Wellington, in appreciation of her work on *Cavellia* species and other landsnails in New Zealand's national collection at the Museum of New Zealand Te Papa Tongarewa. Noun in the genitive case.

Allodiscus southlandicus new species

(Figs 1M, 8F–J, 13C)

Allodiscus planulatus. – Goulstone, 1991a: 4, text fig. (not of Hutton, 1883).

TYPE MATERIAL: Holotype NMNZ M.157472: South Island, SE of Maitua, Catlins Forest Park, Egremont Road, 320 m (NZMS 260 F46/073185), Jan. 1994, P.C. Mayhill. Paratypes: N of Lumsden, Mt Bee, Jan. 1986, P.C. Mayhill, M.146958 (1); NE of Bluff, Seaward Downs Reserve, 24 Feb. 1967, P. Cresswell, M.21445 (2).

MATERIAL EXAMINED (3 lots): Type material (see above).

DESCRIPTION: Shell up to 4.15 mm wide, wider than high (HWR 0.57–0.62), thin, spire moderately elevated (15.5–20.8% SH), very narrow umbilicus half overhung by inner lip. Protoconch pale translucent and colourless; teleoconch translucent white with yellowish-brown pattern of irregular axial maculations, more or less radial on spire, zigzag pattern on sides and base.

Protoconch moderately elevated, of about 1.10 convex whorls, 630–670 µm wide, sculptured with fine, crisp, widely spaced spiral threads surmounted by low periostracal lamellae; distinctly wavy at nucleus, more or less even thereafter.

Teleoconch of up to 3.00 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and more closely spaced axial periostracal lamellae, intersections finely beaded; spiral threads almost entirely obsolete after first whorl; lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; outer lip thin, weakly and evenly thickened within; inner lip slightly thicker, rim overhanging edge of umbilicus.

DISTRIBUTION: Southern South Island (Fig. 13C).

BIOLOGY: *Allodiscus southlandicus* is known from litter of *Nothofagus* and broadleaved/podocarp forests.

CONSERVATION STATUS: *Allodiscus southlandicus* is presently known from only a total of four specimens from three locations in Southland. The species is evidently not common, but further survey is required to establish its conservation status properly. Our assessment is that *Allodiscus southlandicus* should be ranked 'data deficient' pending further search effort.

REMARKS: Among species treated herein, *Allodiscus southlandicus* is distinctive in that the spiral threads become obsolete after the first teleoconch whorl. The Chatham Island species *Allodiscus morioria* n.sp. also has a tendency to loss of spiral sculpture, although the spirals become discontinuous from axial rib to rib, rather than more or less entirely lost.

The anatomy of *Allodiscus southlandicus* is not presently known.

ETYMOLOGY: After Southland province, to which the species is restricted. Adjective in the nominative case.

Allodiscus tullia (Gray, 1850)

(Figs 1N, 8K–O, 9B)

Nanina tullia Gray, 1850: 165.

Helix tullia.– Reeve, 1854, pl. 207, fig. 1460; Martens, 1873: 12.

Helix (Thalassia) tullia.– Hector, 1873: 5.

Patula (Flammulina) tullia.– Hutton, 1880: 11.

Nanina (Thalassia) tullia.– Pfeiffer & Clessin, 1881: 46.

Charopa (Psyra) tullia.– Tryon, 1886: 211, pl. 62, fig. 40.

Psyra tullia.– Hutton, 1884b: 201; Suter, 1892a: 275; Suter, 1892b: 291, pl. 21, figs 18, 19.

Psyra tullia forma *albina* Suter, 1892a: 275 (nude name).

Allodiscus tullius.– Suter, 1893: 147.

Allodiscus tullia.– Hedley & Suter, 1893: 638 (in part = *A. wairoaensis* Suter, 1894); Suter, 1913: 646, pl. 25, figs 15, 15a, b (in part = *A. wairoaensis*); Powell, 1937: 88 (in part: North Island record erroneous); Powell, 1946: 92 (in part: North Island record erroneous); Powell, 1957: 117 (in part: North Island record erroneous); Powell, 1962: 110 (in part: North Island record erroneous); Powell, 1976: 117 (in part: North Island record erroneous); Powell, 1979: 321 (in part: North Island record erroneous); Goulstone, 1985: 7, text fig. 5; Worthy & Holdaway, 1995: 365; Spencer & Willan, 1996: 40.

Flammulina (Allodiscus) tullia.– Pilsbry, 1893: 14, pl. 2, figs 11, 12, pl. 3, fig. 12; Suter, 1894b: 146 (in part = *A. wairoaensis* + *A. mahlfeldae* n.sp.); Suter, 1894d: 251, pl. 9, figs 2–2c (in part = *A. wairoaensis*); Suter, 1901: 208.

Flammulina (Allodiscus) planulata.– Suter, 1894b: 146 (in part of Hutton, 1883); Suter, 1894d: 252 (in part of Hutton).

Allodiscus planulatus.– Suter, 1913: 643 (in part not of Hutton).

Allodiscus tullia var. *albinus* Suter, 1913: 646. (Unavailable infrasubspecific name: ICZN Art. 45.6.4. Work contains both subspecific and varietal names, and *albinus* has never been used as a valid species or subspecies – Art. 45.6.4.1.)

Allodiscus (Allodiscus) wairoaensis.– Climo, 1969b: 52 (not of Suter, 1894) (in part = *A. adriana* Hutton, 1883).

?*Allodiscus* sp. C Worthy & Roscoe, 2003: 48.

NOT *Psyra tullia*.– Suter, 1892a: 272 (= *A. mahlfeldae* n.sp.).

NOT *Allodiscus tullia*.– Whitten, 1957: 2 (= *A. goulstonei* n.sp.).

TYPE MATERIAL: *Nanina tullia* – lectotype (here selected) BMNH 1849.12.22.128 (paralectotype BMNH 1849.12.22.129 lost?); 'Auckland' (error – see below), Captain J.L. Stokes. Type locality here restricted to South Island, Kaikoura, Fyffe Palmer Reserve.

MATERIAL EXAMINED (230 lots): M.12149 (6), M.14229 (7), M.14455 (1), M.22247 (2), M.22312 (3), M.22349 (2), M.22551 (1), M.22935 (1), M.22936 (1), M.22937 (3), M.22938 (5), M.22943 (2), M.22944 (7), M.22947 (1), M.23184 (many), M.25067 (1), M.25123 (2), M.25250 (4), M.26060 (4), M.29705 (1), M.29933 (1), M.30539 (15), M.30565 (3), M.30570 (3), M.30885 (1), M.36349 (30), M.37195 (1), M.37265 (1), M.37366 (1), M.37563 (3), M.38120 (1), M.38285 (3), M.38714 (1), M.38772 (7), M.38792 (1), M.38976 (1), M.48051 (many), M.48291 (3), M.56109 (1), M.56190 (30), M.56871 (5), M.67953 (5), M.69608 (4), M.69838 (1), M.72532 (1), M.72569 (1), M.72834 (1), M.72942 (many), M.73152 (6), M.76520 (5), M.82137 (2), M.88816 (5), M.88854 (1), M.88875 (18), M.88971 (1), M.88982 (14), M.89002 (3), M.89018 (6), M.92719 (2), M.92888 (2), M.92925 (1), M.92942 (1), M.92971 (5), M.93016 (1), M.98398 (2), M.98745 (1), M.99032 (1), M.99676 (3), M.99766 (1), M.99900 (11), M.99915 (1), M.100067 (1), M.100100 (many), M.100167 (1), M.100941 (4), M.101001 (12), M.101170 (25), M.101348 (many), M.101757 (10), M.101820 (16), M.101874 (9), M.102040 (1), M.102959 (1), M.103255 (many), M.103416 (6), M.103619 (13), M.104796 (1), M.104820 (1), M.104878 (7), M.105253 (2), M.105263 (1), M.105345 (3), M.105470 (2), M.105480 (2), M.105678 (many), M.106152 (1), M.106380 (many), M.106484 (6), M.106503 (1), M.106653 (8), M.106801 (5), M.106843

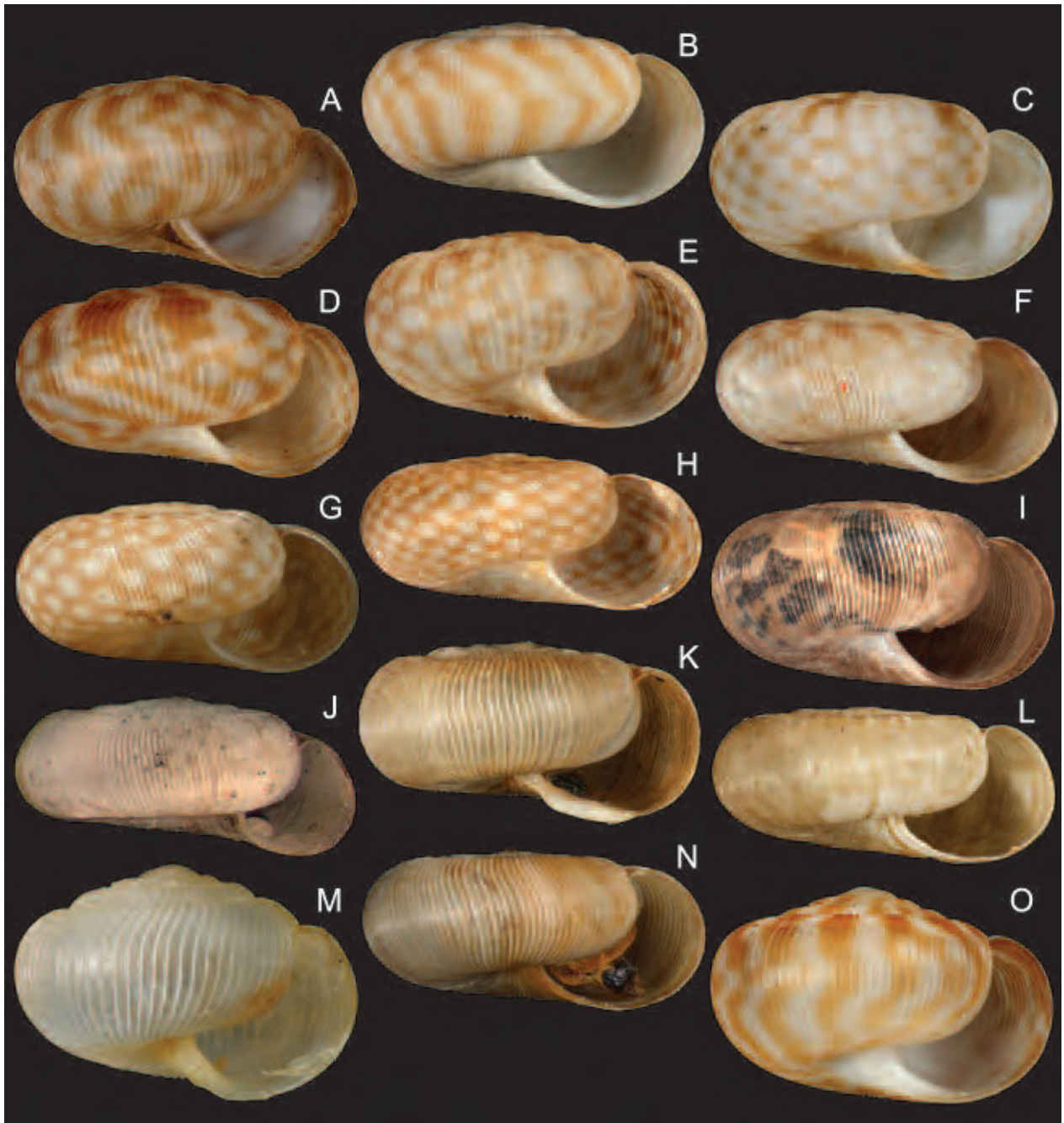


Fig. 10 Shells of *Allodiscus* species. A, *Allodiscus wairoaensis* Suter, 1894, Denniston Bush, N of Geraldine, M.103810 (1.90 × 3.30 mm); B, *Allodiscus waitomo* n.sp., W of Te Kuiti, Catherwoods Cave, holotype, M.183098 (2.70 × 4.83 mm); C, *Allodiscus climoi* n.sp., WSW of Collingwood, Anaweka River valley, holotype, M.183092 (1.85 × 3.10 mm); D, *Allodiscus ergodes* n.sp., S of Nelson, Hackett Track, holotype, M.180816 (1.50 × 2.50 mm); E, *Allodiscus laganus* n.sp., Punakaiki, near Tourist Cavern, holotype, M.183093 (1.65 × 2.80 mm); F, *Allodiscus negiae* n.sp., NE of Mangarakau, WSW of Collingwood, holotype, M.180085 (1.15 × 2.20 mm); G, *Allodiscus punakaiki* n.sp., E of Punakaiki, Bullock Creek Track, holotype, M.76317 (1.35 × 2.50 mm); H, *Allodiscus tataensis* (Climo, 1971), NE of Takaka, Tata Islands, Ngawhiti Island, M.102669 (1.25 × 2.60 mm); I, *Allodiscus tongariro* n.sp., NE of Ohakune, W slope of Mt Tongariro, Whakapapaiti, holotype, M.180045 (D, E, 1.65 × 3.00 mm); J, *Allodiscus cryptobidens* (Suter, 1891), NNW of Mt Cook Village, Hooker Valley, White Horse Hill, lectotype, M.125092 (0.85 × 1.75 mm); K, *Allodiscus godeti* (Suter, 1891), Hooker Valley, N of Mt Cook Village, M.88980 (2.25 × 4.20 mm); L, *Allodiscus mirificus* n.sp., Lake Wakatipu, The Remarkables, Rastus Burn, holotype, M.180040 (2.05 × 4.40 mm); M, *Allodiscus chion* (Sykes, 1896), S of New Plymouth, Pouaki Range, Mangorei Track, M.79596 (3.35 × 4.85 mm); N, *Allodiscus patulus* n.sp., SE of Milford

(many), M.106917 (many), M.106962 (1), M.107292 (2), M.107425 (many), M.107983 (many), M.108029 (2), M.108183 (3), M.108190 (10), M.108304 (many), M.108437 (10), M.108484 (15), M.108533 (1), M.108576 (1), M.108620 (many), M.108743 (8), M.109885 (2), M.109921 (1), M.109957 (6), M.114035 (1), M.114052 (1), M.114275 (1), M.114373 (3), M.114458 (1), M.115969 (1), M.116778 (1), M.120570 (many), M.120645 (1), M.120881 (1), M.120902 (2), M.121022 (4), M.121094 (1), M.121246 (1), M.121275 (many), M.121598 (1), M.121634 (1), M.121674 (3), M.121939 (1), M.121990 (1), M.121993 (3), M.122065 (1), M.122084 (2), M.122318 (2), M.122359 (many), M.122458 (1), M.122826 (1), M.122938 (1), M.122948 (2), M.123161 (3), M.123401 (many), M.123755 (1), M.123833 (1), M.123915 (9), M.124054 (8), M.124519 (3), M.126701 (11), M.126718 (11), M.127523 (17), M.127637 (2), M.127865 (2), M.128655 (6), M.128658 (many), M.128659 (17), M.128681 (4), M.128709 (2), M.128719 (1), M.128720 (1), M.128723 (3), M.128732 (many), M.129374 (7), M.146878 (1), M.146903 (2), M.146915 (1), M.156795 (1), M.156798 (5), M.157344 (1), M.157361 (3), M.157530 (2), M.157794 (1), M.157824 (4), M.157827 (1), M.157867 (3), M.157868 (5), M.157871 (9), M.157891 (1), M.157980 (3), M.159629 (2), M.159651 (8), M.159746 (1), M.159769 (2), M.159804 (2), M.159949 (5), M.161012 (2), M.161038 (11), M.161305 (2), M.161487 (2), M.161501 (5), M.161636 (1), M.161688 (2), M.161695 (6), M.161742 (4), M.162516 (14), M.162749 (5), M.162785 (2), M.162819 (1), M.162843 (2), M.162867 (5), M.162874 (30), M.162951 (6), M.164587 (4), M.166188 (4), M.169374 (1), M.169378 (1), M.170142 (6), M.170144 (1), M.170145 (2), M.170149 (1), M.170150 (2), M.170210 (2), M.170212 (5), M.170229 (3), M.170230 (2), M.175086 (7), M.175194 (4), M.175381 (2), M.176178 (1), M.177462 (4), M.179695 (many).

REDESCRIPTION: Shell up to 4.60 mm wide, thin, low and broad (HWR 0.50–0.55), spire weakly elevated (17–27% SH), narrowly umbilicate or umbilicus partly or fully invaded by inner lip (width <4.6% SW). Protoconch and teleoconch ground translucent white; teleoconch with irregular pattern of yellowish-brown zigzag radial lines.

Protoconch of 1.25–1.40 convex whorls, weakly elevated, 730–800 µm wide, sculptured with crisp, widely spaced spiral threads that number 13–16 on spire on last half-whorl, distinctly and irregularly wavy at nucleus, more or less regular thereafter, each surmounted by low periostracal

lamella; interspaces with weak, irregular, prosocline radial lines.

Teleoconch of up to 3.60 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by much finer reticulating spiral threads and periostracal lamellae, spiral threads finely nodular at intersections; lamellae at summit and bordering each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, outer lip thin at rim, slightly thicker within; inner lip thicker than outer, projected abaperturally and partly overhanging or completely invading umbilicus.

DISTRIBUTION: Northeastern and central South Island (Fig. 9B). Also known as fossils in Late Pleistocene and Holocene caves deposits (e.g. M.72942, M.106843, M.126701, M.126718, M.128732, M.179695).

BIOLOGY: *Allodiscus tullia* is broadly distributed geographically and environmentally. It occurs in a range of indigenous habitats, from coastal flax and mixed broadleaved shrublands, lowland to montane broadleaved, mixed broadleaved/podocarp and *Nothofagus* forests, to subalpine shrublands, herbfields and tussocklands up to 1800 m elevation. The species is moderately tolerant of habitat disturbance and is not uncommon in *Leptospermum* and Kānuka secondary shrublands and forests, in relictual shrublands in pastures, and in exotic plantations such as those of *Larix*. *Allodiscus tullia* is a ground-dweller, common in litter, but also often found associated with woody debris and rock substrates.

CONSERVATION STATUS: *Allodiscus tullia* is widely distributed and is not rare. Our assessment is that the species is of no immediate conservation concern.

REMARKS: The lectotype of *Nanina tullia* is a well-preserved example of a species that is widely distributed in the northern South Island. It most closely resembles specimens from the northeastern South Island, specifically from the Avon River valley (southwest of Blenheim) southward to Riccarton Bush, Christchurch (M.14455, M.22551, M.25067, M.107292, M.170145). Given that the lectotype was presumably obtained by Captain Stokes during the survey by HMS *Acheron*, it seems likely to have come from a coastal locality, presumably Christchurch or Kaikoura judging from shell morphology. Although the lectotype quite possibly originated from Christchurch (it occurred at

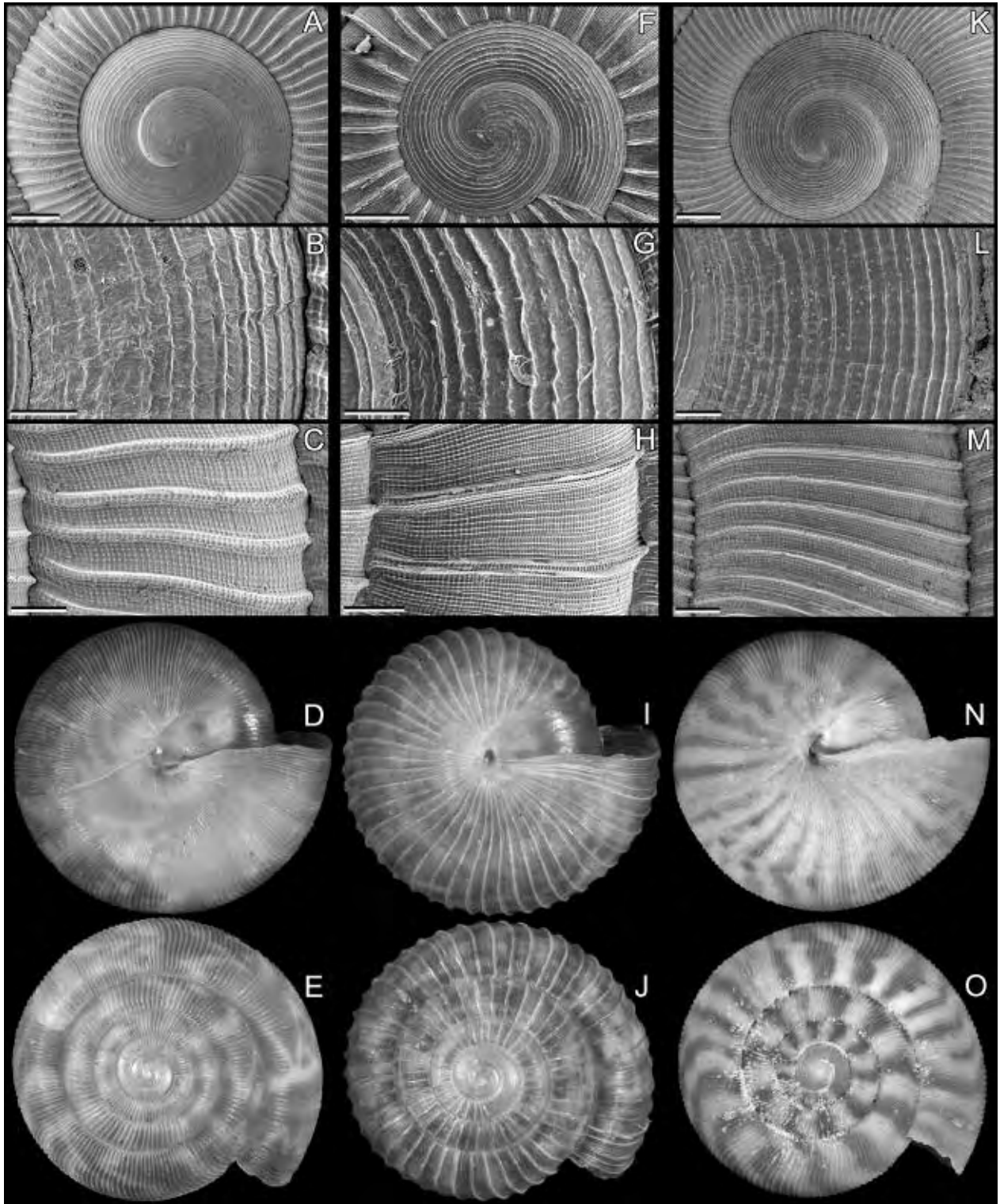


Fig. 11 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus wairarapa* n.sp., N of Masterton, Mt Bruce, paratype, M.46875 (A–C), and holotype, M.180064 (D, E, 3.10 × 5.20 mm); F–J, *Allodiscus wairoaensis* Suter, 1894, S of Wakefield, Wairoa River Right Branch, M.106597 (1.90 × 3.30 mm); K–O, *Allodiscus waitomo* n.sp., W of Te Kuiti, Catherwoods Cave, paratype, M.39097 (K–M), and holotype, M.183098 (N, O, 2.70 × 4.83 mm). Scale bars 50 µm (B, G, L), 100 µm (C, H, M), 200 µm (A, F, K).

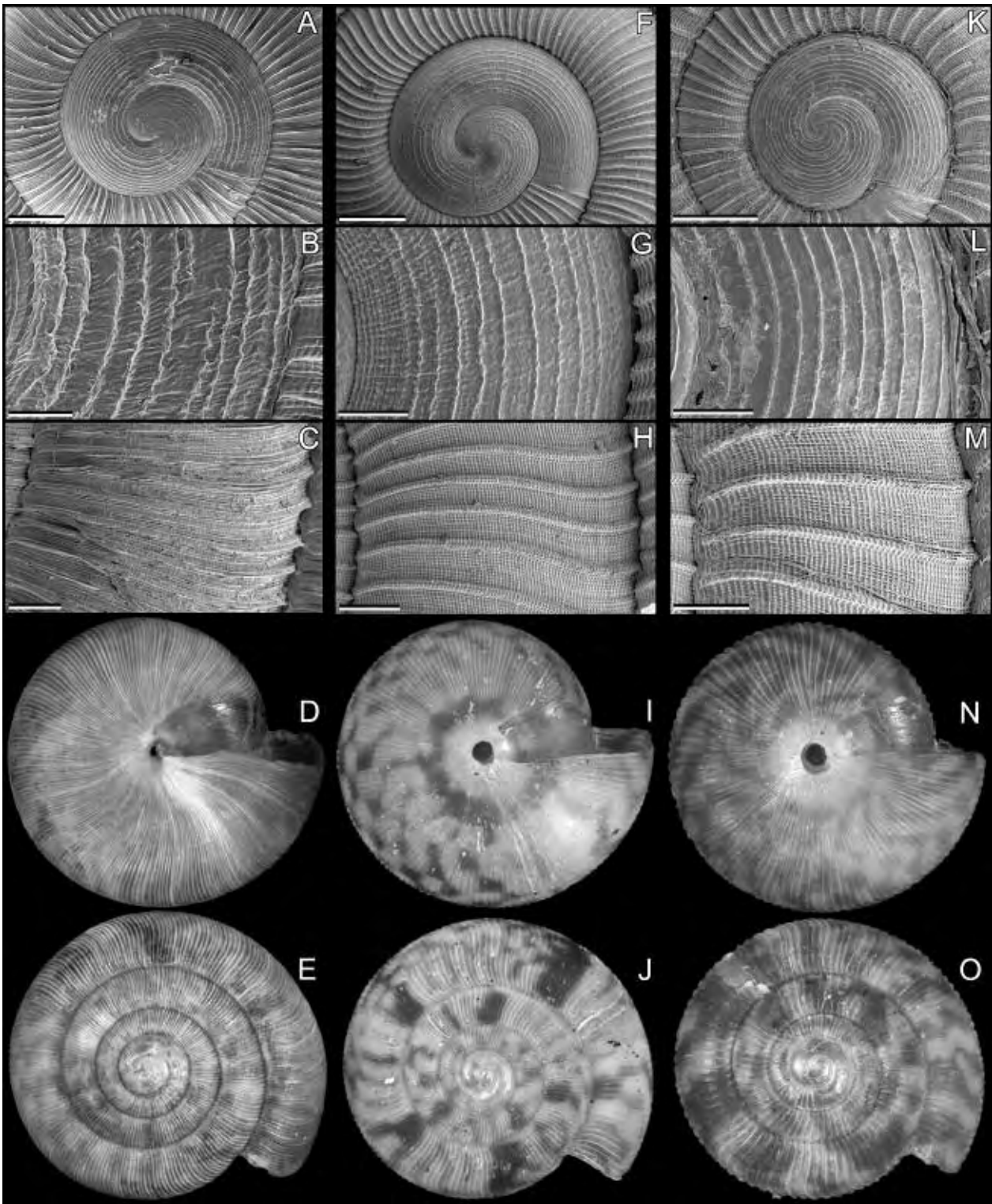


Fig. 12 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus yaldwyni* n.sp., Antipodes Island, Hut Cove Flat, paratypes, M.76710 (A–C), and holotype (D, E, 2.10 × 3.55 mm); F–J, *Allodiscus climoi* n.sp., WSW of Collingwood, Anaweka River valley, paratype, M.109478 (F–H), and holotype, M.183092 (I, J, 1.85 × 3.10 mm); K–O, *Allodiscus ergodes* n.sp., S of Nelson, Hackett Track, paratype, M.128673 (K–M), and holotype, M.180816 (N, O, 1.50 × 2.50 mm). Scale bars 50 µm (B, G, L), 100 µm (C, H, M), 200 µm (A, F, K).

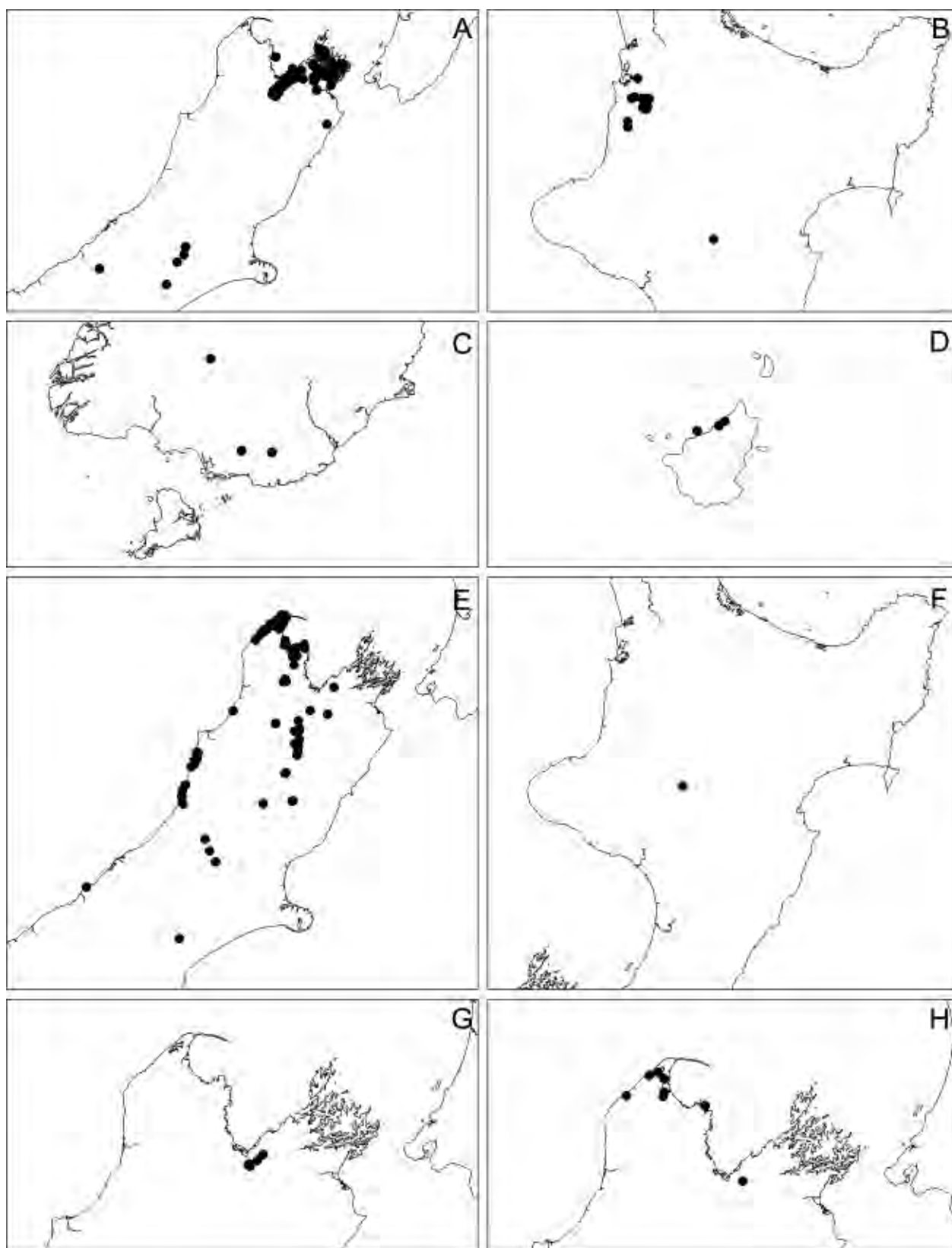


Fig. 13 Distributions of *Allodiscus* (*s. lat.*) species within New Zealand. A, *Allodiscus wairoaensis* Suter, 1894; B, *Allodiscus waitomo* n.sp.; C, *Allodiscus southlandicus* n.sp.; D, *Allodiscus yaldwyni* n.sp.; E, *Allodiscus climoi* n.sp.; F, *Allodiscus tongariro* n.sp.; G, *Allodiscus ergodes* n.sp.; H, *Allodiscus negiae* n.sp.

Dean's Bush, Riccarton until at least Suter's time – e.g. M.170145), we have opted for Kaikoura as type locality (recently taken alive in Fyffe Palmer Reserve, M.107292) because there is no evidence that the species still lives at Christchurch (Goulstone 1986).

Specimens accordant with the type material have been obtained from forest habitats throughout the geographic range. Specimens taken from forests have smaller protoconchs in the northern part of the range than in the south, and there is fluid intergradation in protoconch size between populations. Specimens that are otherwise similar, but that measure up to 5.40 mm wide and have protoconchs ranging up to 900 µm wide or more (so-called 'big *tullia*'), accumulate in vast numbers in the outer parts of some limestone caves in the northern South Island, between Takaka and Motueka (e.g. M.179695). Specimens from Kairuru, Predator and Ngarua caves and their vicinity on Takaka Hill have the largest protoconchs (e.g. M.56190, M.128659, M.179695), but protoconchs of specimens from other northern caves (e.g. Elliott's Cave, south of East Takaka, M.23184) are no larger than those from nearby forests. Although mosaic variation suggests a single species, we cannot yet preclude the possibility that the large cave form is a specifically distinct obligate calcicole.

The original specimen of *Allodiscus tullia* var. *albinus* Suter, 1913 (NMNZ M.170149), 'Sealey Range, near the Hermitage, Mount Cook', indeed appears to be an albino specimen of *A. tullia*. It has no type status as the name is infrasubspecific and thus unavailable (ICZN Arts 45.6.4 and 45.6.4.1). Climo (1969b) recorded the occurrence (under the name *Allodiscus wairoaensis* Suter, 1894) of an albino form at Lake Sumner and Arthur's Pass.

Climo (1969b: 1) stated 'South Island records of *Allodiscus tullia* (Gray, 1850) (*sensu* Suter, 1913) are shown to refer to *A. wairoaensis* Suter, 1894. Examination of a type specimen of *Allodiscus tullia* (Gray) from the British Museum (Nat. Hist.), has shown that this species is synonymous with *Charopa (Ptychodon) pseudoleioda* (Suter, 1890).' We have re-examined the type material of *Nanina tullia* Gray, 1850 and affirm its placement in genus *Allodiscus* (*s. lat.*). Further, as indicated in the synonymy (see above), we find that *Allodiscus tullia sensu* Suter (1913) and *A. wairoaensis sensu* Climo (1969b) are species complexes involving both *A. tullia* (Gray, 1850) and *A. wairoaensis* Suter, 1894. Suter's (1892b, 1913) descriptions of the jaw and radula of *Allodiscus tullia* evidently do belong to that species. The material dissected by Climo (1969b) and described under

the name *Allodiscus wairoaensis* Suter, 1894 has not been located in NMNZ, but the details of the radular dentition described by Climo differ from that given for *A. tullia* by Suter and so must be assumed to refer to *A. wairoaensis* Suter, 1894.

Suter's (1892b) description of the jaw and radula were reproduced by Pilsbry (1893) and Suter (1913). The radular formula was given as 15 + 6 + 1 + 6 + 15. Central tooth tricuspid, mesocone extending to about three-quarters the length of the basal plate, the side cusps subobsolete; lateral teeth bicuspid by suppression of the endocone, with prominent mesocone that becomes progressively longer, sabre-like and extending slightly beyond the length of the basal plate towards the lateral–marginal transition; marginal teeth primarily tricuspid, with cusps corresponding to re-established endocone, mesocone and ectocone, towards margin of radular ribbon cusps short, of similar length and then teeth becoming bicuspid.

The reproductive anatomy of *Allodiscus tullia* is not presently known.

Allodiscus wairarapa new species

(Figs 10, 9D, 11A–E)

Allodiscus chion.–Powell, 1979: 319 (in part of Sykes, 1896);

Spencer & Willan, 1996: 40 (in part of Sykes).

TYPE MATERIAL: Holotype NMNZ M.180064 and paratypes M.46875 (4), AIM AK 73280 (1): North Island, Wairarapa, Mt Bruce, N of Masterton, outside Bathtub Cave (NZMS 260 T25/318504), 7 Mar. 1971, D.J. Roscoe. MATERIAL EXAMINED (11 lots): Type material (see above), M.22932 (1), M.73365 (2), M.80170 (2), M.85686 (1), M.98163 (1), M.103579 (3), M.156793 (1), AIM AK 19842 (5).

DESCRIPTION: Shell up to 5.20 mm wide, thin, low and broad (HWR 0.60–0.63), spire weakly to moderately elevated (32–34% SH), juveniles narrowly umbilicate, adults anomphalous. Protoconch colourless and translucent; teleoconch ground translucent white, with pattern of large yellowish-brown to reddish-brown irregular subsutural maculations, which, near suture, transform to narrow zigzag bands that extend around periphery and across base to white umbilical depression.

Protoconch of 1.25–1.30 convex whorls, weakly but distinctly elevated, 870–930 µm wide, sculptured with crisp, rounded, widely spaced spiral threads that number 12–14 on spire on last half-whorl, irregularly wavy at immediate nucleus, more or less regular thereafter, interspaces with a finely wrinkled surface.

Teloconch of up to 3.60 convex whorls, sculptured throughout with prominent, widely and regularly spaced primary axial ribs; these overlain by weak spiral threads and crisp periostracal lamellae, spirals finely nodular at intersections; periostracal lamella at summit and borders of each primary axial rib considerably stronger than interstitial lamellae. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, outer lip thin at rim, moderately thickened within; inner lip thicker than outer lip, spreading abaperturally.

DISTRIBUTION: Southern North Island (Fig. 9D).

BIOLOGY: A litter-dwelling species known from lowland to montane forests and subalpine shrublands.

CONSERVATION STATUS: *Allodiscus wairarapa* was listed as potentially of conservation concern owing to its limited range. Hitchmough (2002) and Hitchmough *et al.* (2007) subsequently listed the species as 'range restricted'. The collections available in the present study indicate the species is rather widely distributed, but not common, in the Tararua, Rimutaka and Akatarawa ranges.

REMARKS: *Allodiscus wairarapa* resembles the large forms of *A. tullia* (Gray, 1850) from caves at the summit of Takaka Hill in size (e.g. M.179695), but differs in having both a fully closed umbilicus and a shallower umbilical depression, in having a more strongly wrinkled surface between the spiral threads on the protoconch, and in having coarser beads on the spiral threads on the teloconch at equivalent stages of growth. Specimens of *Allodiscus wairarapa* labelled 'Rimutaka Range, 1200' [366 m]', ex A.C. O'Connor collection, were the basis for Powell's (1979) record of *A. chion* (Sykes, 1896) from there (AIM AK 19842).

The anatomy of *Allodiscus wairarapa* is not presently known.

ETYMOLOGY: After the region of the type locality. Noun in apposition.

Allodiscus wairoaensis Suter, 1894

(Figs 10A, 11F–J, 13A)

Allodiscus tullia.– Hedley & Suter, 1893: 638 (in part of Gray, 1850); Suter, 1913: 646 (in part).

Allodiscus wairoaensis Hedley & Suter, 1893: 639 (nude name); Suter, 1894b: 146 (nude name); Suter, 1894c: 488, pl. 22, figs 3–3b; Suter, 1913: 648, pl. 25, figs 18a,b; Powell, 1937: 88; Powell, 1946: 92; Powell, 1957: 117; Powell, 1962: 110; Climo, 1968: 46; Powell, 1976: 117; Forman, 1978: 104; Powell, 1979: 321; Spencer & Willan, 1996: 40; Marshall, 1996: 40.

Flammulina (Allodiscus) tullia.– Suter, 1894b: 146 (in part of Gray + *A. mahlfeldae* n.sp.); Suter, 1894d: 251 (in part).

Flammulina (Allodiscus) wairoaensis.– Pilsbry, 1893: 15; Suter, 1894d: 253.

Allodiscus (Allodiscus) tessellatus.– Climo, 1969b: 46, figs 1a, 8, 20a–b, 24a,b (in part of Powell, 1941 + *A. worthyi* n.sp. + *A. mahlfeldae* n.sp.).

Allodiscus (Allodiscus) wairoaensis.– Climo, 1969b: 52, figs 1c, 7, 16c–e, 24a,c (in part = *A. tullia* Gray, 1850 + *A. adriana* Hutton, 1883).

?*Allodiscus* sp. 2 Goulstone, 1985: 7, text fig. 7.

TYPE MATERIAL: Syntypes NMNZ M.125203 (4), M.125204 (1): South Island, 'Wairoa Gorge, near Nelson', J.T. Meeson.

MATERIAL EXAMINED (103 lots): Type material (see above), M.22945 (2), M.23076 (1), M.23078 (5), M.25227 (6), M.25305 (4), M.25487 (2), M.30558 (5), M.36659 (2), M.37037 (1), M.37801 (2), M.46837 (4), M.70340 (1), M.73397 (4), M.80122 (2), M.80142 (1), M.81722 (1), M.83036 (1), M.89275 (1), M.92765 (many), M.100770 (2), M.101288 (2), M.103098 (7), M.103443 (1), M.103810 (4), M.104693 (15), M.104940 (5), M.104975 (10), M.104978 (many), M.105001 (1), M.105089 (1), M.105128 (20), M.105195 (many), M.105206 (4), M.105275 (many), M.105379 (3), M.105553 (many), M.106360 (many), M.106459 (1), M.106523 (3), M.106559 (5), M.106597 (18), M.106737 (1), M.106981 (many), M.107178 (2), M.107411 (1), M.107436 (many), M.108394 (1), M.108698 (3), M.109728 (2), M.116453 (2), M.121113 (5), M.121467 (12), M.121502 (4), M.121547 (12), M.121581 (30), M.121658 (1), M.121715 (1), M.122101 (15), M.122148 (2), M.122179 (2), M.122193 (1), M.122243 (1), M.122256 (1), M.122283 (1), M.122639 (4), M.122657 (1), M.122786 (1), M.122977 (1), M.123006 (1), M.123007 (1), M.123015 (7), M.123062 (1), M.123424 (5), M.124158 (2), M.128672 (13), M.128679 (6), M.128680 (20), M.128682 (4), M.128686 (2), M.128713 (1), M.128714 (7), M.128722 (1), M.128726 (15), M.128728 (5), M.156807 (1), M.159812 (1), M.162730 (1), M.164422 (2), M.164463 (1), M.166291 (3), M.166304 (1), M.166332 (1), M.166369 (2), M.169381 (2), M.169398 (7), M.170143 (6), M.170231 (2), M.170233 (1), M.175367 (2), M.175380 (many), M.175382 (1).

REDESCRIPTION: Shell up to 4.30 mm wide, thin, low and broad (HWR 0.53–0.62), spire weakly to moderately elevated (19–36% SH), narrowly umbilicate (3.4–7.6% SW), or umbilicus partly or fully invaded by inner lip.

Protoconch and teleoconch ground translucent white; teleoconch with irregular pattern of yellowish-brown isolated or anastomosing wavy radial lines.

Protoconch of 1.25–1.30 convex whorls, weakly elevated, 730–870 µm wide, sculptured with crisp, widely spaced spiral threads that number 12–16 on spire on last half-whorl, irregularly wavy at immediate nucleus, more or less regular thereafter, each surmounted by low periostracal lamella; interspaces with weak, irregular, prosocline radial lines.

Teleoconch of up to 3.30 convex whorls, sculptured throughout with prominent, widely and regularly spaced primary axial ribs; these overlain by weak spiral threads and crisp periostracal lamellae, spirals finely nodular at intersections; periostracal lamella at summit and borders of each primary axial rib considerably stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, outer lip thin at rim, slightly thicker within; inner lip thicker than outer, projected abaperturally and partly overhanging or completely invading umbilicus.

DISTRIBUTION: South Island, in Nelson and Marlborough, and in the eastern foothills of the Southern Alps in mid Canterbury (Fig. 13A).

BIOLOGY: The species occurs in leaf litter and under stones in habitats ranging from coastal shrublands and broadleaved forests, to open scrublands, montane *Nothofagus* forests and subalpine scrublands and forests up to about 1000 m elevation.

CONSERVATION STATUS: *Allodiscus wairoaensis* is widely distributed and not rare. Our assessment is that the species, as interpreted here, is not threatened. However, we note that the taxonomic status of the disjunct southern populations remains to be established.

REMARKS: Compared with the superficially similar species *Allodiscus tullia* (Gray, 1850), with which it is locally sympatric, *A. wairoaensis* differs markedly in having considerably more widely spaced primary axial ribs on the teleoconch. The specimens examined are from two clusters of localities over 200 km apart (Fig. 13A). We are unable to detect any significant differences between the northern and southern populations, but comparisons of gene sequences and anatomy are clearly required to be sure that the southern populations really are conspecific.

The radula and reproductive anatomy of *Allodiscus wairoaensis* described by Climo (1969b) is assumed to relate to this species (see remarks under *A. tullia* above). The radular formula was given as 9 + 7 + 1 + 7 + 9; central tooth

tricuspid, with mesocone extending to about half length of basal plate, cusps on either side well developed; lateral teeth bicuspid by suppression of the endocone, mesocone extending to about length of basal plate; marginal teeth multicuspid due to splitting of ectocone and mesocone.

In the reproductive system, the bursa duct is narrow at its origin in the oviduct but is rapidly expanded to a spindle-shaped section, before narrowing to a long, slender duct to the sac; vagina rather short, slender; penis proximally a bulky, cylindrical organ, bifurcating at the apex to caecae, one more elongate and slender and with the penial retractor attachment terminally, and the other with a bulbous terminus; vas deferens opening through the medial lateral wall of this proximal penis; distal penis a simple short duct running to the atrium.

Allodiscus waitomo new species

(Figs 10B, 11K–O, 13B)

Allodiscus (*Allodiscus*) *parkinsoni* Climo, 1969b: 40, figs 1a, 4d–e (not available: ICZN Article 8).

?*Allodiscus tullia*.—Solem *et al.*, 1981: 480 (not Gray, 1850).

Allodiscus ‘flat extreme’ *tullia*-group n.sp. McGuinness, 2001: 587; Hitchmough, 2002: 120.

Allodiscus ‘flat extreme’ *tullia*-group’ (NMNZ M.48100) Hitchmough *et al.*, 2007: 83.

Charopidae sp. 153 (NMNZ M.48100) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.183098 and paratypes M.39097 (~200), AIM AK 73282 (3): North Island, Green Gorge Entrance, Catherwoods Cave, Waipapa Road Cave System, W of Te Kuiti (NZMS 260 R16/872163), Hamilton Junior Naturalists’ Club, 1970–72, S. Easterbrook-Smith.

MATERIAL EXAMINED (22 lots): Type material (see above), M.22352 (1), M.23816 (9), M.24030 (many), M.24446 (many), M.31239 (many), M.39207 (many), M.45761 (many), M.47574 (many), M.47608 (many), M.48100 (many), M.55977 (many), M.68866 (5), M.77413 (many), M.77615 (many), M.81948 (many), M.82573 (many), M.86849 (many), M.169697 (1), M.176175 (many).

DESCRIPTION: Shell up to 5.30 mm wide, wider than high (HWR 0.54–0.57), thin, spire moderately elevated (19.4–28.0% SH); umbilicus narrow and fully open in juveniles less than about 2.30 mm wide, progressively invaded by inner lip in larger specimens until a narrow chink remains. Protoconch pale translucent, colourless; teleoconch translucent white with yellowish-brown colour pattern of wavy

axial maculations of rather irregular width and spacing, entirely traversing spire whorls, extending around periphery, inwardly narrowing over base, weakening and vanishing over inner third of base.

Protoconch weakly elevated, of 1.20–1.40 convex whorls, 900–970 µm wide, sculptured with fine, crisp, widely spaced spiral threads that number about 20 on spire on last half-whorl (probably surmounted by periostracal lamellae in life).

Teleoconch of up to 3.30 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, spiral and weak axial threads with finely and crisply beaded intersections. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; outer lip thin, weakly and evenly thickened within; inner lip thicker and progressively invading narrow umbilicus.

DISTRIBUTION: Western North Island, from limestone caves in the vicinity of Kawhia Harbour and Waitomo, southward to Mahoenui, northeast of Awakino, with occurrence in the central North Island at Waipuna Caves, east-southeast of Waiouru (Fig. 13B).

BIOLOGY: *Allodiscus waitomo* has been extensively collected in association with karst cave systems. It is probably a calcicole, living on dimly lit walls of the outer parts of caves.

CONSERVATION STATUS: *Allodiscus waitomo* was listed by McGuinness (2001) as of potential conservation concern owing to limited range size. Subsequently, the species was listed as 'range restricted' by Hitchmough (2002) and Hitchmough *et al.* (2007), based on information suggesting restriction to the karst areas of western North Island. The record of an extant population in the central North Island at Waipuna Caves suggests the species occurs more widely, although the habitat is of limited extent and prone to disturbance by human activities. Our assessment is that the species is of some conservation concern, and that ranking as 'range restricted' is appropriate.

REMARKS: *Allodiscus waitomo* most closely resembles specimens of the large form of *A. tullia* (Gray, 1950) occurring in the outer parts of limestone caves in the northern South Island (see above), differing principally in being larger relative to the number of whorls, in having more numerous spiral threads on the protoconch (about 20, versus 13–16), and in having closer primary axial ribs on the teleoconch. Compared with *Allodiscus wairarapa* n.sp., *A. waitomo* has a less elevated spire, more numerous spiral threads on the protoconch (20, versus 12–14), finer beading on the spiral threads on the teleoconch, and lacks the pronounced surface wrinkles between the spiral threads on the protoconch.

All specimens collected to date are shells from accumulations in talus from limestone caves, some of which are so fresh that it seems unlikely that the animals had been dead long. Presumably the species lives and feeds on algae, mosses and/or liverworts on moist walls and ceilings in the transitional zone near the cave entrances.

The anatomy of *Allodiscus waitomo* is not presently known.

ETYMOLOGY: After the place-name Waitomo, meaning 'water cave' (Māori), alluding to both its proximity to the localities, and the occurrence of the species in caves. Noun in apposition.

Allodiscus yaldwyni new species

(Figs 12A–E, 13D, 19I)

Allodiscus planulatus.– Powell, 1955: 123 (not of Hutton, 1883); Powell, 1979: 321 (in part of Hutton); Spencer & Willan, 1996: 40 (in part of Hutton + *A. tawhiti* n.sp.).

TYPE MATERIAL: Holotype NMNZ M.183100 and paratypes M.76710 (23), AIM AK 73284 (2): Antipodes Islands, Antipodes Island, Hut Cove Flat (49°40.2'S, 178°48.3'E), 3 Mar. 1985, J.C. Yaldwyn. Additional paratypes: Antipodes Island, Hut Cove Flat, under *Stilbocarpa*, 2 Mar. 1985, J.C. Yaldwyn, M.75600 (17).

MATERIAL EXAMINED (9 lots): Type material (see above), M.38929 (1), M.68463 (2), M.75607 (4), M.156991 (1), M.156992 (4).

DESCRIPTION: Shell up to 3.90 mm wide, wider than high (HWR 0.52–0.60), thin, spire moderately elevated (25–36% SH); umbilicus very narrow, partly overhung by inner lip (3.9–4.2% SW). Protoconch translucent, white. Teleoconch translucent white ground colour, with pale yellowish-brown pattern of irregular maculations on spire, becoming largely obsolete over periphery.

Protoconch moderately elevated, of 1.25–1.30 convex whorls, 770–830 mm wide, sculptured with fine, rounded spiral threads surmounted by low periostracal lamellae, numbering about 10–12 on last half-whorl, interspaces with irregular radial wrinkles.

Teleoconch of up to 3.00 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and more closely spaced axial periostracal lamellae, intersections very weakly beaded; lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; outer lip thin, weakly, evenly

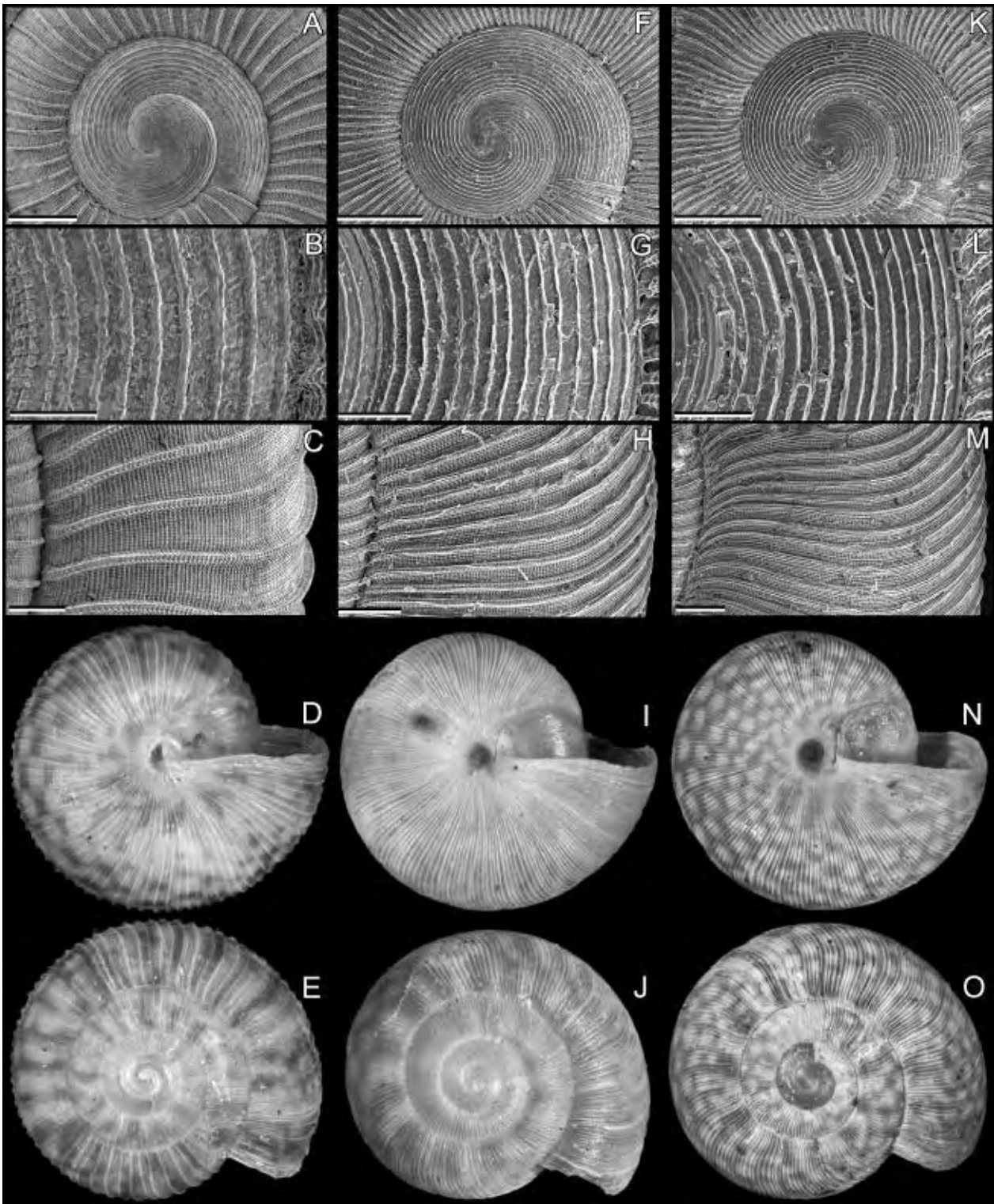


Fig. 14 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus laganus* n.sp., Punakaiki, near Tourist Cavern, paratype, M.77880 (A–C), and holotype, M.183093 (D, E, 1.65 × 2.80 mm); F–J, *Allodiscus negiae* n.sp., WSW of Collingwood, NE of Mangarakau, holotype, M.180085 (1.15 × 2.20 mm); K–O, *Allodiscus punakaiki* n.sp., E of Punakaiki, Bullock Creek Track, holotype, M.76317 (1.35 × 2.50 mm). Scale bars 50 µm (B, G, L), 100 µm (C, H, M), 200 µm (A, F, K).

thickened within; inner lip more strongly thickened, rim overhanging edge of umbilicus.

DISTRIBUTION: Antipodes Islands (Fig. 13D).

BIOLOGY: *Allodiscus yaldwyni* occurs in litter of tussocklands and scrublands.

CONSERVATION STATUS: *Allodiscus yaldwyni* is 'range restricted'.

REMARKS: *Allodiscus yaldwyni* is distinctive in the combination of size, size relative to the number of whorls, narrow umbilicus and pale colour pattern.

The anatomy of *Allodiscus yaldwyni* is not presently known.

ETYMOLOGY: After the late J.C. Yaldwyn (Wellington), who collected the type material. Noun in the genitive case.

Group C (*climoi*)

DIAGNOSIS: Shell small (maximum width 4.15–6.05 mm), low (HWR 0.43–0.60), spire weakly to moderately elevated (10.2–33% SH). Narrowly to widely umbilicate (4.2–18% SW) or anomphalous. Protoconch small or medium sized (width 520–770 µm), sculptured with 13–20 crisp spiral threads, each surmounted by low periostracal blade, in some species crowded subsuturally and with addition of radial riblets, interspaces elsewhere wider than each spiral.

REMARKS: The group comprises *Allodiscus climoi* n.sp., *A. ergodes* n.sp., *A. laganus* n.sp., *A. negiae* n.sp., *A. punakaiki* n.sp., *A. tataensis* (Climo, 1971) and *A. tongariro* n.sp. All are restricted to the northern South Island, with the exception of *Allodiscus tongariro*, from Mt Tongariro in the central North Island. Members of this group are similar to Group B species in gross facies, but they attain smaller size relative to the number of whorls and most have smaller protoconchs. Group B species lack a narrow subsutural zone of axial riblets on the protoconch, although not all Group C species possess them. Our interpretation of species limits in this group is conservative, as we strongly suspect that the material examined includes additional, undescribed species.

Allodiscus climoi new species

(Figs 10C, 12F–J, 13E)

Allodiscus tullia.—Climo, 1968: 45 (not of Gray, 1850).

Allodiscus (Allodiscus) onetaua Climo, 1969b: 38, figs 2b, 9a–c, 20d–e, 24a, 25c (not available: ICZN Article 8).

Allodiscus sp. B Worthy & Roscoe, 2003: 48.

Charopidae sp. 61 (NMNZ M.81053) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.183092 and paratypes M.109478 (~100), AIM AK 73268 (3): South Island, WSW of Collingwood, Anaweka River valley (NZMS 260 M25/512501), 23 Apr. 1992, F.M. Climo.

MATERIAL EXAMINED (143 lots): Type material (see above), M.22949 (1), M.22951 (2), M.23058 (1), M.25203 (1), M.28869 (1), M.30069 (many), M.30524 (many), M.30531 (1), M.30534 (2), M.30535 (many), M.32823 (2), M.32910 (1), M.36681 (1), M.37102 (1), M.37873 (1), M.37882 (1), M.38053 (2), M.38056 (many), M.38187 (1), M.38206 (1), M.38835 (many), M.55573 (1), M.55597 (2), M.56886 (many), M.61663 (5), M.61849 (many), M.62999 (many), M.63007 (10), M.70425 (many), M.73047 (many), M.73469 (5), M.75747 (1), M.77372 (1), M.78443 (1), M.79581 (1), M.79808 (5), M.80837 (many), M.80844 (1), M.80915 (many), M.80969 (1), M.81003 (many), M.81008 (6), M.81036 (many), M.81053 (many), M.81088 (many), M.82558 (5), M.86489 (many), M.86572 (many), M.86619 (many), M.87707 (1), M.88913 (many), M.89007 (1), M.89292 (1), M.89295 (4), M.89764 (1), M.89776 (2), M.89862 (1), M.96514 (3), M.96774 (1), M.99721 (1), M.99912 (1), M.100068 (1), M.100720 (3), M.101030 (1), M.101221 (1), M.101284 (4), M.101286 (many), M.103113 (6), M.103181 (5), M.103422 (many), M.103797 (5), M.104891 (many), M.105468 (3), M.105589 (6), M.105659 (6), M.105717 (many), M.105851 (1), M.105915 (many), M.106341 (1), M.106409 (2), M.106528 (1), M.106534 (4), M.106627 (7), M.106659 (many), M.106846 (1), M.106890 (many), M.106923 (4), M.106976 (5), M.107140 (2), M.107218 (1), M.107657 (2), M.107947 (1), M.108139 (many), M.108236 (1), M.108271 (3), M.108303 (many), M.109500 (1), M.109539 (many), M.109794 (many), M.109842 (3), M.109965 (many), M.110023 (1), M.114087 (1), M.114585 (1), M.115984 (1), M.116329 (1), M.120277 (many), M.120416 (many), M.121794 (1), M.121979 (6), M.121999 (2), M.122041 (1), M.122109 (1), M.122397 (6), M.122426 (1), M.122618 (1), M.122872 (11), M.123862 (many), M.124545 (4), M.125814 (3), M.125822 (1), M.128731 (many), M.128735 (1), M.156980 (1), M.157763 (2), M.159102 (1), M.159429 (1), M.161219 (2), M.161273 (1), M.161692 (2), M.161721 (4), M.161780 (2), M.162371 (1), M.162620 (1), M.162800 (2), M.162830 (1), M.175157 (many), M.175288 (1), M.175376 (1), M.177536 (20).

DESCRIPTION: Shell up to 3.35 mm wide, thin, wider than high (HWR 0.53–0.58), spire weakly to moderately elevated (17–26% SH), narrow umbilicus (4.2–7.1% SW) fully open or edge overhung by inner-lip rim. Protoconch

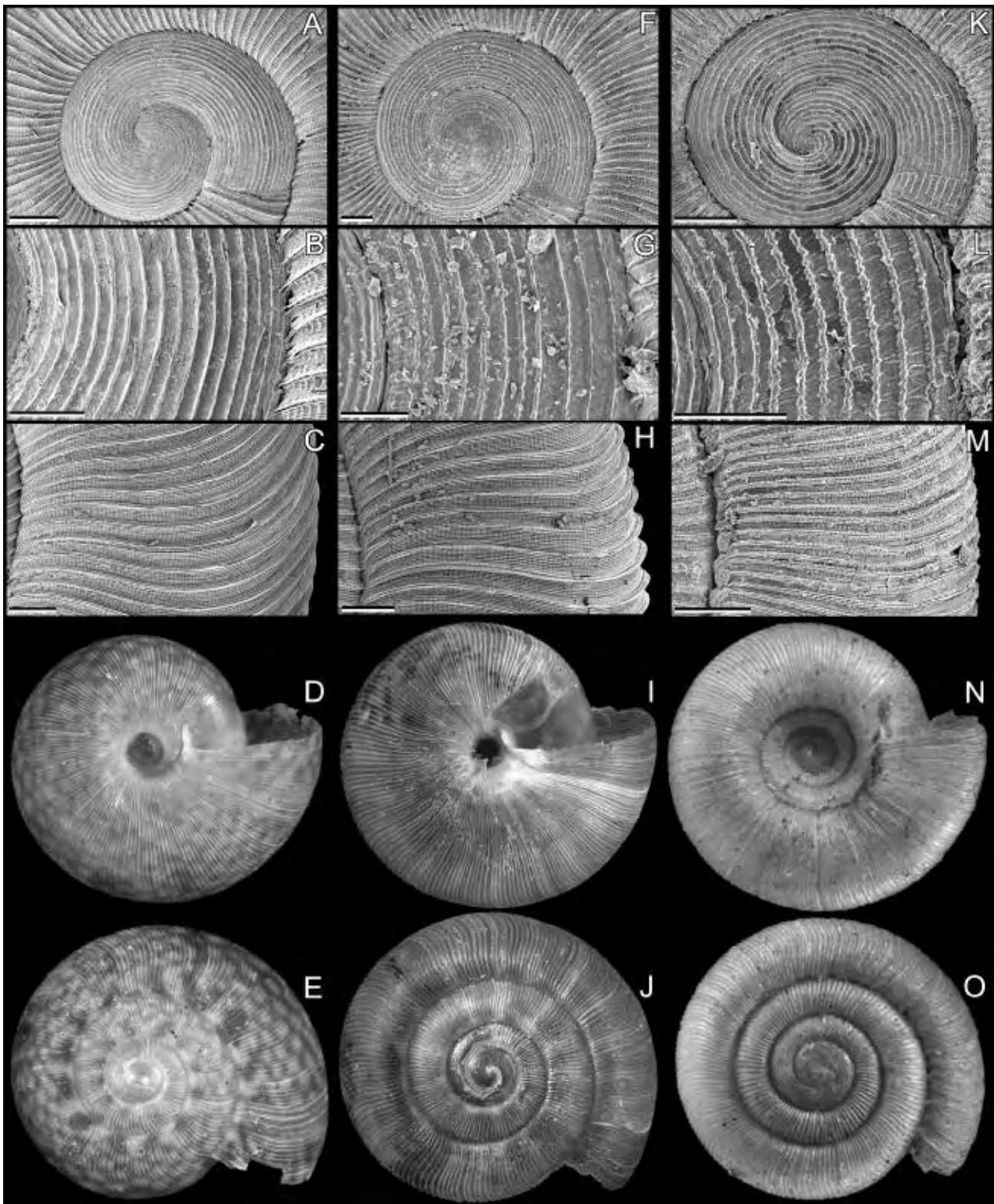


Fig. 15 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus tataensis* (Climo, 1971), NE of Takaka, Tata Islands, Ngawhiti Island, M.102669 (D, E, 1.25 × 2.60 mm); F–J, *Allodiscus tongariro* n.sp., NE of Ohakune, W slope of Mt Tongariro, Whakapapaiti, paratype, M.82155 (F–H), and holotype, M.180045 (I, J, 1.65 × 3.00 mm); K–O, *Allodiscus cryptobidens* (Suter, 1891), N of Mt Cook Village, Hooker Valley, M.156977 (K–M), and Hooker Valley, White Horse Hill, lectotype, M.125092 (N, O, 0.85 × 1.75 mm). Scale bars 50 µm (B, G, L), 100 µm (A, C, F, H, K, M).

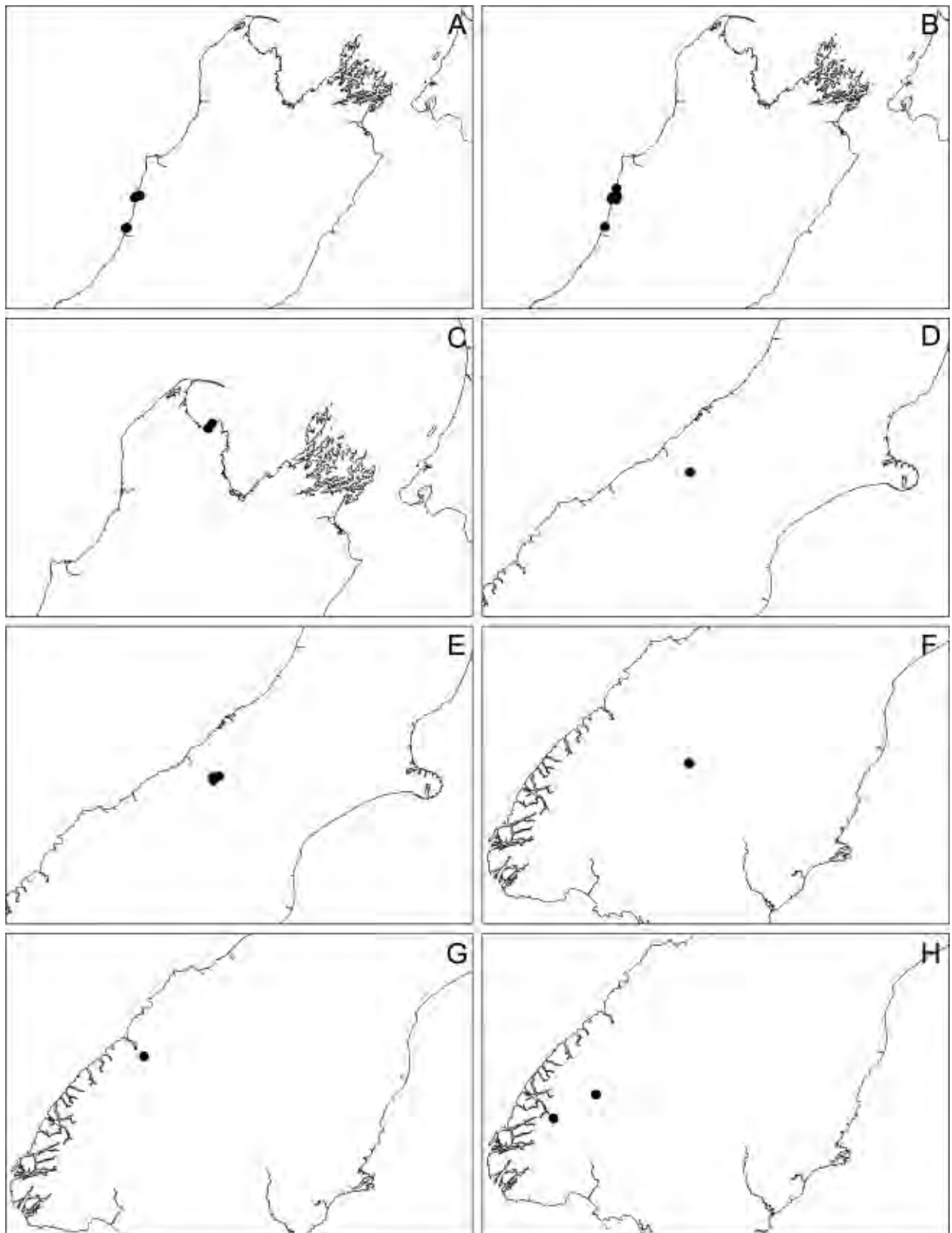


Fig. 16 Distributions of *Allodiscus* (*s. lat.*) species within New Zealand. A, *Allodiscus laganus* n.sp.; B, *Allodiscus punakaiki* n.sp.; C, *Allodiscus tataensis* (Climo, 1971); D, *Allodiscus cryptobidens* (Suter, 1891); E, *Allodiscus godeti* (Suter, 1891); F, *Allodiscus mirificus* n.sp.; G, *Allodiscus patulus* n.sp.; H, *Allodiscus aurora* n.sp.

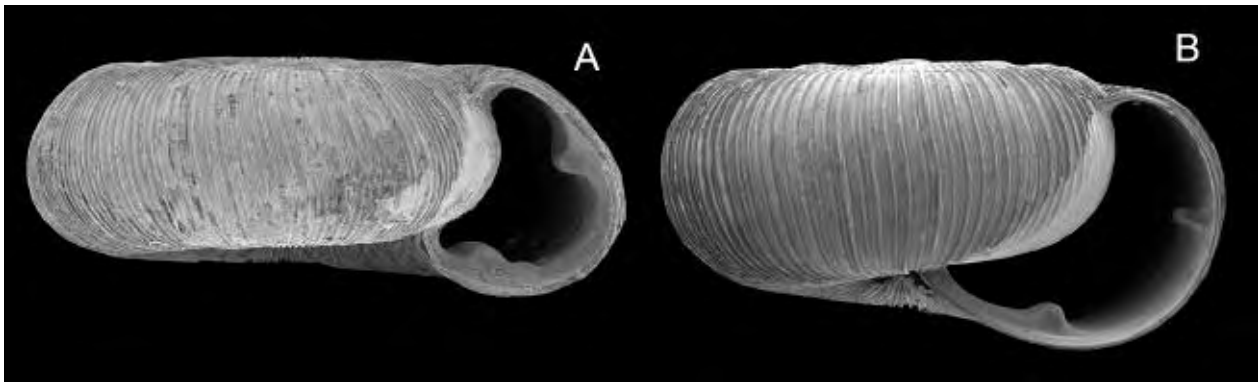


Fig. 17 Apertural barriers of *Allodiscus* (*s. lat.*) species. A, *Allodiscus cryptobidens* (Suter, 1891), N of Mt Cook Village, Hooker Valley, M.156977 (0.70 × 1.70 mm); B, *Allodiscus godeti* (Suter, 1891), N of Mt Cook Village, Hooker Valley, M.88980 (1.90 × 3.80 mm).

translucent and colourless; teleoconch translucent white with reddish-brown pattern on spire and yellowish to orange pattern on sides and base; irregular, sparse maculations and radial lines on spire; pattern transforming near insertion to regular diagonal reticulation that extends around periphery and over base to spiral band bordering umbilical depression; umbilical depression and umbilical wall white.

Protoconch of about 1.25 convex whorls, 630–700 µm wide, nucleus with flocculent sculpture, post-nuclear whorls sculptured with fine, crisp spiral threads, crowded and forming squarely reticulate pattern with axial riblets in narrow subsutural zone, widely spaced elsewhere; interspaces with finer, less sharply defined, irregular radial threads.

Teleoconch of up to 3.00 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp spiral threads and much weaker axial threads surmounted by axial lamellae, strong beading at intersections; lamellae at summit and border of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker.

DISTRIBUTION: Northern South Island (Fig. 13E). Also known from fossils in karst caves within the extant range (e.g. M.82558, M.114585, M.120277) (see also Worthy & Roscoe 2003).

BIOLOGY: *Allodiscus climoi* occurs in litter on the ground, on rock ledges, in rubble, at cave entrances and suspended in *Freyinetia* and other arboreal sites in coastal shrublands, lowland-montane broadleaved/podocarp and *Nothofagus* forests. The species also occurs in subalpine shrublands and tussocklands up to about 1500 m elevation.

CONSERVATION STATUS: *Allodiscus climoi* is widely distributed and not uncommon. Accordingly, our assessment is that the species is of no immediate conservation concern. Note, however, that our interpretation of *Allodiscus climoi* is conservative, and may well include other taxa.

REMARKS: *Allodiscus climoi* appears to be quite variable in colour pattern, umbilicus width and spire height. Most populations examined resemble the type material in the combination of rather sparse colour pattern on spire and solidly pigmented band bordering a white umbilicus, narrow umbilicus and modestly elevated spire. Most specimens from the West Coast of the South Island from Paparoa National Park southwards (e.g. M.101286, M.177536) are similar in shape and colour pattern, yet they have a distinctly narrower umbilicus that is typically more or less occluded by the inner lip (and thus difficult to measure): an almost identical form occurs at Copperstain Creek, south of Collingwood (e.g. M.30069, M.88913), bounded to the northwest and southeast by more widely umbilicate forms. Our interpretation of *Allodiscus climoi* may well encompass more than one allopatric species.

Climo (1969b) (M.38056) described the reproductive system as characterised by the talon on very long duct, and the penis being moderately short, cylindrical, tapering apically to attachment of the retractor muscle and insertion of the vas deferens, in its medial part bearing a large, curved diverticulate appendix, and narrowing distally to atrium. Radular formula 13 + 6 + 1 + 6 + 13; central tooth tricuspid, mesocone extending a little over half the length of the basal plate, cusps on either side well developed; lateral teeth bicuspid by suppression of the endocone, mesocone moderately elongate; marginal teeth tricuspid, with bifurcated mesocone

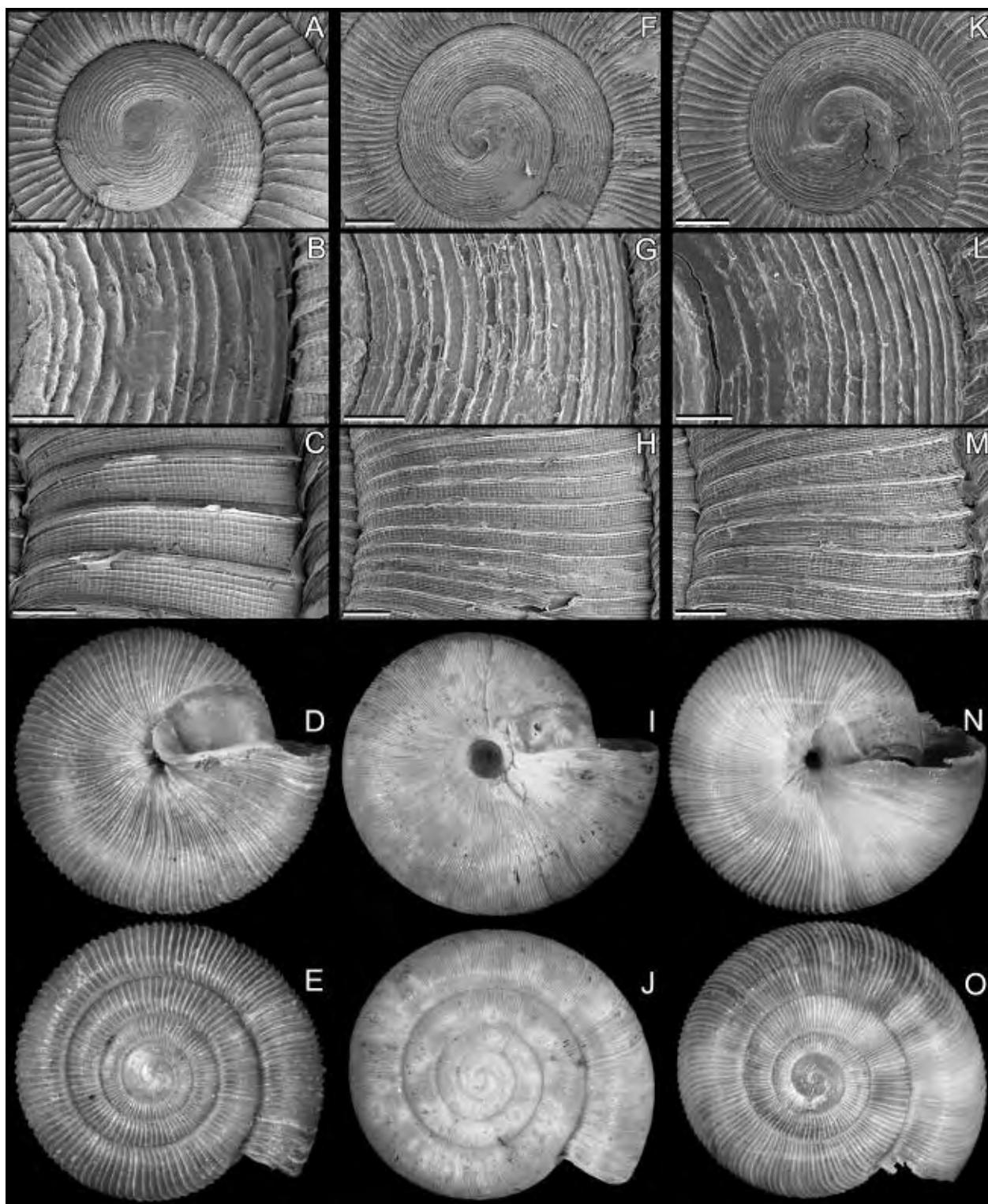


Fig. 18 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus godeti* (Suter, 1891), N of Mount Cook Village, Hooker Valley, M.88980 (D, E, 2.25 × 4.20 mm); F–J, *Allodiscus mirificus* n.sp., Lake Wakatipu, The Remarkables, Rastus Burn, paratype (F–H), and holotype M.180040 (I, J, 2.05 × 4.40 mm); K–O, *Allodiscus patulus* n.sp., SE of Milford Sound, Darran Mountains, Gertrude Saddle, holotype, M.180065 (2.00 × 4.15 mm). Scale bars 50 µm (B, G, L), 100 µm (C, H, M), 200 µm (A, F, K).

and small ectocone in inner teeth, becoming more claw-like, tricuspid towards the radular margin.

ETYMOLOGY: After F.M. Climo (Wellington), who collected the type material, and in recognition of his substantial contribution to the systematics of New Zealand Punctoidea. Noun in the genitive case.

Allodiscus ergodes new species

(Figs 10D, 12K–O, 13G)

Allodiscus ‘coarse axials’ *miranda*-group n.sp. McGuinness, 2001: 587; Hitchmough, 2002: 120; Hitchmough *et al.*, 2007: 82.

Charopidae sp. 150 (NMNZ M.101299) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.180816 and paratypes M.128673 (-50), AIM AK 73269 (3): South Island, S of Nelson, Hackett Track (NZMS 260 N28/293796), 9 Oct. 1983, D.J. Roscoe.

MATERIAL EXAMINED (27 lots): Type material (see above), M.101299 (2), M.101311 (1), M.104911 (many), M.104998 (many), M.105077 (1), M.105428 (many), M.105867 (many), M.107468 (many), M.109738 (many), M.109905 (many), M.121326 (many), M.121339 (many), M.121343 (many), M.121417 (many), M.121435 (4), M.121436 (7), M.121468 (many), M.121504 (many), M.121546 (2), M.121585 (many), M.121723 (many), M.128674 (many), M.128678 (many), M.162731 (1).

DESCRIPTION: Shell up to 2.75 mm wide, thin, wider than high (HWR 0.53–0.60), spire moderately elevated (17–33% SH), narrowly umbilicate (8.4–11.5% SW). Protoconch translucent and colourless; teleoconch translucent white with reddish-brown pattern; irregular maculations on spire, transforming near insertion to regular diagonal reticulation covering periphery, pattern transforming on base to wavy axial bands that traverse base and fuse in outer part of umbilical depression, rest of umbilical depression and umbilical wall white.

Protoconch of about 1.25 convex whorls, 520–570 µm wide, sculptured with about 12 fine, crisp, widely spaced spiral threads, interspaces on outer third of last half-whorl with obscure radial lines, elsewhere essentially smooth.

Teleoconch of up to 3.25 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp, squarely reticulate pattern of spiral threads, and much weaker collabral growth lines surmounted by axial lamellae, strong beading at intersections; lamellae at summit and border of each primary

axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker.

DISTRIBUTION: Northern South Island, Barnicoat Range (Fig. 13G).

BIOLOGY: *Allodiscus ergodes* occurs in the litter, under logs, and under stones in *Nothofagus* forest and subalpine shrubland.

CONSERVATION STATUS: *Allodiscus ergodes* was listed by McGuinness (2001) as potentially of conservation concern owing to its limited range. The species was subsequently listed as ‘range restricted’ by Hitchmough (2002) and Hitchmough *et al.* (2007). Our assessment is that *Allodiscus ergodes* is range restricted but not uncommon.

REMARKS: Among species recorded herein, *Allodiscus ergodes* most closely resembles *A. climoi* n.sp. and *A. laganus* n.sp. Compared with *Allodiscus climoi*, *A. ergodes* differs in having more widely spaced primary axial ribs on the teleoconch, a smaller protoconch (width 520–570 µm, versus 630–700 µm) and (compared with the type material) a slightly wider umbilicus. For comparison with *Allodiscus laganus*, see below.

The anatomy of *Allodiscus ergodes* is not presently known. **ETYMOLOGY:** Troublesome (Greek), alluding to our difficulties in coming to grips with this particular group of species. Adjective in the nominative case.

Allodiscus laganus new species

(Figs 10E, 14A–E, 16A)

Charopidae sp. 114 (NMNZ M.77880) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.183093 and paratypes M.77880 (-200), AIM AK 73272 (3): South Island, Punakaiki, ledge in bush at Tourist Cavern (NZMS 260, K30/723982), 27 Apr. 1983, P.R. Millener.

MATERIAL EXAMINED (16 lots): Type material (see above), M.73167 (8), M.77858 (many), M.78426 (many), M.78459 (18), M.79269 (2), M.89915 (8), M.101238 (25), M.114645 (12), M.120492 (5), M.120857 (1), M.127466 (1), M.159407 (many), M.177454 (5).

DESCRIPTION: Shell up to 3.45 mm wide, thin, wider than high (HWR 0.54–0.59), spire rather weakly elevated (17–23% SH); umbilicus very narrow in juveniles, becoming almost entirely invaded by inner lip rim from early stage of growth. Protoconch translucent and colourless; teleoconch translucent white with yellowish-brown pattern; irregular,



Fig. 19 Shells of *Allodiscus* (*s. lat.*) species. A, *Allodiscus austrodimorphus* Dell, 1955, Doubtful Sound, Secretary Island, M.82258 (3.20 × 4.80 mm); B, *Allodiscus aurora* n.sp., Te Anau, Aurora Caves, holotype, M.146539 (3.05 × 4.80 mm); C, *Allodiscus goulstonei* n.sp., SSE of Port Waikato, Waikawau, holotype, M.169536 (2.30 × 3.75 mm); D, *Allodiscus kakano* n.sp., E of Wellington, behind Days Bay, holotype, M.23580 (2.00 × 3.25 mm); E, *Allodiscus morioria* n.sp., Chatham Island, N of Waitangi, beside Lake Te Roto, holotype, M.180041 (2.47 × 3.72 mm); F, *Allodiscus pygmaeus* n.sp., Chatham Island, NNE of Cape L'Eveque, Taiko Hill, holotype, M.183094 (1.80 × 2.85 mm); G, *Allodiscus tawhiti* n.sp., Auckland Islands, Enderby Island, Sandy Bay, holotype, M.183095 (1.75 × 2.95 mm); H, *Allodiscus tessellatus* Powell, 1941, S of Whakatane, Ruatoki, paratype, M.4741 (2.60 × 4.10 mm); I, *Allodiscus yaldwyni* n.sp., Antipodes Island, Hut Cove Flat, holotype (2.10 × 3.55 mm); J, *Allodiscus absidatus* n.sp., Bluff Walkway, holotype, M.79306 (1.40 × 2.05 mm); K, *Allodiscus basiliratus* N. Gardner, 1967, SE of Cape Reinga, Tapotupotu, M.31965 (1.02 × 1.55 mm); L, *Allodiscus brooki* n.sp., S of Ahipara, Herekino N head, paratype, M.175003 (N, O, 1.13 × 1.65 mm); M, *Allodiscus hazelwoodi* n.sp., NE of Opononi, Mountain Road, holotype, M.181315 (1.20 × 1.90 mm); N, *Allodiscus occidentaneus* n.sp., NNE of Greymouth, N of 10 mile Creek, holotype, M.115091 (1.35 × 1.95 mm); O, *Allodiscus urquharti* Suter, 1894, Ngaruawahia, Hakirimata Track, M.168590 (1.15 × 1.70 mm).

sparse maculations and radial lines on spire; pattern transforming near insertion to regular diagonal reticulation that extends around periphery and outer quarter of base, pattern extending and progressively weakening over base to spiral band bordering umbilical depression or vanishing before reaching it, umbilical depression and umbilical wall white.

Protoconch of 1.30–1.50 convex whorls, 670–730 µm wide, sculptured with fine, crisp spiral threads, crowded and intersected by radial grooves in narrow subsutural zone, widely spaced and even elsewhere; interspaces with finer, obscure, irregular radial threads.

Teleoconch of up to 2.80 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp spiral threads and much weaker axial threads surmounted by axial lamellae, strong beading at intersections; lamellae at summit and border of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker.

DISTRIBUTION: Western South Island, in the vicinity of Punakaiki (Fig. 16A).

BIOLOGY: Litter-dwelling in coastal to lowland shrublands and broadleafed forests.

CONSERVATION STATUS: *Allodiscus laganus* is range restricted according to the criteria of Molloy *et al.* (2002), but not uncommon.

REMARKS: *Allodiscus laganus* closely resembles narrowly umbilicate forms of *A. climoi* n.sp., but differs principally in having more widely spaced axial riblets. A form of *Allodiscus climoi* with a similarly restricted umbilicus occurs within its geographic range (broadly sympatric), but they have not been taken together (asyntopic). Compared with *Allodiscus ergodes* n.sp., which is also closely similar, *A. laganus* differs principally in being more narrowly umbilicate, and in that the spiral threads on the protoconch are crowded beside the suture and intersected by radial grooves; the two species are strongly allopatric.

The anatomy of *Allodiscus laganus* is not presently known.

ETYMOLOGY: Pancake (Latin), alluding to the proximity of the type locality to the Pancake Rocks. Noun in apposition.

Allodiscus negiae new species

(Figs 10F, 13H, 14F–J)

TYPE MATERIAL: Holotype NMNZ M.180085 and paratypes M.99613 (2), AIM AK 73276 (1), South Island, NE of Mangarakau, WSW of Collingwood, pukatea, rātā and

nīkau forest bordering mudflats (NZMS 260 M25/680647), Oct. 1986, G. Park.

MATERIAL EXAMINED (12 lots): Type material (see above), M.56866 (1), M.67948 (1), M.80864 (3), M.80909 (1), M.101787 (1), M.128687 (1), M.156736 (1), M.161267 (3), M.162463 (1).

DESCRIPTION: Shell up to 2.40 mm wide, thin, wider than high (HWR 0.50–0.54), spire weakly elevated (18–26% SH), narrowly umbilicate (7.2–7.9% SW). Protoconch translucent and colourless; teleoconch pale translucent buff with pale yellowish-brown pattern of axial maculations on spire that transform at insertion to peripheral diagonally reticulate pattern, which fades and vanishes at about middle of base.

Protoconch of about 1.25 convex whorls, 550–650 µm wide, sculptured with 16–17 fine, crisp, widely spaced spiral threads surmounted by periostracal lamellae, interspaces weakly wrinkled.

Teleoconch of up to 2.30 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp reticulate pattern of spiral threads, and much weaker axial threads surmounted by axial lamellae, fine beading at intersections; lamellae at summit and border of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip rim thin, weakly and evenly thickened within; inner lip slightly thicker.

DISTRIBUTION: Northern South Island (Fig. 13H).

BIOLOGY: *Allodiscus negiae* is known from leaf litter and rocky ledges in shrublands and forests at elevations ranging from near sea-level to about 900 m.

CONSERVATION STATUS: *Allodiscus negiae* has been collected from a limited number of sites and is clearly not common. However, the species occurs in a range of habitat types, suggesting it may be more broadly distributed in the northern South Island. Our assessment is that *Allodiscus negiae* should be regarded as ‘data deficient’, and that further survey is needed to establish more clearly the species’ conservation status.

REMARKS: Compared with *Allodiscus climoi* n.sp., with which it is locally sympatric, *A. negiae* differs in attaining a smaller size, in being smaller relative to the number of whorls, in lacking the circular band outside the umbilicus, and in that the surface between the spiral threads on the protoconch is at most weakly wrinkled rather than traversed by weak radial threads.

The anatomy of *Allodiscus negiae* is not presently known. ETYMOLOGY: After Negia Hoblyn (formerly of the Museum of New Zealand Te Papa Tongarewa), who databased most of the material examined. Noun in the genitive case.

***Allodiscus punakaiki* new species**

(Figs 10G, 14K–O, 16B)

Allodiscus new species 1 Goulstone, 1988: 9, text figs.

TYPE MATERIAL: Holotype NMNZ M.76317: South Island, E of Punakaiki, Bullock Creek Track (NZMS 260 K30/777995), 21 Nov. 1977, J.K. Barnes. Paratypes: S of Punakaiki, 10 Sep. 1982, F.M. Climo, M.73110 (2); NNE of Punakaiki, Fox River, 23 Dec. 1982, F.M. Climo, M.115072 (2); Punakaiki, N side Pororai River bridge, 8 Mar. 1980, D.J. Roscoe, M.120485 (2); Punakaiki, Pancake Rocks, 25 Apr. 1977, B.F. Hazelwood, M.56453 (1).

MATERIAL EXAMINED (7 lots): Type material (see above), M.57232 (1), M.115205 (4).

DESCRIPTION: Shell up to 2.65 mm wide, thin, wider than high (HWR 0.50–0.54), spire weakly elevated (16.7–23.0% SH), narrowly umbilicate (7.3–12.4% SW). Protoconch translucent and colourless; teleoconch pale translucent buff with reddish-brown pattern of axial maculations on spire against suture that transform to diagonally reticulate pattern, this extending from spire into umbilicus.

Protoconch of 1.15–1.25 convex whorls, 530–570 μ m wide, sculptured with about 17 fine, crisp, widely spaced spiral threads surmounted by periostracal lamellae, interspaces essentially smooth.

Teleoconch of up to 2.50 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp, reticulate pattern of spiral threads, and much weaker axial threads surmounted by axial lamellae, no beading at intersections; lamellae at summit and border of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer-lip rim thin, weakly and evenly thickened within, inner lip slightly thicker.

DISTRIBUTION: West Coast of South Island, between Fox River and Rapahoe (Fig. 16B).

BIOLOGY: *Allodiscus punakaiki* occurs in leaf litter on the ground in coastal flax, in broadleaved shrublands, and in lowland *Nothofagus* and broadleaved/podocarp forests.

CONSERVATION STATUS: *Allodiscus punakaiki* is restricted in geographic range and habitat types, and is not common. Our assessment is that the species should be ranked ‘range

restricted’ according to the criteria of Molloy *et al.* (2002). REMARKS: Compared with the superficially very similar species *Allodiscus tataensis* (Climo, 1971), *A. punakaiki* differs in having a narrower umbilicus, more closely spaced spiral threads on the teleoconch, and in that the protoconch ranges to larger size (width 530–570 μ m, versus 500–530 μ m). The two species are strongly allopatric in the northwestern South Island (Figs 16B,C).

The anatomy of *Allodiscus punakaiki* is not presently known.

ETYMOLOGY: From the type locality (Māori). Noun in apposition.

***Allodiscus tataensis* (Climo, 1971) new combination**

(Figs 10H, 15A–E, 16C)

Pseudallodiscus tataensis: Climo, 1969b: 67, figs 1B, 11D–F (not available: ICZN Article 8); Climo, 1971a: 103, figs 2D–F; Powell, 1976: 117; Powell, 1979: 322; Spencer & Willan, 1996: 41.

TYPE MATERIAL: Holotype NMNZ M.22458 and paratype M.22459: South Island, NE of Takaka, Tata Islands, Motu Island, 15 Nov. 1967, F.M. Climo.

MATERIAL EXAMINED (11 lots): Type material (see above), M.56406 (6), M.56438 (many), M.57273 (5), M.68692 (5), M.69887 (5), M.89288 (many), M.102669 (many), M.123707 (4), M.156981 (2).

REDESCRIPTION: Shell up to 2.80 mm wide, thin, wider than high (HWR 43.0–51.0), spire weakly elevated (10.2–21.4% SH), widely umbilicate (14–18% SW). Protoconch translucent and colourless; teleoconch translucent white with reddish-brown pattern of subsutural maculations that transform to diagonally reticulate pattern, this extending over spire, periphery and base, fading and vanishing on outer part of umbilical depression.

Protoconch of 1.10–1.20 convex whorls, 500–530 μ m wide, sculptured with fine, crisp, widely spaced spiral threads surmounted by periostracal lamellae, interspaces essentially smooth.

Teleoconch of up to 2.30 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp, squarely reticulate pattern of spiral threads, and much weaker axial threads surmounted by axial lamellae, fine beading at intersections; lamellae at summit and border of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, lips thin, weakly and evenly thickened within.

DISTRIBUTION: Tata Islands and adjacent mainland at Pohara, northeast of Takaka, northern South Island (Fig. 16C).

BIOLOGY: *Allodiscus tataensis* has been collected from under logs and in leaf litter from coastal broadleaved shrublands and forests.

CONSERVATION STATUS: *Allodiscus tataensis* has been overlooked in previous assessments of the conservation status of New Zealand landsnails. While not uncommon in the occupied habitat, the species is very restricted geographically, and must be ranked 'range restricted' according to the criteria of Molloy *et al.* (2002).

REMARKS: When introducing this species, Climo (1971a) stated that protoconchs of the two type specimens were worn but indistinctly radially costate. In reality, their worn protoconchs show faint traces of spiral sculpture, and the shells are perfectly accordant with well-preserved specimens from the type locality, where the species is common and where, moreover, *Pseudallodiscus* species (with axially ribbed protoconchs) are not known to occur. Nevertheless, apart from protoconch sculpture and smaller size, *Allodiscus tataensis* is extremely similar to *Pseudallodiscus ponderi* Climo, 1971 in shape, teleoconch morphology, colour and colour pattern (Figs 26J, 34F–J).

The anatomy of *Allodiscus tataensis* is not presently known.

Allodiscus tongariro new species

(Figs 10I, 13F, 15F–J)

Allodiscus new sp. Whakapapaiti Mayhill, 1994; 31, 60, text fig.

Allodiscus cf. [*sic* = aff.] *planulatus* n.sp. McGuinness, 2001: 587; Hitchmough, 2002: 121.

Allodiscus 'aff. *planulatus*' (NMNZ M.82155) Hitchmough *et al.*, 2007: 128.

TYPE MATERIAL: Holotype NMNZ M.180045 and paratypes M.82155 (3): North Island, SW slope of Mt Ruapehu, NE of Ohakune, Whakapapaiti, 1560 m (NZMS 260 S20/288147), Dec. 1981, P.C. Mayhill.

MATERIAL EXAMINED (2 lots): Type material (see above).

DESCRIPTION: Shell up to 3.00 mm wide, thin, wider than high (HWR 0.56–0.57), spire weakly elevated (19.3–20.5% SH), narrowly umbilicate (8.3–9.0% SW). Protoconch translucent and colourless; teleoconch pale translucent buff with close reddish-brown axial bands that extend over spire, periphery and base, fusing as band at outer part of umbilical depression, umbilical wall white.

Protoconch of about 1.30 convex whorls, 730–770 μm wide, sculptured with fine, crisp, widely spaced spiral threads, of which about 11 are exposed on spire, interspaces essentially smooth; additionally with narrow subsutural zone of axial pleats.

Teleoconch of up to 2.50 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp, reticulate pattern of spiral threads, and weaker and closer axial threads surmounted by axial lamellae, intersections weakly beaded; lamellae at summit and border of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture broadly and shallowly sigmoidal. Aperture simple, outer lip thin at rim, weakly and evenly thickened within, inner lip slightly thicker.

DISTRIBUTION: Central North Island, southwestern slope of Mt Ruapehu (Fig. 13F).

BIOLOGY: *Allodiscus tongariro* occurs in subalpine scrub.

CONSERVATION STATUS: *Allodiscus tongariro* was listed by McGuinness (2001) as of potential conservation concern because of its limited distribution and apparent rarity. Hitchmough (2002) listed the species as 'range restricted', but this ranking was subsequently downgraded by Hitchmough *et al.* (2007) to 'data deficient'. Presently the species is known from a single location, and further survey in the Tongariro National Park area is required to determine its status properly.

REMARKS: *Allodiscus tongariro* is unique among species treated here in its combination of size, size relative to the number of whorls, the protoconch size and sculpture, relatively wide umbilicus, and in details of colour pattern and teleoconch sculpture. *Allodiscus climoi* n.sp. from the northern South Island is the most similar in size, shape and in sculpture of both the protoconch and the teleoconch, but *A. tongariro* differs in having finer beading at the intersections of the spiral threads and the axial lamellae, and in details of colour pattern.

The anatomy of *Allodiscus tongariro* is not presently known.

ETYMOLOGY: After the type locality, Mt Tongariro. Noun in apposition.

Group D (*godeti*)

DIAGNOSIS: Shell very small to medium sized (maximum width 1.70–4.70 mm), low (HWR 0.37–0.54), spire planar or weakly to moderately elevated (0.08–23% SH). Narrowly

to very widely umbilicate (6–37% SW). Protoconch small or medium sized (width 500–930 µm), sculptured with 11–17 crisp spiral threads, each surmounted by low periostracal blade, interspaces wider than each spiral.

REMARKS: Group members *Allodiscus cryptobidens* (Suter, 1891), *A. godeti* (Suter, 1891), *A. mirificus* n.sp. and *A. patulus* n.sp. are distinctive in combining a very pale colour pattern or lack of one, strongly depressed spire, and protoconch sculpture of crisp, widely spaced spiral threads surmounted by periostracal lamellae. *Allodiscus cryptobidens* and *A. godeti* are further highly distinctive among taxa treated here in having apertural denticles at maturity.

Allodiscus cryptobidens (Suter, 1891)

(Figs 10J, 15K–O, 16D, 17A)

Pityis cryptobidens Suter, 1891a: 89, pl. 17, figs 7, 71-c, m, n; Marshall, 1996: 36.

Patula (Endodonta) cryptobidens.– Pilsbry, 1892b: 85, pl. 24, figs 28–31.

Endodonta cryptobidens.– Hedley & Suter, 1893: 651; Suter, 1913: 685, pl. 9, figs 14a,b.

Endodonta (Thaumatodon) cryptobidens.– Suter, 1894d: 258.

Ptychodon cryptobidens.– Iredale, 1915: 481; Powell, 1937: 89; Powell, 1946: 92; Powell, 1957: 118; Powell, 1962: 111.

Charopa (Ptychodon) cryptobidens.– Climo, 1969a: 186; Climo, 1969c: 185, text fig. 5; Powell, 1976: 115; Powell, 1979: 304.

Allodiscus cryptobidens.– Climo, 1978: 189; Spencer & Willan, 1996: 40.

TYPE MATERIAL: Lectotype here selected (Climo's 1969c, text fig. 5 statement that the specimen was the 'holotype' is not available as an inadvertent lectotype designation – ICZN Art. 74.5. Another specimen recorded by Suter has not been found. Suter dissected a third.), NMNZ M.125092: South Island, NNW of Mt Cook Village, Hooker Valley, White Horse Hill, amongst mould in subalpine bush, H. Suter.

MATERIAL EXAMINED (2 lots): Type material (see above), M.156977 (1).

REDESCRIPTION: Shell up to 1.70 mm wide, wider than high (HWR 0.37), thin, spire planar to weakly elevated (0–8.0% SH), umbilicus very wide (37% SW). Uniform translucent white.

Protoconch of about 1.25 convex whorls, 500 µm wide, sculptured throughout with fine, crisp, widely spaced, tightly and irregularly zigzagging spiral threads that number about

13 on spire on first three-quarter-whorls, last sixth-whorl additionally traversed by much weaker, irregular radial lirae.

Teleoconch of up to 2.25 convex whorls, sides distinctly tapered adapically, sculptured throughout with prominent, more or less regularly spaced primary axial ribs; these overlain by crisp spiral threads and fine axial periostracal lamellae, spiral threads very weakly beaded at intersections with axial lamellae, lamella at summit of each primary axial rib stronger than interstitial lamellae. Axial sculpture shallowly and broadly sigmoidal. Adult outer lip rapidly thickened, with prominent, rounded, spirally elongate denticle at about adapical third and another at base beside inner lip.

DISTRIBUTION: South Island, Hooker Valley, north of Mt Cook Village (Fig. 16D).

BIOLOGY: The biology of *Allodiscus cryptobidens* is poorly known. The species is thought to be confined to montane *Nothofagus* forest, where it has been recorded as a litter-dweller on the forest floor.

CONSERVATION STATUS: *Allodiscus cryptobidens* has been overlooked in previous assessments of the conservation status of New Zealand landsnails. On present evidence, the species must be regarded as restricted to the Hooker Valley. Despite the high numbers of tourists enjoying the scenery and leisure activities offered by the Hooker Valley and its surrounds, the *Nothofagus* forest habitat of *Allodiscus cryptobidens* remains relatively secure. On the criteria of Molloy *et al.* (2002), *Allodiscus cryptobidens* is 'range restricted'.

REMARKS: Climo (1978) established the association of *Pityis cryptobidens* Suter, 1891 with the genus *Allodiscus* Pilsbry, 1892. Unfortunately, the compilation of Powell's (1979) catalogue of the New Zealand fauna pre-dated that paper by Climo, but went to press in 1979. Thus Powell (1979) inadvertently reinstated the association with *Charopa (Ptychodon)* established a decade earlier by Climo (1969a,c) but recognised by Climo (1978) as probably erroneous. In an appendix to his catalogue, Powell (1979) referred to Climo (1978) but failed to mention the taxonomic change proposed by Climo in relation to *cryptobidens* Suter, 1891. We thus re-establish the association of *Pityis cryptobidens* Suter, 1891 with the genus *Allodiscus*.

Allodiscus cryptobidens is strongly characterised by the combination of small, colourless shell, flattened spire, extremely wide umbilicus, and internally dentate outer lip. Remarkably enough, *Allodiscus godeti*, the only other species from New Zealand combining apertural denticles with a flattened spire, a spirally lirated protoconch and lack of a colour pattern, has the same highly restricted distribution. *Allodiscus*

cryptobidens differs from *A. godeti* (Suter, 1891), however, in attaining a much smaller size, in being considerably smaller relative to the number of whorls, in having a much wider umbilicus, and in details of shape and sculpture as well as position and shape of the apertural denticles (Fig. 17). The only specimen known other than the type material was collected from the vicinity of the type locality, where it was recorded as sympatric with *A. godeti*.

Suter dissected *Allodiscus cryptobidens*, describing the radula and jaw (Suter 1891a, 1913). The central and lateral teeth were stated to be tricuspid, the inner marginals tricuspid and the outer marginals bicuspid.

***Allodiscus godeti* (Suter, 1891)**

(Figs 10K, 16E, 17B, 18A–E)

Pyra godeti Suter, 1891a: 90, pl. 17, figs 8, 8a–8b, o, p; Suter, 1891b: 95; Suter, 1892a: 275; Marshall, 1996: 37.

Gerontia (Allodiscus) godeti.– Pilsbry, 1892b: 68, pl. 22, figs 43–45.

Allodiscus godeti.– Hedley & Suter, 1893: 639; Suter, 1913: 640, pl. 25, figs 12–12b; Powell, 1937: 88; Powell, 1946: 92; Powell, 1957: 117; Powell, 1962: 110; Powell, 1976: 117; Powell, 1979: 320; Spencer & Willan, 1996: 40; McGuinness, 2001: 588; Hitchmough, 2002: 114; Hitchmough *et al.*, 2007: 76.

Flammulina (Allodiscus) godeti.– Suter, 1894b: 146; Suter, 1894d: 253; Pilsbry, 1893: 14, pl. 2, figs 13, 14.

Allodiscus (Allodiscus) godeti.– Climo, 1969b: 32, figs 2b, 14a–e, 23d, 24a.

TYPE MATERIAL: Lectotype (here selected) NMNZ M.125111 and paralectotypes M.125110 (4): South Island, ‘foot of Sealy Range, Hooker Valley’, under stones, H. Suter. **MATERIAL EXAMINED** (8 lots): Type material (see above), M.38771 (3), M.88980 (many), M.114330 (3), M.114657 (1), M.157826 (2), M.157832 (4).

REDESCRIPTION: Shell up to 4.60 mm wide, thin, very low and broad (HWR 0.47–0.54), spire weakly to moderately elevated (12–23% SH), narrowly umbilicate (4.2–6.2% SW), uniform translucent buff.

Protoconch of 1.20–1.30 convex whorls, weakly elevated, 800–830 µm wide, sculptured with crisp, widely spaced spiral threads that number 14 on spire on last half-whorl, distinctly and irregularly wavy at nucleus, more or less regular thereafter, each surmounted by a low periostracal lamella; interspaces with weak, irregular, prosocline radial lines; last eighth-whorl additionally with a number of irregular, irregularly spaced axial ribs that form a reticulate pattern with spiral threads.

Teleoconch of up to 3.50 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by much finer reticulating spiral threads and periostracal lamellae, intersections simple, periostracal lamella at summit of each primary axial rib most prominent. Axial sculpture shallowly and broadly sigmoidal. Aperture in subadults simple; adults typically with 2 strong, roundly trigonal, laterally compressed lamellae a short distance within, one basal, the other at about mid-height of outer lip; inner lip thicker than outer, projected abaperturally and partly overhanging umbilicus.

DISTRIBUTION: South Island in vicinity of Mt Cook (Fig. 16E).

BIOLOGY: Most common under scree in moist moss-covered areas.

CONSERVATION STATUS: McGuinness (2001) listed *Allodiscus godeti* as being of potential conservation concern owing to the species’ restricted range. Hitchmough (2002) and Hitchmough *et al.* (2007) subsequently ranked the species as ‘range restricted’. We have confirmed that the *Allodiscus godeti* is not known outside the Hooker Valley and thus must be regarded as ‘range restricted’. *Allodiscus godeti* occurs in the same area as *A. cryptobidens*, which is also a species of conservation concern.

REMARKS: Compared with *Allodiscus tullia* (Gray, 1850), which it most resembles in gross facies, including the presence of primary axial ribs on the last approximately eighth-whorl of the protoconch, *A. godeti* differs in having a larger protoconch (width 800–830 µm, versus 730–770 µm), in lacking a shell colour pattern, in having stronger, more widely spaced primary axial ribs, and in that adult specimens typically have two strong apertural lamellae. The only other species treated herein with apertural denticles is the much smaller, more widely umbilicate *Allodiscus cryptobidens* (Suter, 1891) (see above).

As noted by Climo (1969b), the apertural lamellae are often poorly developed and indeed are absent in many specimens.

The jaw and radular dentition were originally described by Suter (1891a), then reproduced by Pilsbry (1893) and Suter (1913). Suter gave the radular formula as 14 + 6 + 1 + 6 + 14. Climo (1969b) gave the formula as 10 + 8 + 1 + 8 + 10. The variance in these formulae evidently relates to differences in the assignment of teeth in the lateral–marginal transitional position by the respective authors. The central tooth is tricuspid, with the mesocone extending to, or near to, the foot of the basal plate, and with well-developed cusps either side;

lateral teeth are bicuspid by suppression of the endocone; marginal teeth are initially tricuspid owing to bifurcation of the ectocone, then multicuspid with splitting of the mesocone and further splitting of the ectocone, and finally reduced to tricuspid or bicuspid at the margin of the radula.

According to Climo (1969b), the male genitalia are characterised by the ovoid penis, bearing apically a slender, tapering caecum with the penial retractor muscle issuing from its terminus and the vas deferens opening laterally towards its base; and subapically giving rise to a digitiform, curved appendix. Other aspects of the reproductive anatomy are not presently known.

Allodiscus mirificus new species

(Figs 10L, 16F, 18F–J)

TYPE MATERIAL: Holotype NMNZ M.180040 and paratypes M.99637 (2), AIM AK 73274 (1): South Island, Lake Wakatipu, The Remarkables, Rastus Burn, 1830 m (NZMS 260 F41/814642), Jan. 1989, P.C. Mayhill. Additional paratypes: The Remarkables, 1 Dec. 1989, B.H. Patrick, M.101155 (1), 16 Apr. 1994, J. Townsend, M.116471 (4), Jan. 1989, P.C. Mayhill, M.163312 (7).

MATERIAL EXAMINED (6 lots): Type material (see above).

DESCRIPTION: Shell up to 4.40 mm wide, thin, very low and broad (HWR 0.41–0.51), spire very weakly elevated (0.08–0.20% SH), rather widely umbilicate (13.2–15.5% SW), uniform translucent buff.

Protoconch of 1.30–1.50 convex whorls, weakly elevated, 900–930 µm wide, sculptured with crisp, widely spaced spiral threads that number about 17 on spire on last half-whorl, distinctly and irregularly wavy at nucleus, more or less regular thereafter, interspaces essentially smooth.

Teleoconch of up to 2.80 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine spiral threads and weaker axial threads, the latter surmounted by fine periostracal lamellae, intersections finely beaded; periostracal lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, lips thin, weakly thickened within.

DISTRIBUTION: Southwestern South Island, The Remarkables (Fig. 16F).

BIOLOGY: *Allodiscus mirificus* is known only from subalpine scrubland at elevations of 1770–1900 m in the Rastus Burn area of The Remarkables.

CONSERVATION STATUS: *Allodiscus mirificus* is 'range restricted' according to the criteria of Molloy *et al.* (2002).

REMARKS: *Allodiscus mirificus* superficially resembles *A. godeti* (Suter, 1891) in size and in lack of colour pattern, but it differs in a number of details, including lower spire, wider umbilicus, lack of axial riblets on the last part of the protoconch, lack of apertural denticles, and in having finer, more crowded primary axial ribs on the teleoconch.

The anatomy of *Allodiscus mirificus* is not presently known.

ETYMOLOGY: Causing wonder (Latin), alluding to the name of the type locality. Adjective in the nominative case.

Allodiscus patulus new species

(Figs 10N, 16G, 18K–O)

Charopidae sp. 66 (NMNZ M.116767) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.180065 and paratype M.116767: South Island, Darran Mountains, SE of Milford Sound, Gertrude Saddle, 1250 m (NZMS 260 D40/158949), Jan. 1989, P.C. Mayhill.

MATERIAL EXAMINED (2 lots): Type material (see above).

DESCRIPTION: Shell up to 4.70 mm wide, thin, low and broad (HWR 0.49–0.50), spire weakly elevated (15.0–21.2% SH), narrowly umbilicate (width 6% SW), becoming partly overhung by inner lip. Protoconch translucent pale buff. Teleoconch ground colour translucent pale buff, with faint yellowish-brown pattern of broad axial maculations that transform to zigzag bands over periphery

Protoconch of 1.25–1.30 convex whorls, weakly elevated, 800 µm wide, sculptured with crisp, widely spaced spiral threads that number 15 on spire on last half-whorl, distinctly and irregularly wavy at nucleus, more or less regular thereafter, each surmounted by low periostracal lamella; interspaces essentially smooth.

Teleoconch of up to 3.20 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by much finer, reticulating spiral threads and periostracal lamellae, spiral threads extremely finely beaded at intersections; lamellae at summit and bordering each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, outer lip thin at rim, slightly thicker within; inner lip thicker than outer, projected abaperturally and partly overhanging umbilicus.

DISTRIBUTION: Southwestern South Island, Darran Mountains (Fig. 16G).

BIOLOGY: Little is known of the biology of *Allodiscus patulus*. The habitat at the type locality comprises subalpine scrubland.

CONSERVATION STATUS: *Allodiscus patulus* is presently known only from the type locality in the Gertrude Saddle, Darran Mountains. While the species may be ranked 'range restricted', further survey in the Fiordland mountains is required to establish its conservation status properly.

REMARKS: Compared with the superficially similar species *Allodiscus tullia* (Gray, 1850), *A. patulus* differs principally in having a lower spire, in being considerably larger relative to the number of whorls, and in having a very weak colour pattern. *Allodiscus patulus* is readily separable from *A. godeti* (Suter, 1891) by the lack of apertural denticles and lack of axial riblets on the protoconch, and from *A. mirificus* n.sp. by the much finer and more numerous primary axial ribs on the teleoconch.

The anatomy of *Allodiscus patulus* is not presently known.

ETYMOLOGY: Broad (Latin), alluding to the low, broad shape of the shell. Adjective in the nominative case.

Group E (*tessellatus*)

DIAGNOSIS: Shell medium sized (maximum width 3.15–4.90 mm), low (HWR 0.52–0.64), spire moderately to strongly elevated (15–36% SH). Narrowly umbilicate (width 2.5–6.5% SW) or anomphalous due to invasion by inner lip. Protoconch medium sized to large (width 700–1000 µm), sculptured with 15–23 crisp, rounded spiral threads, interspaces wider than each spiral.

REMARKS: Compared with members of groups B and C, which have more or less similar gross facies, Group E species differ in having spiral threads on the protoconch that are rounded rather than more or less square-cut, and that are not surmounted by low periostracal blades. The group includes *Allodiscus aurora* n.sp., *A. austrodimorphus* Dell, 1955, *A. chion* (Sykes, 1896), *A. goulstonei* n.sp., *A. kakano* n.sp., *A. morioria* n.sp., *A. pygmaeus* n.sp., *A. tawhiti* n.sp., *A. tessellatus* Powell, 1941 and *A. worthyi* n.sp.

Allodiscus aurora new species

(Figs 16H, 19B, 21A–E)

Allodiscus austrodimorphus.—Mayhill, 1985: 5, text fig. (in part of Dell, 1955).

TYPE MATERIAL: Holotype NMNZ M.146539: South Island, Te Anau, Aurora Caves, 420 m (NZMS 260 D42/956327), Feb. 1985, P.C. Mayhill.

MATERIAL EXAMINED (2 lots): Type material (see above), M.146228 (1).

DESCRIPTION: Shell (holotype) 4.90 mm wide, wider than high (HWR 0.61), thin, spire moderately elevated (24% SH); umbilicus narrow and partly overhung by

inner-lip rim in subadult (shell width 4.10 mm), fully invaded by inner lip.

Protoconch translucent, colourless; teleoconch translucent white with reddish-brown pattern of wavy axial maculations of rather irregular width and spacing, entirely traversing spire whorls, transforming near insertion to broad, diagonal, chequer-board pattern that extends around periphery and over base to umbilical depression. Protoconch weakly elevated, of 1.35 convex whorls, 1000 µm wide, sculptured with fine, crisp, rather widely spaced spiral threads that are broken by narrow, irregular, irregularly spaced grooves, numbering about 22 on spire on last half-whorl.

Teleoconch of 3.00 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and very weak axial threads surmounted by periostracal lamellae, their intersections finely and crisply beaded. Axial sculpture broadly sigmoidal, weakly opisthocline on spire. Aperture simple; outer lip thin, weakly and evenly thickened within; inner lip thicker and progressively invading narrow umbilicus.

DISTRIBUTION: Southwestern South Island, near Lake Te Anau and Mt Barber (Fig. 16H).

BIOLOGY: *Allodiscus aurora* is known from limestone at 420 m (near Aurora Caves in *Nothofagus* forest) and 1210 m elevation (subalpine shrubland) in the mountains of Fiordland. It is probably a calcicole.

CONSERVATION STATUS: *Allodiscus aurora* is presently known from only two localities. While the species is possibly restricted to limestone areas of Fiordland, further survey is required to establish its conservation status properly. Thus, *Allodiscus aurora* must be ranked 'data deficient'.

REMARKS: *Allodiscus aurora* is distinctive in the combination of large protoconch sculptured with crisp spiral threads that are interrupted by irregular grooves, chequer-board colour pattern and closed umbilicus. It differs from members of Group B (*tullia*) in having a larger protoconch (width 1000 µm, versus 630–970 µm) with more numerous, interrupted spiral threads. It superficially resembles *Allodiscus tessellatus* Powell, 1941 in gross facies and colour pattern, but differs in having a coarser diagonal colour pattern on the sides and the base, more widely spaced spiral threads on the teleoconch, and in having a closed umbilicus. See below for comparison with the superficially similar species *Allodiscus worthyi* n.sp.

The anatomy of *Allodiscus aurora* is not presently known.

ETYMOLOGY: After the type locality, Aurora Caves. Noun in apposition.

Allodiscus austrodimorphus Dell, 1955

(Figs 19A, 20A, 22A–E)

Allodiscus dimorphus.– Suter, 1913: 640 (in part).*Allodiscus austrodimorphus* Dell, 1955: 1137, fig. 1; Climo, 1968: 45; Gardner, 1976: 5; Powell, 1979: 318; Roscoe, 1992: 7; Marshall, 1996: 35.*Allodiscus (Allodiscus) austrodimorphus*.– Climo, 1969b: 13, figs 1A, 12A–C, 15A,B, 23B, 25A.*Allodiscus austrodimorphus*.– Powell, 1957: 117; Powell, 1962: 110; Goulstone & Gardner, 1975: 8, text fig.; Powell, 1976: 117; Goulstone & Gardner, 1976: 4, text fig.; Gardner, 1977: 38; Gardner & Goulstone, 1977: 5; Mayhill, 1985: 5, text fig. (in part = *A. aurora* n.sp.); Spencer & Willan, 1996: 40.

TYPE MATERIAL: Holotype NMNZ M.6149: South Island, Caswell Sound, beside Stillwater River, 13 Mar. 1949, R.K. Dell. Paratype NMNZ M.6151 (1): NW of Te Anau, Lake Te Au, Jan. 1953, R.R. Forster.

MATERIAL EXAMINED (35 lots): Type material (see above), M.14263 (2), M.22306 (2), M.29915 (3), M.30363 (1), M.31146 (2), M.62150 (1), M.69037 (2), M.77365 (many), M.78619 (5), M.81991 (1), M.82095 (2), M.82258 (1), M.82440 (1), M.82744 (1), M.82755 (1), M.85652 (5), M.85735 (2), M.89844 (1), M.89875 (1), M.100149 (1), M.146089 (5), M.146193 (1), M.146233 (1), M.146348 (3), M.146515 (many), M.146561 (1), M.146583 (3), M.146627 (2), M.146926 (1), M.156788 (2), M.157320 (3), M.157521 (2), M.175085 (1).

REDESCRIPTION: Shell up to 5.75 mm wide, thin, wider than high (HWR 0.57–0.67), spire moderately elevated (19–29% SH), juveniles narrowly umbilicate, adults anomphalous. Translucent, teleoconch with large, irregular reddish-brown maculations on spire, sides and base with a reddish-brown diagonally reticulate chequer-board pattern.

Protoconch of about 1.25 convex whorls, 830–1070 μ m wide, sculptured with crisp spiral threads that number about 15 on spire on last half-whorl, each surmounted by low periostracal lamella; interspaces with weak, irregular, radial lines.

Teleoconch of up to 3.50 broadly convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; and overlying fine, crisp spiral threads and axial periostracal lamellae of similar width and spacing, spirals weakly beaded at intersections; lamellae at summit and borders of each primary axial rib higher than interstitial lamellae. Axial sculpture weakly to moderately strongly

sigmoidal. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thickened, completely filling narrow umbilicus in adults.

DISTRIBUTION: Western South Island, from vicinity of Boddytown, south of Greymouth, to as far south as Dusky Sound (Fig. 20A).

BIOLOGY: *Allodiscus austrodimorphus* occurs in litter, under woody debris and under rock rubble in broadleaved/podocarp forests, *Nothofagus* forests and subalpine scrubland from near sea-level to about 1200 m elevation.CONSERVATION STATUS: *Allodiscus austrodimorphus* is widely distributed and not uncommon. Our assessment is that the species is of no immediate conservation concern.REMARKS: *Allodiscus austrodimorphus* is characterised by the combination of elevated spire, large size, wide protoconch, chequer-board colour pattern on the sides and base, and lack of an umbilicus in adults (juveniles narrowly umbilicate). Since there are stronger and markedly fewer spiral threads on the protoconch than in *Allodiscus (s. str.)*, *Allodiscus austrodimorphus* is unlikely to be congeneric, and seems more likely to be related to species in Group E – perhaps *A. taubhiti* n.sp., which has similar protoconch sculpture. *Allodiscus austrodimorphus* is locally sympatric with *A. aurora* n.sp. in Fiordland. We concur with Climo (1969b) in regarding Suter's (1913) record of *Allodiscus dimorphus* (Reeve, 1852) from Milford Sound, Fiordland, as referring to *A. austrodimorphus*.Climo (1969b) described the anatomy of *Allodiscus austrodimorphus* based on specimens from Arthur's Pass, Canterbury. The radular formula is given as 19 + 10 + 1 + 10 + 19, indicating a relatively high number of lateral and marginal teeth. Central tooth tricuspid, the mesocone extending about two-thirds the length of the basal plate; lateral teeth initially tricuspid, but towards radular margin become bicuspid by suppression of the endocone and then secondarily tricuspid with bifurcation of the mesocone; marginal teeth tricuspid, claw-like.

The reproductive system is characterised by bursa duct broadly open to oviduct, strongly bulbous at its base, but abruptly narrowing to slender, long duct to bursa sac; vagina short, stout; penis long, cylindrical, tapered to short caecum apically to the attachment of the penial retractor muscle, vas deferens opening at base of this caecum; main body of penis internally subdivided into three chambers by transverse folds, the middle chamber equipped with spinate papillae, the distal chamber with low, longitudinal folds.

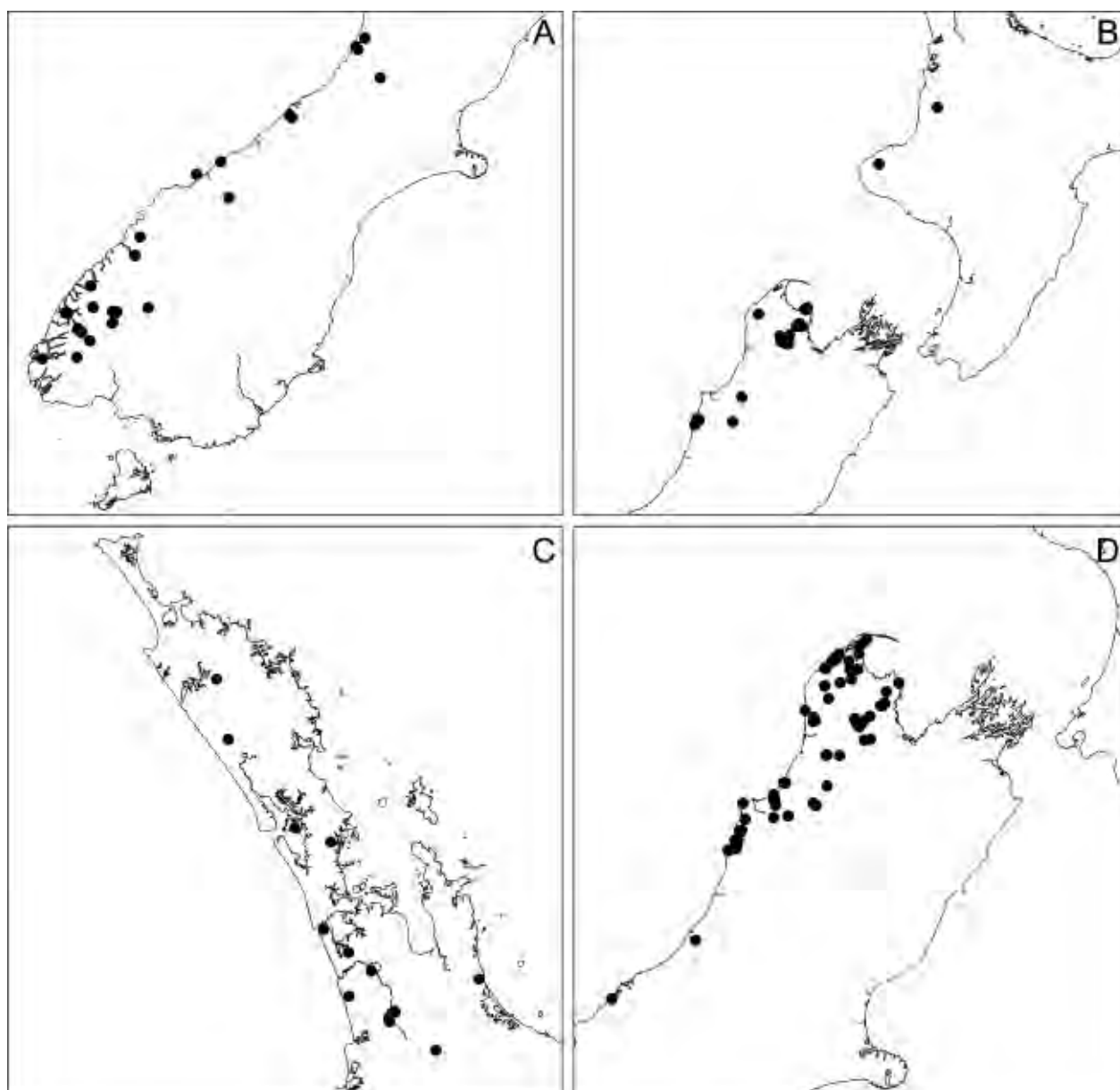


Fig. 20 Distributions of *Allodiscus* (*s. lat.*) species within New Zealand. A, *Allodiscus austrodimorphus* Dell, 1955; B, *Allodiscus chion* (Sykes, 1896); C, *Allodiscus goulstonei* n.sp.; D, *Allodiscus worthyi* n.sp.

Allodiscus chion (Sykes, 1896)

(Figs 10M, 20B, 21F–J)

Patula venulata.– Hutton, 1884a: 165, pl. 11, fig. Y (not of Pfeiffer, 1857, in part = *Phacussa* sp.).

Psyra venulata.– Hutton, 1884b: 201 (not of Pfeiffer, in part = *Phacussa* sp.).

Flammulina (Allodiscus) venulata.– Pilsbry, 1893: 15 (in part); Suter, 1894d: 251 (in part).

Allodiscus venulata.– Hedley & Suter, 1893: 638 (not of

Pfeiffer, in part = *Phacussa* sp.); Suter, 1913: 647 (not of Pfeiffer, in part = *Phacussa* sp.).

Flammulina (Allodiscus) venulata.– Suter, 1894b: 146 (not of Pfeiffer, in part = *Phacussa* sp.).

Flammulina (Allodiscus) chion Sykes, 1896: 107, text figs; Marshall, 1996: 36.

Allodiscus chion.– Suter, 1913: 638, pl. 25, figs 11–11b; Powell, 1937: 88; Powell, 1946: 92; Powell, 1957: 117; Powell, 1962: 110; Parkinson, 1974: 174; Powell, 1976:

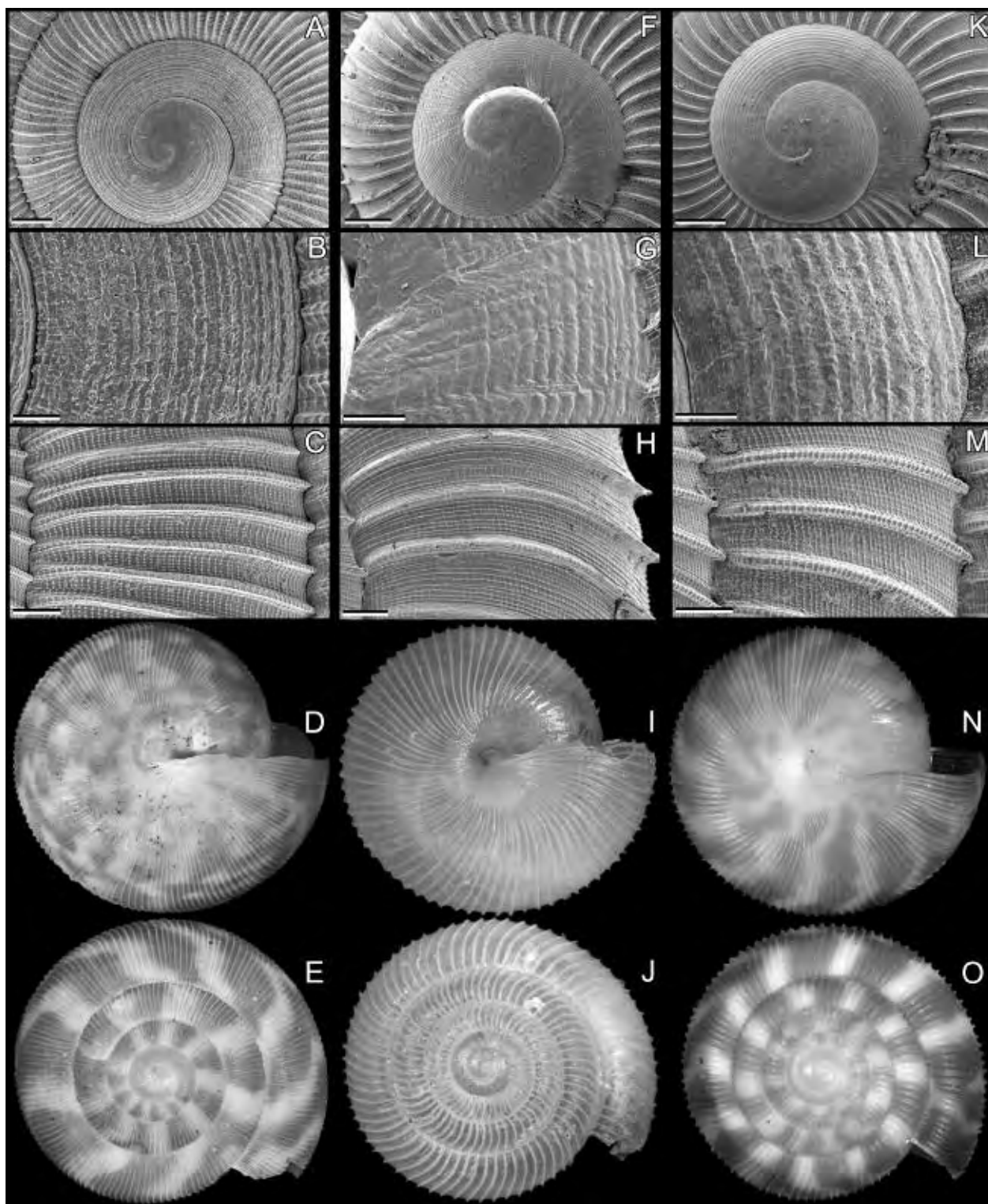


Fig. 21 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus aurora* n.sp., Te Anau, Aurora Caves, holotype, M.146539 (3.05 × 4.80 mm); F–J, *Allodiscus chion* (Sykes, 1896), S of New Plymouth, Pouaki Range, Mangorei Track, M.97862 (F–H), and M.79596 (I, J, 3.35 × 4.85 mm); K–O, *Allodiscus worthyi* n.sp., NE of Karamea, Great Arch entrance, paratype, M.79695 (K–M), and holotype, M.183099 (N, O, 3.20 × 5.00 mm). Scale bars 50 μm (B, G, L), 100 μm (C, H, M), 200 μm (A, F, K).

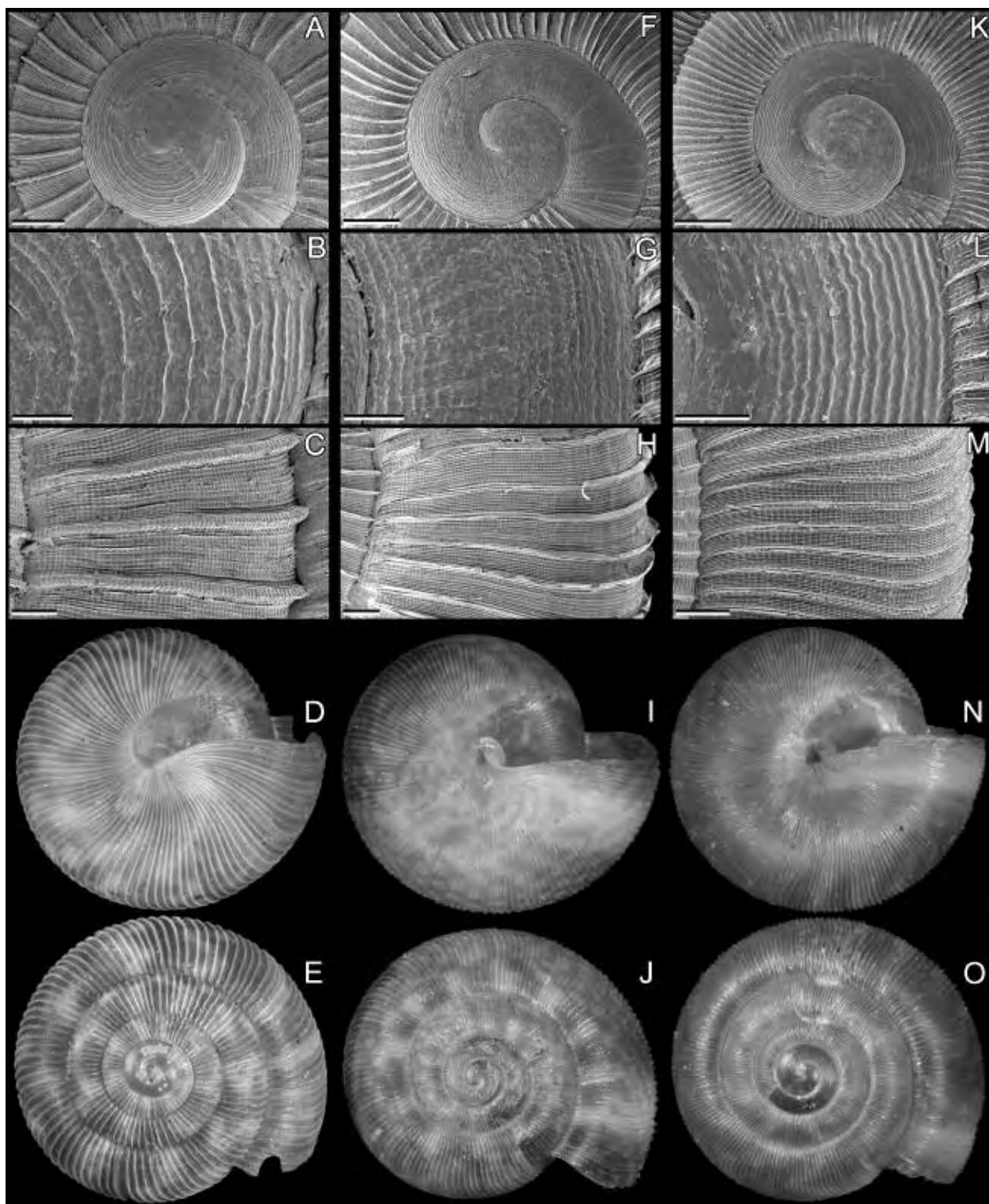


Fig. 22 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus austrodimorphus* Dell, 1955, Doubtful Sound, Deep Cove, Brasell Point (A–C), and Doubtful Sound, Secretary Island, M.82258 (D, E, 3.20 × 4.80 mm); F–J, *Allodiscus goulstonei* n.sp., SSE of Port Waikato, Waikawau, holotype, M.169536 (2.30 × 3.75 mm); K–O, *Allodiscus kakano* n.sp., Hutt Valley, Naenae, Rata Street track, paratype, M.32104 (K–M), and E of Wellington, behind Days Bay, holotype, M.23580 (N, O, 2.00 × 3.25 mm). Scale bars 50 µm (B, G, L), 100 µm (C, H, M), 200 µm (A, F, K).

117; Powell, 1979: 319 (in part = *A. wairarapa* n.sp.); Spencer & Willan, 1996: 40 (in part = *A. wairarapa*).

Allodiscus (Allodiscus) chion.—Climo, 1969b: 20, figs 1b, 12d–f, 25a.

?*Allodiscus (Allodiscus) cf. chion*.—Climo, 1969b: 20, figs 1b, 12g.

'*Allodiscus venulatus*'.—Worthy & Holdaway, 1994: 391 (not of Pfeiffer).

Allodiscus sp. D Worthy & Roscoe, 2003: 48.

TYPE MATERIAL: Syntypes BMNH 1915.1.4.129 (1), 1896.2.29.56–58 (4), NMNZ M.125083: North Island, 'near Inglewood', H.B. Preston.

MATERIAL EXAMINED (43 lots): Type material (see above), M.4068 (2), M.4074 (1), M.22292 (4), M.25256 (2), M.25276 (8), M.25280 (1), M.26059 (8), M.29009 (3), M.30020 (1), M.30361 (many), M.30662 (1), M.47511 (2), M.55530 (2), M.55641 (5), M.56848 (2), M.57745 (2), M.69052 (1), M.70068 (2), M.79596 (1), M.88817 (1), M.97862 (2), M.101282 (5), M.105700 (many), M.106178 (5), M.106243 (6), M.106284 (3), M.106526 (3), M.106816 (2), M.106886 (1), M.113979 (9), M.114575 (many), M.115924 (4), M.116620 (1), M.127853 (2), M.128734 (2), M.128883 (many), M.159454 (many), M.162462 (1), M.165965 (3), M.170199 (3).

REDESCRIPTION: Shell up to 6.25 mm wide, thin, wider than high (HWR 0.60–0.68), spire rather strongly elevated (21–29% SH), juveniles narrowly umbilicate, umbilicus becoming invaded by inner lip and adults typically fully anomphalous. Uniform translucent white or buff.

Protoconch of 1.20–1.25 convex whorls, 870–970 µm wide; tip of nucleus more or less smooth, thereafter sculptured with about 20 fine, crowded, rounded spiral threads, and less distinct, irregular, irregularly spaced radial grooves and wrinkles.

Teleoconch of up to 4.20 broadly convex whorls, sculptured throughout with prominent, widely and regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and axial periostracal lamellae of similar width and spacing, spirals very finely beaded at intersections; periostracal lamella at summit of each primary axial rib considerably more prominent than those in interspaces. Axial sculpture broadly sigmoidal, markedly opisthocline on spire. Aperture simple, outer lip thin, weakly and evenly thickened within; inner lip thicker, its thin rim projected into umbilical depression.

DISTRIBUTION: Southwestern North Island and northwestern South Island (Fig. 20B). Also known from Late

Quaternary deposits in cave systems within this range (e.g. M.113979, M.114575, M.128734) (also see Worthy & Roscoe, 2003).

BIOLOGY: *Allodiscus chion* occurs as a ground-dweller in lowland to montane broadleaved shrublands, broadleaved/podocarp forests and *Nothofagus* forests, and in subalpine shrublands up to 1500 m elevation. While predominately occurring in litter, the species is not uncommonly associated with limestone rock rubble and as a consequence is found in cave deposits.

CONSERVATION STATUS: *Allodiscus chion* is widely distributed and not uncommon. The species is not of immediate conservation concern.

REMARKS: *Allodiscus chion* is highly distinctive in the combination of closely spirally lirate protoconch; medium-sized uniform white or buff shell; relatively strongly elevated spire; and widely spaced, strongly sigmoidal primary axial ribs. North Island and South Island specimens are identical in shell morphology.

Powell's (1979) record of *Allodiscus chion* from the Rimutaka Range is based on specimens of *A. wairarapa* n.sp. (AIM AM 19842) (see above). *Allodiscus worthyi* n.sp. is a superficially similar species but has a maculate colour pattern; it is described below.

Climo (1969b) regarded *Allodiscus chion* as closely related to *A. venulatus* (L. Pfeiffer, 1857).

Suter (1913) and Climo (1969b) reported the anatomy as being unknown. Hutton (1884a), however, had described the radula under the name *Patula venulata* Pfeiffer, 1857. Hutton gave the formula as 17 + 1 + 17, but his illustration of the dentition enables reinterpretation as 12 + 5 + 1 + 5 + 12. Central tooth tricuspid, with mesocone extending beyond the foot of the basal plate, and flanked on either side by well-developed cusps; lateral teeth tricuspid, of similar form to central tooth; marginal teeth tricuspid, the endocone and mesocone more or less of similar size and partially fused, ectocone subobsolete to obsolete at margin of radula.

Allodiscus goulstonei new species

(Figs 19C, 20C, 22F–J)

Allodiscus tullia.—Suter, 1892a: 277 (not of Gray, 1850); Suter, 1913: 646 (in part of Gray); Whitten, 1957: 2 (not Gray).

Allodiscus planulatus.—Suter, 1913: 643 (in part of Hutton, 1883); ?Milligan & Sumich, 1954: 123; Whitten, 1957: 2; ?Gardner, 1966: 89; Spencer, 1977: 7 (not of Hutton?, in part = *A. kakano* n.sp.); Goulstone, 1979b: 25, text figs

(not of Hutton?, in part = *A. kakano*); Goulstone, 1980c: 1 (not of Hutton?, in part = *A. kakano*); Mayhill & Broomfield, 1982: 6 (not of Hutton?, in part = *A. kakano*); Mahlfeld, 2000: appendix 3 & subseq. (not of Hutton?, in part = *A. kakano*); Barker, 2005: 77; Barker, 2006: 137 (not of Hutton?, in part = *A. kakano*).

Psyra planulata.—Adams, 1886: 180 (not of Hutton).

Allodiscus cf. [*sic* = aff.] *venulatus* n.sp. McGuinness, 2001: 588.

Charopidae sp. 123 (NMNZ M.79585) Brook, 2002b: 92; Hitchmough *et al.*, 2007: 84; Spencer *et al.*, in press.

Charopidae sp. 4 (NMNZ M.79585) Hitchmough, 2002: 122.

TYPE MATERIAL: Holotype NMNZ M.169536: North Island, Waikawau, opposite County Reserve, SSE of Port Waikato, 40 m (NZMS 260 R13/688096), Jun. 1979, P.C. Mayhill. Paratypes: North Island, Crispe's Bush, W of Pukekohe, 16 Feb. 1981, F.M. Climo, M.77815 (17), AIM AK 73270 (2).

MATERIAL EXAMINED (28 lots): Type material (see above), M.30523 (3), M.57889 (2), M.62995 (1), M.70637 (2), M.77360 (1), M.78469 (5), M.79585 (1), M.79590 (1), M.97946 (1), M.103519 (1), M.155002 (1), M.165699 (1), M.168314 (1), M.168548 (2), M.168636 (5), M.168977 (1), M.169460 (1), M.170193 (1), M.170194 (2), M.170195 (2), M.170197 (1), M.170222 (1), M.170232 (1), M.176078 (2), M.177673 (1).

DESCRIPTION: Shell up to 4.65 mm wide, wider than high (HWR 0.52–0.59), thin, spire weakly elevated (15–26% SH), juveniles very narrowly umbilicate, umbilicus becoming invaded by inner lip to leave narrow chink. Protoconch pale translucent buff; teleoconch translucent white with yellowish-brown pattern of axial maculations of rather irregular width and spacing on spire, which transform abapically into pale diagonal chequer-board pattern on side, which in turn transforms to a broken zigzag pattern on base.

Protoconch weakly elevated, of 1.20–1.25 convex whorls, 830–930 µm wide, sculptured with fine, low spiral threads that number about 23–28 on spire on last half-whorl, last sixth-whorl additionally traversed by weak radial lirae.

Teleoconch of up to 2.75 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by crisp spiral threads and fine axial periostacal lamellae; spiral threads very weakly beaded at intersections with axial lamellae, lamella at summit of each primary axial rib more prominent than interstitial lamellae. Axial sculpture shallowly and broadly sigmoidal. Aperture

simple; outer lip thin, moderately thickened and white within; inner lip thicker, projected rim overhanging tiny umbilical chink.

DISTRIBUTION: North Island, from vicinity of Dargaville to as far south as Matamata (Fig. 20C).

BIOLOGY: *Allodiscus goulstonei* occurs in lowland *Agathis*, broadleaved and broadleaved/podocarp forests, where it occupies crevices and bryophyte growth on tree trunks (Barker 2005), and leaf litter on the forest floor.

CONSERVATION STATUS: The conservation status of *Allodiscus goulstonei* has varied as more information on the species has progressively come to hand. McGuinness (2001) considered the species of possible conservation concern, but 'insufficiently known'. Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007) listed *Allodiscus goulstonei* as 'range restricted (data poor)' based on two records, from Mangamuka (M.79585) and Puketi Forest (M.155002). The collections available for the present study show the species to be more common and widely distributed than originally thought. Our assessment is that *Allodiscus goulstonei* is not of immediate conservation concern, according to the criteria of Molloy *et al.* (2002).

REMARKS: Compared with the superficially similar species *Allodiscus tessellatus* Powell, 1941, *A. goulstonei* differs in having finer protoconch sculpture, in having closer primary axial ribs on the first half teleoconch whorl, in that the umbilicus is invaded by the inner lip, and in that the chequer-board pattern is confined to the periphery. The southern (allopatric) species *Allodiscus mahlfeldae* n.sp. is also similar, but has narrower, more sharply defined spiral threads on the protoconch.

The anatomy of *Allodiscus goulstonei* is not presently known.

ETYMOLOGY: Named in honour of the outstanding collector, the late James F. Goulstone. Noun in the genitive case.

Allodiscus kakano new species

(Figs 19D, 22K–O, 23A)

Psyra planulata.—Suter, 1892a: 272 (not of Hutton, 1883).

Allodiscus planulatus.—?Suter, 1893: 152; Hedley & Suter, 1893: 638 (in part of Hutton, 1883); Suter, 1913: 643 (in part of Hutton); Dell, 1955: 1137 (not of Hutton); Rees, 1959: 21 (not of Hutton); ?Gardner, 1966: 89 (not of Hutton?); ?Gardner, 1975: 118 (not of Hutton?); Goulstone & Gardner, 1975: 9, text figs (not of Hutton); Gardner, 1976: 25 (not of Hutton); Goulstone, 1976: 5, text fig. (not of Hutton); Goulstone & Gardner, 1976: 4

- (not of Hutton); ?Gardner, 1977: 38 (not of Hutton?); Gardner & Goulstone, 1977: 5 (not of Hutton); Goulstone, 1977a: 10 (not of Hutton); Spencer, 1977: 7 (in part); ?Forman, 1978: 105 (not of Hutton?); ?Goulstone, 1978: 6 (not of Hutton?); Goulstone, 1979a: 3 (not of Hutton); Goulstone, 1979b: 25, text figs (not of Hutton, in part = *A. goulstonei* n.sp.); Goulstone, 1980c: 1 (not of Hutton, in part = *A. goulstonei*); Goulstone, 1981b: 9 (not of Hutton); Solem *et al.*, 1981: 485 (not of Hutton); Goulstone, 1982: 5 (not of Hutton); Mayhill & Broomfield, 1982: 6 (not of Hutton, in part = *A. goulstonei*); Goulstone, 1983a: 7, text figs (not of Hutton); Goulstone, 1983b: 28, text figs (not of Hutton); Goulstone, 1983c: 1 (not of Hutton); Goulstone, 1984: 1 (not of Hutton); Mayhill, 1985: 5, text fig. (not of Hutton); Goulstone, 1988: 9, text figs (not of Hutton); Mason, 1988: 90 (not of Hutton); Goulstone, 1990: 31, text figs (not of Hutton); Goulstone, 1991a: 15 (not of Hutton); Goulstone, 1991c: 9 (not of Hutton); Barker & Mayhill, 1999: 238 (not of Hutton); Brook & Goulstone, 1999: 130 (not of Hutton); Mahlfeld, 2000: appendix 3 (not of Hutton, in part = *A. goulstonei*); Barker, 2006: 137 (not of Hutton, in part = *A. goulstonei*).
- Flammulina (Allodiscus) planulata*.—Pilsbry, 1893: 15, pl. 3, figs 4–6 (in part of Hutton?); Suter, 1894d: 252 (in part of Hutton).
- Allodiscus tullia*.—Suter, 1913: 646 (in part of Gray, 1850).
- ?*Allodiscus* aff. *tullius*.—Parkinson, 1974: 174.
- Allodiscus planulatus [sic]*.—Mayhill, 1982: 12, text fig. (not of Hutton).
- ?*Allodiscus* sp. 1 Goulstone, 1985: 7, text fig. 6.
- ?*Allodiscus* aff. *planulatus* Roscoe, 1992: 7.
- Allodiscus planulatus*.—Mayhill, 1994: 31, 58, text fig. (not of Hutton).
- '*Allodiscus planulatus*'.—Worthy & Holdaway, 1994: 391 (not of Hutton).
- Allodiscus* sp. E Worthy & Roscoe, 2003: 48.
- Allodiscus* n.sp. 1 (*planulatus*) Hazelwood *et al.*, 2002: 30 (not of Hutton).
- TYPE MATERIAL: Holotype NMNZ M.23580: E of Wellington, behind Days Bay, 1957, A.G. Beu. Paratypes: NE of Lower Hutt, Stokes Valley, 30 Nov. 1947, R.K. Dell, M.30575 (1); Hutt Valley, Silverstream, Keith George Memorial Park, 26 Jan. 1981, F.M. Climo, M.69517 (1); Wainuiomata, Brookfield Scout Camp, 22 Jul. 1956, W.F. Ponder, M.127867 (1); NE of Wellington, top of Wainuiomata Hill Road, 16 Apr. 1948, R.K. Dell, M.30561 (1); E of Wellington, Days Bay, 29 Jan. 1981, F.M. Climo, M.69488 (1); E of Wellington, Eastbourne, Butterfly Creek, 4 Mar. 1958, R.K. Dell, M.14277 (1), AIM AK 73271 (1); Rata Street track, Naenae, 29 Sep. 1957, W.F. Ponder, M.32104 (2).
- MATERIAL EXAMINED (276 lots): Type material (see above), M.8997 (1), M.14209 (9), M.22577 (1), M.24028 (1), M.25167 (2), M.25500 (1), M.28571 (3), M.28993 (1), M.29533 (1), M.29910 (7), M.29973 (1), M.30578 (3), M.30579 (1), M.30681 (4), M.30868 (2), M.32035 (4), M.32104 (2), M.32853 (2), M.36877 (5), M.36892 (1), M.36986 (3), M.37561 (1), M.39300 (1), M.46879 (1), M.47575 (2), M.47903 (1), M.48043 (1), M.48083 (1), M.48126 (1), M.55345 (1), M.55363 (1), M.55531 (2), M.56469 (4), M.56662 (1), M.56851 (6), M.56999 (2), M.57132 (1), M.57184 (1), M.57462 (1), M.57673 (1), M.57746 (2), M.57887 (1), M.61537 (1), M.62649 (1), M.63098 (1), M.63477 (1), M.68201 (1), M.68790 (1), M.68836 (2), M.68937 (1), M.70140 (5), M.70268 (1), M.70328 (1), M.72311 (2), M.72832 (2), M.73124 (1), M.73274 (1), M.73332 (1), M.75417 (1), M.75532 (2), M.75851 (2), M.75902 (3), M.75909 (3), M.75987 (1), M.76132 (1), M.76230 (3), M.76249 (1), M.76302 (2), M.76444 (4), M.77531 (8), M.77557 (1), M.78121 (3), M.78405 (1), M.78858 (1), M.79068 (1), M.79194 (14), M.81061 (1), M.81121 (1), M.81625 (1), M.81640 (2), M.81684 (1), M.81930 (1), M.81999 (1), M.82724 (1), M.85031 (1), M.85219 (2), M.85237 (5), M.85358 (1), M.85514 (1), M.85640 (1), M.86195 (1), M.86250 (1), M.87584 (1), M.88820 (3), M.89367 (1), M.93157 (1), M.97056 (1), M.97115 (1), M.97407 (1), M.97708 (1), M.97805 (1), M.98083 (1), M.98406 (2), M.98462 (1), M.98701 (1), M.98743 (1), M.98757 (1), M.98879 (2), M.98907 (3), M.98909 (2), M.98975 (1), M.98981 (3), M.98998 (1), M.99075 (1), M.99410 (1), M.99725 (1), M.99933 (3), M.100079 (1), M.101178 (1), M.101196 (1), M.101285 (2), M.101301 (1), M.101552 (1), M.101714 (1), M.101760 (1), M.102680 (1), M.103736 (2), M.103851 (1), M.104050 (1), M.105074 (1), M.107144 (2), M.107327 (1), M.110028 (1), M.114381 (3), M.114665 (1), M.115786 (1), M.115878 (2), M.116085 (3), M.120630 (1), M.121545 (1), M.121635 (1), M.125426 (1), M.126474 (1), M.127862 (2), M.127864 (1), M.127970 (1), M.127975 (1), M.127976 (1), M.127999 (1), M.128671 (1), M.128710 (1), M.129402 (3), M.146090 (1), M.146152 (1), M.146211 (3), M.146291 (2), M.146350 (2), M.146386 (1),

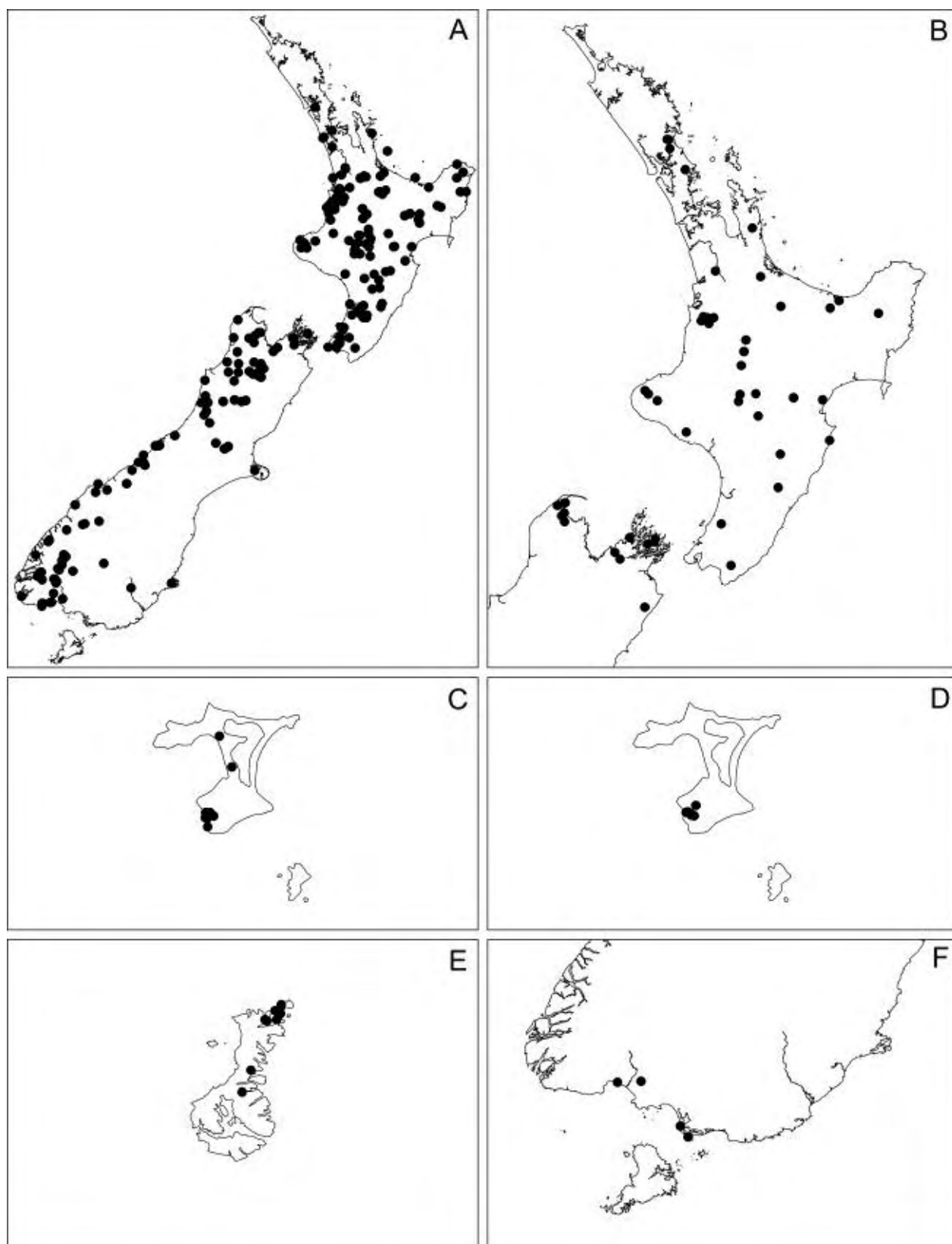


Fig. 23 Distributions of *Allodiscus* (*s. lat.*) species within New Zealand. A, *Allodiscus kakano* n.sp.; B, *Allodiscus tessellatus* Powell, 1941; C, *Allodiscus morioria* n.sp.; D, *Allodiscus pygmaeus* n.sp.; E, *Allodiscus tawhiti* n.sp.; F, *Allodiscus absidatus* n.sp.

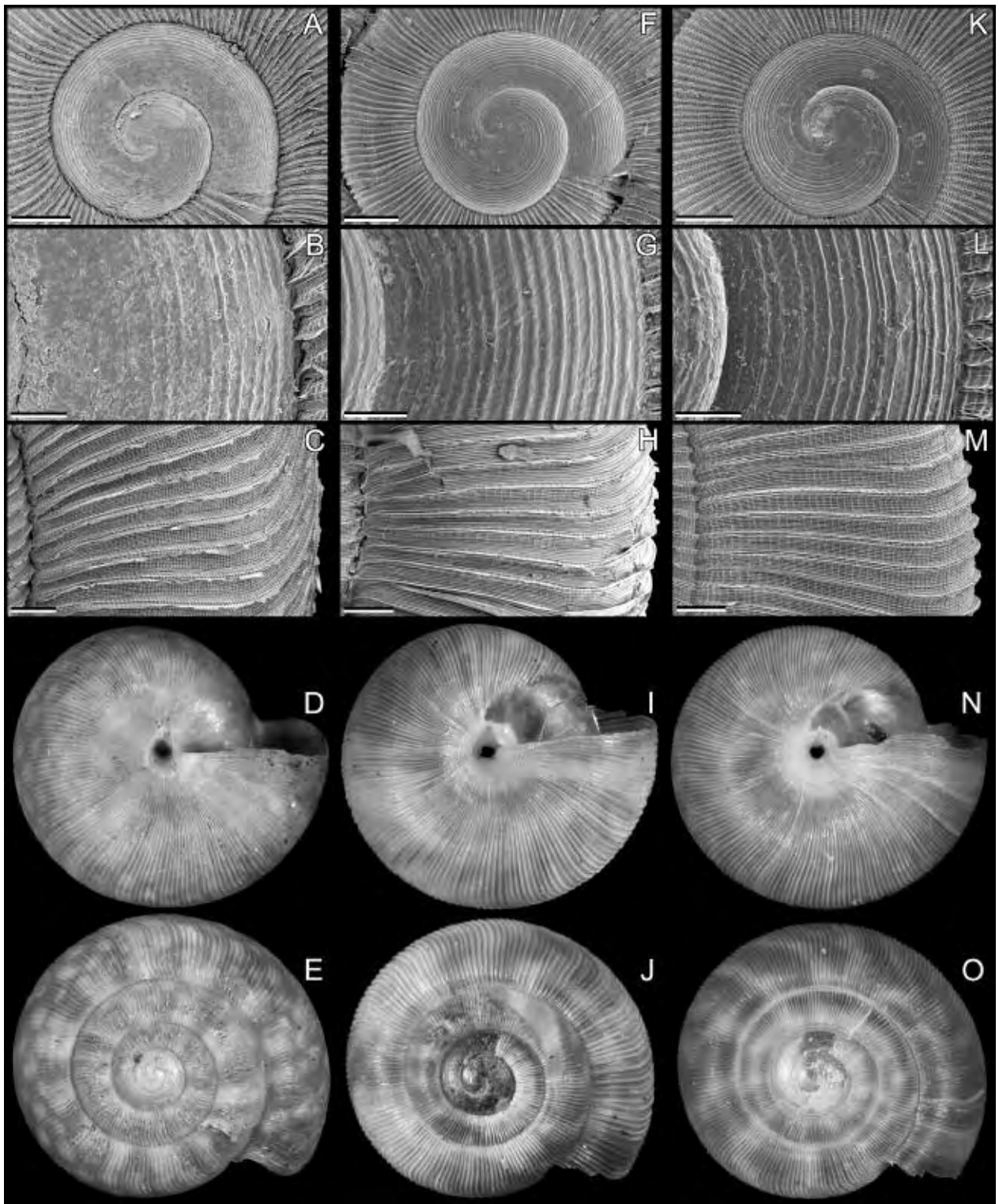


Fig. 24 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus morioria* n.sp., Chatham Island, N of Waitangi, beside Lake Te Roto, paratype, M.38742 (A–C), and holotype, M.180041 (D, E, 2.47 × 3.72 mm); F–J, *Allodiscus pygmaeus* n.sp., Chatham Island, NNE of Cape L’Eveque, Taiko Hill, paratype, M.169393 (F–H), and holotype, M.183094 (I, J, 1.80 × 2.85 mm); K–O, *Allodiscus tawhiti* n.sp., Auckland Islands, Enderby Island, Sandy Bay, paratype, M.89769 (K–M), and holotype, M.183095 (N, O, 1.75 × 2.95 mm). Scale bars 50 µm (B, G, L), 100 µm (C, H, M), 200 µm (A, F, K).

M.146436 (1), M.146480 (1), M.146562 (3), M.146607 (3), M.146658 (6), M.146665 (1), M.146682 (1), M.146683 (1), M.146709 (1), M.146781 (1), M.146790 (3), M.146815 (1), M.146821 (2), M.146836 (1), M.146851 (5), M.156792 (2), M.156797 (1), M.157427 (1), M.157486 (7), M.157494 (1), M.157502 (4), M.157710 (1), M.157727 (4), M.157733 (2), M.157756 (1), M.157778 (1), M.157845 (1), M.157937 (2), M.159534 (1), M.159545 (3), M.159623 (1), M.159921 (2), M.159930 (1), M.159962 (1), M.161020 (1), M.161055 (1), M.161416 (1), M.161548 (1), M.161614 (1), M.161619 (2), M.161680 (2), M.161704 (1), M.162824 (1), M.165955 (1), M.166057 (2), M.166071 (1), M.166362 (1), M.166939 (1), M.168351 (1), M.168647 (2), M.168650 (1), M.168867 (8), M.168878 (7), M.168969 (1), M.169352 (1), M.169369 (1), M.169597 (1), M.169628 (1), M.169698 (2), M.169708 (2), M.169727 (1), M.169749 (1), M.169774 (1), M.169797 (1), M.169804 (1), M.169806 (1), M.169807 (1), M.169808 (2), M.169809 (1), M.169810 (1), M.169811 (2), M.169812 (1), M.169814 (1), M.169815 (5), M.169816 (3), M.169817 (1), M.169818 (2), M.169822 (1), M.169832 (4), M.169864 (1), M.169892 (2), M.169899 (1), M.169904 (5), M.169908 (3), M.169917 (1), M.169932 (1), M.169943 (2), M.169965 (1), M.170188 (1), M.170189 (2), M.170190 (4), M.170191 (1), M.170214 (1), M.170216 (3), M.170218 (1), M.170219 (1), M.170220 (3), M.175064 (8), M.175069 (2), M.175071 (2), M.175084 (3), M.175121 (1), M.175128 (2), M.175129 (1), M.175166 (2), M.175176 (1), M.175384 (1), M.178056 (1), M.178057 (1).

DESCRIPTION: Shell up to 3.25 mm wide, thin, wider than high (HWR 0.57–0.60), spire moderately elevated (19–29% SH), umbilicus very narrow and partly occluded by inner lip at maturity (width typically <3.4% SW). Translucent colourless or buff; teleoconch traversed by irregular yellowish brown axial maculations, radial on spire, wavy below insertion on sides and base, umbilicus and concave area bounding it white.

Protoconch moderately elevated, of 1.20 convex whorls, 730–770 µm wide, sculptured with fine, rounded, irregularly wavy, widely spaced spiral threads that number about 15 on spire, interspaces essentially smooth.

Teleoconch of up to 2.75 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by crisp spiral threads and fine, closer axial periostacal lamellae; spiral threads very weakly beaded at intersections with axial lamellae, stronger beside umbilicus than elsewhere; periostacal lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae,

that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Apertural rim thin, inner lip partly overhanging narrow umbilicus, adults with a thickened opaque white band a short distance within.

DISTRIBUTION: North Island (including islands off the East Coast) as far north as Kaipara, and South Island (Fig. 23A). Recorded as a Holocene fossil from north Whananaki (Brook & Goulstone 1999), which is north of the extant range of the species.

BIOLOGY: *Allodiscus kakano* is geographically and environmentally broadly distributed. The species occurs from sea-level in coastal shrublands and broadleaved forests, through a range of lowland and montane broadleaved/podocarp and *Nothofagus* forests, to subalpine scrublands at about 1400 m elevation. It occurs predominately in litter on the forest floor, but is also known from under bark on rotting logs and trunks, from under limestone boulders and cave-entrance talus, and from ledges on escarpments.

CONSERVATION STATUS: *Allodiscus kakano* is of no immediate conservation concern.

REMARKS: Compared with *Allodiscus goulstonei* n.sp., which it much resembles, *A. kakano* differs in having a smaller protoconch (width 730–770 µm, versus 830–930 µm), in being larger relative to the number of whorls, and in having axial bands at the periphery rather than a diagonal chequer-board pattern. The thick white band a short distance within the adult outer lip is particularly distinctive.

We are unable to detect any differences between North Island and South Island specimens in shell morphology. Specimens from Fiordland and high altitudes in the South Island, however, tend to have slightly larger protoconchs (width 800–830 µm) than northern specimens, although there is fluid mosaic intergradation in protoconch size within and between populations.

The anatomy of *Allodiscus kakano* is not presently known.

ETYMOLOGY: Seed (Māori). Noun in apposition.

Allodiscus morioria new species

(Figs 19E, 23C, 24A–E)

Allodiscus planulatus.—Powell, 1979: 321 (in part not of Hutton, 1883); Climo, 1991: 3 (not of Hutton).

Charopidae sp. 152 (NMNZ M.38742) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.180041 and paratypes M.38742 (10), AIM AK 73275 (2): Chatham Island, N of Waitangi, beside Lake Te Roto, karaka bush (NZMS 260, CH1/434702), Feb. 1933, A.W.B. Powell.

MATERIAL EXAMINED (19 lots): Type material (see above), M.52097 (7), M.75457 (1), M.76766 (2), M.97979 (1), M.113837 (many), M.113872 (12), M.113888 (many), M.113922 (5), M.113933 (2), M.169385 (1), M.169387 (1), M.169389 (1), M.169390 (1), M.169391 (3), M.169392 (6), M.177460 (1).

DESCRIPTION: Shell up to 4.15 mm wide, wider than high (HWR 0.59–0.62), thin, spire moderately elevated (22–30% SH), umbilicus very narrow, remaining fully open although edge partly overhung by inner lip (2.6–5.1% SW). Protoconch pale translucent buff; teleoconch translucent white with yellowish-brown pattern of axial maculations of rather irregular width and spacing on spire, which transform abapically into finer, diagonal chequer-board pattern that extends over sides and base; position of pattern transformation at insertion on first approximately 1.5 whorls, climbing adapically thereafter.

Protoconch moderately elevated, of 1.25–1.30 convex whorls, 770–870 µm wide, sculptured with fine, rounded, slightly wavy spiral threads, more or less obsolete over adapical third, crisp elsewhere.

Teleoconch of up to 2.80 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by crisp spiral threads and finer axial threads, the latter surmounted by periostracal lamellae, spiral threads weakly beaded at intersections with axials, lamella at summit of each primary axial rib much stronger than others. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; outer lip thin, weakly and evenly thickened within; inner lip slightly thicker, rim overhanging edge of umbilicus.

DISTRIBUTION: Chatham Islands, Chatham Island (Fig. 23C). Also known from fossils in Holocene dunes at Te One, Lake Huro, Chatham Island (M.52097), and subrecent in limestone overhangs nearby (M.113837, M.113872, M.113888, M.113922).

BIOLOGY: *Allodiscus morioria* occurs in *Dracophyllum*, mixed *Dracophyllum*/broadleaved and *Corynocarpus* forests and shrublands, where it has been recorded from leaf litter and tree trunks.

CONSERVATION STATUS: *Allodiscus morioria* is 'range restricted' according to the criteria of Molloy *et al.* (2002).

REMARKS: *Allodiscus morioria* most closely resembles *A. tessellatus* Powell, 1941, especially specimens from the eastern North Island, in shell morphology and colour pattern, differing principally in having coarser, more widely spaced spiral threads on the teleoconch.

The anatomy of *Allodiscus morioria* is not presently known.

ETYMOLOGY: After the Moriori, the original inhabitants of the Chatham Islands. Noun in apposition.

Allodiscus pygmaeus new species

(Figs 19F, 23D, 24F–J)

Allodiscus sp. Climo, 1991: 3.

TYPE MATERIAL: Holotype NMNZ M.183094 and paratypes M.169393 (5), AIM AK 73278 (1): Chatham Island, Taiko Hill, NNE of Cape L'Eveque, 200 m (NZMS 260 CH2/405416), Dec. 1982, P.C. Mayhill.

MATERIAL EXAMINED (13 lots): Type material (see above), M.58302 (1), M.69544 (1), M.75453 (6), M.75486 (2), M.97986 (1), M.113871 (1), M.113892 (2), M.169384 (2), M.169388 (2), M.176195 (1).

DESCRIPTION: Shell up to 3.15 mm wide, wider than high (HWR 59.0–61.0), thin, spire moderately elevated (18–30% SH), umbilicus narrow, remaining fully open although edge is partly overhung by inner lip (4.2–6.5% SW). Protoconch pale translucent buff; teleoconch translucent white with yellowish-brown pattern of irregular axial maculations, more or less radial on spire, gently wavy on sides and base.

Protoconch moderately elevated, of about 1.20 convex whorls, 700–770 µm wide, sculptured with 17–18 fine, rounded spiral threads more or less obsolete over adapical quarter, crisp elsewhere.

Teleoconch of up to 2.60 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and more closely spaced axial periostracal lamellae, intersections simple; spiral threads crisp, dorsally discontinuous after first whorl in being absent from adapertural side of interspace of each primary axial rib, continuous and stronger than elsewhere bordering umbilicus; lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; outer lip thin, weakly and evenly thickened within; inner lip slightly thicker, rim overhanging edge of umbilicus.

DISTRIBUTION: Chatham Islands, Chatham Island (Fig. 23D). Subrecent under limestone overhangs at NNE of Waitangi (M.113871, M.113892), north of the presently known extant range in the SW of Chatham Island.

BIOLOGY: *Allodiscus pygmaeus* occurs in litter under *Dracophyllum* and mixed *Dracophyllum*/broadleaved forests at elevations of about 100–250 m.

CONSERVATION STATUS: The extant range of *Allodiscus pygmaeus* is evidently confined to the southwestern sector of Chatham Island. The species must therefore be regarded as 'range restricted' according to the criteria of Molloy *et al.* (2002).

REMARKS: Compared with the sympatric species *Allodiscus morioria* n.sp., *A. pygmaeus* differs in numerous details, including smaller maximum size (width up to 3.15 mm, versus 4.15 mm), in being smaller relative to the number of whorls, in having straighter primary axial ribs on the spire, in having discontinuous spiral threads on late teleoconch whorls, and in having a wavy rather than diagonally reticulate colour pattern on the base.

The anatomy of *Allodiscus pygmaeus* is not presently known.

ETYMOLOGY: Dwarf (Latin), alluding to its small size relative to *Allodiscus morioria* n.sp., its presumed phylogenetic sister species. Adjective in the nominative case.

Allodiscus tawhiti new species

(Figs 19G, 23E, 24K–O)

Allodiscus planulatus.—Suter, 1909: 34 (not of Hutton, 1883); Suter, 1913: 643 (in part of Hutton); Powell, 1955: 123 (in part of Hutton); Powell, 1979: 321 (in part of Hutton); Mayhill & Goulstone, 1984: 3, text fig. (not of Hutton); Mayhill & Goulstone, 1986: 89 (not of Hutton); Spencer & Willan, 1996: 40 (in part of Hutton + *A. yaldwyni* n.sp.); Mayhill & Goulstone, 2000: 20, 24, text fig. (not of Hutton).

Allodiscus (Allodiscus) cogitatus Climo, 1969b: 23, figs 6a–c, 19e–f, 23e, 24a (not available: ICZN Art. 8).

Charopidae sp. 63 (NMNZ M.89769) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.183095 and paratypes M.89769 (19), AIM AK 73279 (2): Auckland Islands, Enderby Island, Sandy Bay, under logs in rātā forest (NZMS 260 AI/079185), 18 Mar. 1954, R.K. Dell.

MATERIAL EXAMINED (18 lots): Type material (see above), M.4062 (1), M.22527 (11), M.25344 (1), M.37196 (1), M.79109 (1), M.79118 (2), M.79132 (2), M.146012 (2), M.146022 (1), M.146029 (1), M.146060 (4), M.146066 (1), M.146074 (4), M.170215 (1), M.183096 (13).

DESCRIPTION: Shell up to 3.65 mm wide, wider than high (HWR 0.54–0.59), thin, spire moderately elevated (16–28% SH), umbilicus narrow, remaining fully open although edge is partly overhung by inner lip (3.8–4.9% SW). Protoconch translucent buff; teleoconch translucent white

with yellowish-brown pattern of irregular axial maculations, more or less radial on spire, wavy on sides and base, area around umbilicus white.

Protoconch moderately elevated, of 1.20–1.30 convex whorls, 770–800 µm wide, sculptured with fine, rounded spiral threads, interspaces essentially smooth.

Teleoconch of up to 3.00 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and more closely spaced axial periostracal lamellae, intersections very weakly beaded; spiral threads bordering umbilicus stronger than elsewhere; lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; outer lip thin, weakly and evenly thickened within; inner lip more strongly thickened, rim overhanging edge of umbilicus.

DISTRIBUTION: Auckland Islands (Fig. 23E).

BIOLOGY: *Allodiscus tawhiti* has been collected from leaf litter and, especially, from rotten wood in *Metrosideros* forests and *Dracophyllum* shrublands.

CONSERVATION STATUS: *Allodiscus tawhiti* is confined to the Auckland Islands and thus must be ranked 'range restricted' according to Molloy *et al.* (2002).

REMARKS: Compared with *Allodiscus kakano* n.sp., which is superficially strongly similar, *A. tawhiti* tends to have a narrower umbilicus (width <3.4% of shell width versus 3.8–4.9%) and a smaller protoconch (width 730–830 µm, versus 770–800 µm), differing further in that the adult outer lip is considerably more weakly thickened within. *Allodiscus southlandicus* is also superficially similar, but differs markedly in having narrower, more sharply elevated spiral threads on the protoconch, and weaker spiral threads on the teleoconch.

Climo (1969b) described the anatomy. The radular formula is given as 12 + 6 + 1 + 6 + 12. Central tooth tricuspid, the mesocone extending about half the length of the basal plate, flanked on either side by well-developed cusps; lateral teeth bicuspid by suppression of the endocone and then secondarily tricuspid with bifurcation of the ectocone at the transition to marginals; marginal teeth multicuspid, with prominent bifurcated mesocone and with smaller subdivided ectocone.

The reproductive system is characterised by bursa duct narrowly open to oviduct, a short distance from origin becoming abruptly and strongly bulbous then equally abruptly narrowing to slender, long duct to bursa sac; vagina

of moderate length, slender; penis long, cylindrical, rounded apically with the attachment of the penial retractor muscle and opening of the vas deferens, tapering distally to the atrium.

ETYMOLOGY: Distant (Māori), alluding to the remote location of the type locality. Noun in apposition.

Allodiscus tessellatus Powell, 1941

(Figs 19H, 23B, 25A–E)

Allodiscus adriana.— Suter, 1913: 637 (in part of Hutton, 1883); ?Parkinson, 1970: 139 (not of Hutton).

Allodiscus tullia.— Suter, 1893: 152 (in part of Gray, 1859?); Hedley & Suter, 1893: 638 (in part of Gray); Suter, 1913 (in part of Gray).

Flammulina (*Allodiscus*) *tullia*.— Suter, 1894d: 251 (in part of Gray).

Allodiscus planulatus.— Suter, 1913: 643 (in part of Hutton, 1883).

Allodiscus tessellatus Powell, 1941: 262; Powell, 1946: 92; Brookes, 1953: 1; Powell, 1957: 117; Powell, 1962: 110; Powell, 1976: 117; Powell, 1979: 321, pl. 58, figs 1, 2; Solem *et al.*, 1981: 477; Goulstone, 1983b: 28, text figs; Goulstone, 1990: 31, text fig.; Spencer & Willan, 1996: 40; Mahlfeld, 2000: appendix 2 & subseq.; Barker, 2006: 134, text fig. 3u.

Allodiscus (*Allodiscus*) *tessellatus*.— Climo, 1969b: 46, figs 1a, 8, 20a–b, 24a,b (in part = *A. wairoaensis* Suter, 1894 + *A. worthyi* n.sp. + *A. mahlfeldae* n.sp.).

?*Allodiscus* aff. *tessellatus* [*sic*].— Parkinson, 1974: 174.

Allodiscus cf. *tessellatus*.— Goulstone, 1982: 4, text fig.; Mayhill, 1982: 12, text fig.; Mayhill, 1994: 31, 60, text fig.

TYPE MATERIAL: Holotype AIM AK 70028 and paratypes NMNZ M.4741 (2) and M.127656 (1): North Island, S of Whakatane, Ruatoki, 1939, A.E. Brookes.

MATERIAL EXAMINED (74 lots): Type material (see above), M.25204 (1), M.25378 (1), M.28858 (1), M.30554 (1), M.30557 (1), M.30563 (2), M.36348 (6), M.36380 (6), M.37560 (1), M.39073 (4), M.39109 (3), M.39250 (1), M.45762 (2), M.46748 (2), M.46976 (1), M.46990 (2), M.47609 (3), M.55625 (1), M.55688 (1), M.55693 (2), M.55727 (3), M.55889 (4), M.56819 (many), M.56936 (1), M.57291 (1), M.57773 (1), M.63402 (6), M.67999 (1), M.70139 (1), M.70544 (1), M.72994 (6), M.75914 (1), M.76446 (1), M.77509 (1), M.77624 (2), M.80233 (1), M.80328 (2), M.82585 (2), M.82618 (2), M.85557 (1), M.86347 (1), M.86528 (1), M.86540 (9), M.88880 (4), M.102802 (1), M.103287 (1), M.104551 (1), M.106033

(1), M.106399 (1), M.106868 (1), M.108724 (2), M.115187 (1), M.121123 (7), M.123916 (2), M.124798 (3), M.127868 (2), M.127869 (1), M.127973 (1), M.128736 (3), M.156791 (1), M.156826 (1), M.169805 (1), M.169869 (4), M.170148 (1), M.170183 (1), M.175377 (1), M.175390 (3), M.176173 (1), M.176174 (1), M.176194 (7), M.177468 (1).

REDESCRIPTION: Shell up to 4.50 mm wide, wider than high (HWR 0.54–0.63), thin, spire weakly to moderately elevated (23–30% SH), umbilicus narrow, remaining fully open although edge is partly overhung by inner lip (2.5–4.2% SW). Protoconch pale translucent buff; teleoconch translucent white with reddish-brown to yellowish-brown pattern of axial maculations of rather irregular width and spacing on spire, which transform abapically to finer, diagonally reticulate chequer-board pattern that extends over sides and base; position of pattern transformation at insertion on first whorl, climbing adapically thereafter; umbilicus white.

Protoconch weakly elevated, of 1.25–1.50 convex whorls, 770–930 µm wide, sculptured with fine, rounded, slightly wavy spiral threads that number about 22 on last half-whorl; more crowded and finer adapically.

Teleoconch of up to 2.75 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by crisp spiral threads and fine axial periostracal lamellae; spiral threads very weakly beaded at intersections with axial lamellae, lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; outer lip thin, weakly and evenly thickened within; inner lip thicker, slightly overhanging edge of umbilicus.

DISTRIBUTION: North Island as far north as Waipu Gorge, south of Whangarei, and as far south as Otaki Forks, north-east of Wellington; and northern South Island (Fig. 23B). *Allodiscus tessellatus* has been commonly recovered from Holocene deposits in limestone caves and is known from Late Pleistocene lake beds (M.57773, M.177468) within its extant range.

BIOLOGY: *Allodiscus tessellatus* is broadly distributed geographically and environmentally, with records from lowland podocarp, broadleafed and mixed broadleafed/podocarp forests from near sea-level to the tree-line, and in subalpine scrub to about 1560 m elevation. The species is ground-dwelling, commonly associated with leaf litter and woody debris, including that among rock rubble and on ledges of escarpments. *Allodiscus tessellatus* favours limestone, and is

commonly found in talus and sediment in the transitional zone of caves, where it presumably grazes on the walls, although living specimens have yet to be found in this habitat.

CONSERVATION STATUS: *Allodiscus tessellatus* is widely distributed and not uncommon. Our assessment is that the species is of no immediate conservation concern.

REMARKS: *Allodiscus tessellatus* is distinctive in the combination of low spire, moderate size (width up to 4.50 mm), large protoconch (width 770–930 µm), fine protoconch spirals that are not surmounted by periostracal lamellae, narrow but constantly open umbilicus, and strong chequer-board colour pattern on periphery and base. Two other species that attain similar size and have similar colour patterns are *Allodiscus goulstonei* n.sp. and *A. mahlfeldae* n.sp. from the northwestern and southern North Island, respectively, and *A. morioria* n.sp. from the Chatham Islands (see above).

The anatomy of *Allodiscus tessellatus* is not presently known. Climo's (1969b) description of the radular dentition and reproductive anatomy pertain to *A. mahlfeldae* n.sp.

Allodiscus worthyi new species

(Figs 10O, 20D, 21K–O)

Allodiscus (Allodiscus) tessellatus.— Climo, 1969b: 46, figs 1a, 8, 20a–b, 24a,b (in part of Powell, 1941 + *A. wairoaensis* Suter, 1894 + *A. mahlfeldae* n.sp.).

Allodiscus (Allodiscus) venulatus.— Climo, 1969b: 50, figs 1b, 12h–j, 15c, 23c, 25a (not of Pfeiffer, 1857).

Allodiscus venulatus.— Goulstone, 1985: 7, text fig. 8 (not of Pfeiffer, 1857); Goulstone, 1988: 9, text figs (not of Pfeiffer, 1857).

'*Allodiscus*' *tessellatus* aff. Worthy & Holdaway, 1994: 391 (not of Powell, 1941).

TYPE MATERIAL: Holotype NMNZ M.183099 and paratypes M.79695 (11), AIM AK 73283 (2): South Island, NE of Karamea, Great Arch entrance, under fallen limestone rubble (NZMS 260 L27/418063), 23 Apr. 1984, B.F. Hazelwood. Additional paratypes: NE of Karamea, 1.3 km along Moria Gate track, 16 May 1994, D.J. Roscoe, M.123766 (–100).

MATERIAL EXAMINED (111 lots): Type material (see above), M.4083 (5), M.4100 (1), M.23577 (4), M.25163 (2), M.25202 (1), M.25277 (1), M.25278 (1), M.25279 (1), M.28957 (1), M.30360 (1), M.30365 (many), M.30530 (2), M.32892 (1), M.37312 (1), M.47512 (7), M.47513 (3), M.47518 (10), M.47523 (many), M.47524 (many), M.47531

(many), M.55502 (1), M.56292 (1), M.58000 (1), M.61885 (1), M.72741 (6), M.72992 (many), M.73986 (many), M.75342 (many), M.76463 (many), M.77315 (many), M.77338 (many), M.77432 (many), M.77701 (1), M.77733 (many), M.77756 (many), M.77856 (many), M.77883 (3), M.78440 (7), M.78458 (many), M.79203 (many), M.79253 (many), M.79474 (many), M.81046 (5), M.81060 (1), M.81106 (6), M.82509 (many), M.82559 (many), M.84483 (many), M.86488 (3), M.86550 (3), M.87727 (many), M.88876 (5), M.89854 (9), M.89879 (2), M.89885 (3), M.89895 (many), M.89917 (1), M.96757 (many), M.96762 (1), M.97345 (many), M.97373 (many), M.97465 (many), M.98851 (1), M.98984 (many), M.101037 (1), M.101349 (many), M.101888 (1), M.103103 (2), M.103364 (1), M.103796 (2), M.105144 (3), M.105658 (2), M.105833 (1), M.105856 (many), M.106895 (2), M.106977 (3), M.107699 (4), M.107919 (1), M.108137 (6), M.108284 (2), M.109498 (1), M.109785 (1), M.110005 (1), M.114568 (12), M.114644 (many), M.115078 (1), M.120278 (many), M.120575 (1), M.120603 (1), M.121989 (4), M.122129 (1), M.123599 (1), M.123639 (1), M.124526 (6), M.124527 (2), M.127968 (many), M.128656 (2), M.128693 (5), M.159430 (2), M.159502 (many), M.159883 (1), M.159896 (1), M.161417 (9), M.161570 (1), M.161586 (3), M.161615 (1), M.162662 (3).

DESCRIPTION: Shell up to 5.30 mm wide, wider than high (HWR 0.60–0.69), thin, spire moderately elevated (23–35% SH); umbilicus very narrow but fully open in juveniles less than about 2.30 mm wide, progressively invaded by inner lip in larger specimens until a narrow chink. Protoconch translucent and colourless; teleoconch translucent white with yellowish-brown pattern of wavy axial maculations of rather irregular width and spacing, entirely traversing spire whorls, extending around periphery, inwardly narrowing over base, weakening and vanishing over inner third of base.

Protoconch weakly elevated, of 1.20–1.40 convex whorls, 900–970 µm wide, sculptured with crisp, rather closely spaced, rounded spiral threads, finer and more closely spaced adapically, numbering about 16–17 on spire on last half-whorl.

Teleoconch of up to 3.30 convex whorls, sculptured throughout with prominent, widely and regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and very weak axial threads, their intersections finely and crisply beaded; radial threads surmounted by periostracal lamellae. Axial sculpture broadly sigmoidal, markedly opisthocline on spire. Aperture simple; outer lip thin,

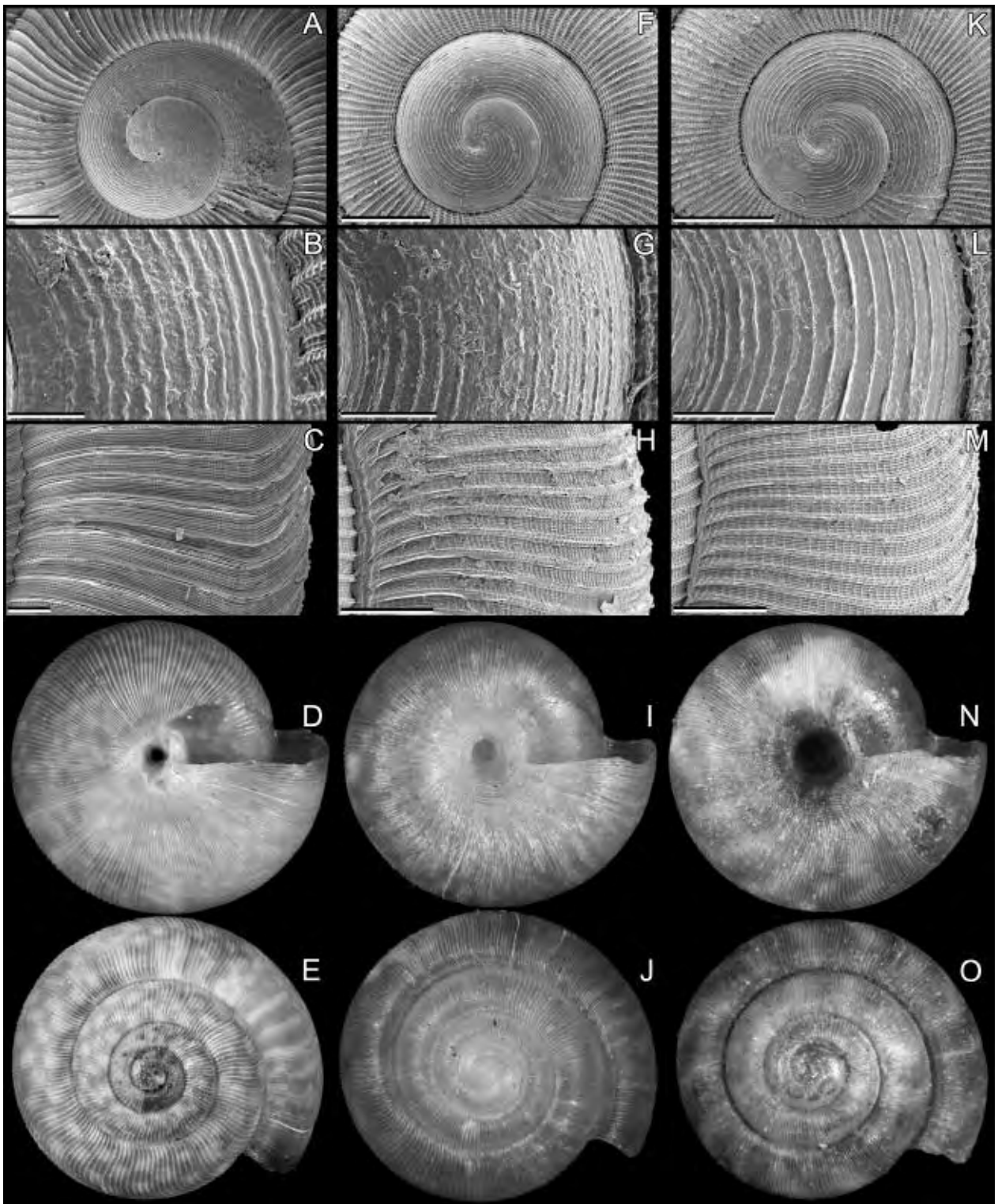


Fig. 25 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus tessellatus* Powell, 1941, S of Whakatane, Ruatoki, paratypes, M.4741 (D, E, 2.60 × 4.10 mm); F–J, *Allodiscus absidatus* n.sp., Bluff Walkway, paratype, M.157035 (F–H), and holotype, M.79306 (I, J, 1.40 × 2.05 mm); K–O, *Allodiscus basiliratus* N. Gardner, 1967, SE of Cape Reinga, Tapotupotu, M.127876 (K–M), and M.31965 (N, O, 1.02 × 1.55 mm). Scale bars 50 µm (B, G, L), 100 µm (C, H, M), 200 µm (A, F, K).

weakly and evenly thickened within; inner lip thicker and progressively invading narrow umbilicus.

DISTRIBUTION: Western South Island, from vicinity of Collingwood to as far south as Punakaikai (Fig. 20D). Recorded as a fossil in cave deposits within the extant range (e.g. M.72741, M.114568, M.114644, M.128656).

BIOLOGY: *Allodiscus worthyi* is probably a calcicole. Like several other *Allodiscus* species, it favours limestone, and is commonly found in talus and sediment in the transitional zone of caves, where it presumably grazes on the walls (although living specimens have yet to be found in this habitat). The habitat ranges from shrublands and forests near the coast, to montane *Nothofagus* forests and subalpine scrublands to about 1250 m elevation.

CONSERVATION STATUS: *Allodiscus worthyi* is widely distributed and not uncommon. Our assessment is that the species is not of immediate conservation concern.

REMARKS: *Allodiscus worthyi* most closely resembles *A. chion* (Sykes, 1896), with which it is broadly sympatric in the northwestern South Island, although we know of none having been taken alive together (asyntopic?). *Allodiscus worthyi* favours limestone areas, and often accumulates in vast numbers in talus in the transitional zone of caves. The shell differs from that of *Allodiscus chion* principally in being smaller relative to the number of whorls, and in having a maculate colour pattern, *A. chion* being invariably uniform white or buff. Compared with *Allodiscus aurora* n.sp., which it much resembles in size, shape and colour pattern, *A. worthyi* differs in having coarser, more closely spaced spiral threads on the protoconch, and in that the axial ribs on the teleoconch are stronger and more widely spaced throughout, and more strongly opisthocline above the periphery.

Climo's (1969b) concept of *Allodiscus venulatus* does not correspond to *venulatus* Pfeiffer, 1857 as interpreted here (supported by the type material). The specimens that Climo had at hand that we have been able to trace within the collections of NMNZ are referable to *Allodiscus worthyi* n.sp. We thus interpret Climo's (1969b) descriptions of the reproductive anatomy and radular dentition as pertaining to *Allodiscus worthyi* n.sp. The radular formula is given as 12 + 9 + 1 + 9 + 12. Central tooth unicuspid, cusp extending about one-quarter the length of the basal plate. Lateral teeth bicuspid by suppression of the endocone, with mesocone progressively elongating to extend beyond the foot of the basal plate in the fifth tooth. Marginal teeth with 3–4 cusps. Reproductive organs characterised by bursa copulatrix duct and penis with common opening to atrium; vagina absent;

bursa duct basally weakly spindle-shaped, gradually tapering to slender, long duct to sac; penis rather short, ovoid, with tapered apical caecum to terminal attachment of the penial retractor muscle and recurved owing to strands of the retractor binding to penial sheath; vas deferens opening to penis at the base of the apical caecum.

ETYMOLOGY: After paleo-ornithologist Trevor H. Worthy, who collected much material of this species and many other landsnails from cave sites. Noun in the genitive case.

Group F (*urquharti*)

DIAGNOSIS: Shell small (maximum width 1.75–2.40 mm), low (HWR 0.57–0.73), spire weakly to strongly elevated (18–38% SH). Narrowly to widely umbilicate (width <6.1–20.5% SW). Protoconch small (width 370–500 µm), sculptured with 13–17 crisp spiral threads, summit of each with a low periostracal lamella, interspaces wider than each spiral.

REMARKS: The following species are referred to Group F: *Allodiscus absidatus* n.sp., *A. basiliratus* N. Gardner, *A. brooki* n.sp., *A. hazelwoodi* n.sp., *A. occidaneus* n.sp., *A. urquharti* Suter, 1894 and *A. wairua* n.sp.

Allodiscus absidatus new species

(Figs 19J, 23F, 25F–J)

Charopidae sp. 56 (NMNZ M.79306) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.79306 and paratype M.157035: South Island, Bluff Walkway (NZMS 260 E47/536884), 80 m, Sep. 1983, P.C. Mayhill. Additional paratype: Omaui, Bluff Peninsula, 23 Jan. 1966, P. Cresswell, M.48197 (1).

MATERIAL EXAMINED (5 lots): Type material (see above), M.25224 (2), M.87477 (8).

DESCRIPTION: Shell up to 2.05 mm wide, wider than high (HWR 0.61–0.70), spire moderately elevated (26–33% SH), thin, narrowly umbilicate (9–13% SW). Protoconch and teleoconch ground translucent white, teleoconch with yellowish-brown to reddish-brown pattern of axial maculations of rather irregular width and spacing on spire, which transform at about point of sutural insertion to diagonal chequer-board pattern that extends over sides and base.

Protoconch weakly elevated, of 1.25 convex whorls, 470–500 µm wide, sculptured throughout with about 16–18 fine, crisp spiral threads, each surmounted by low, thin periostracal lamella.

Teleoconch of up to 2.70 evenly convex, evenly expanding whorls, smoothly curving into umbilicus. Typically a

narrow subsutural groove on last whorl in adults. Sculptured throughout with prominent, regularly spaced, primary axial ribs; these overlain by much finer, closer spiral threads, and fine axial periostracal lamellae that form a reticulate pattern, spirals finely nodular at intersections; periostracal lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Spiral threads markedly stronger on surface entering umbilicus than elsewhere. Axial sculpture weakly sigmoidal. Aperture simple; outer lip weakly and evenly thickened within, inner lip thicker.

DISTRIBUTION: Extreme south of South Island (Fig. 23F).

BIOLOGY: Litter-dweller in coastal and other lowland (<100 m elevation) broadleaved shrublands and broadleaved/podocarp forests.

CONSERVATION STATUS: While *Allodiscus absidatus* is not common and is restricted to lowland Southland, our assessment is that the species is not of immediate conservation concern.

REMARKS: *Allodiscus absidatus* is distinctive in the combination of small size, elevated spire, extensive chequer-board colour pattern and lirate protoconch.

The anatomy of *Allodiscus absidatus* is not presently known.

ETYMOLOGY: Arched (Latin), alluding to the domed spire. Adjective in the nominative case.

Allodiscus basiliratus N. Gardner, 1967

(Figs 19K, 25K–O, 27A)

Allodiscus basilirata [*sic*] Gardner, 1967a: 217, figs 5, 6; Powell, 1976: 117; Powell, 1979: 320.

Allodiscus basiliratus.— Goulstone *et al.*, 1993: 15, text figs; Parrish & Sherley, 1993: 48; Spencer & Willan, 1996: 40; Brook, 1999b: 389; McGuinness, 2001: 568; Brook, 2002b: 64; Hitchmough, 2002: 114; Hitchmough *et al.*, 2007: 76.

Charopidae sp. 120 (NMNZ M.87740) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype AIM AK 71295 and paratypes NMNZ M.29529 (1), M.31965 (1): North Island, E of Cape Reinga, Taputaputa Bay, open bush, Aug. 1965, N.W. Gardner.

MATERIAL EXAMINED (13 lots): Type material (see above), M.77052 (1), M.77077 (3), M.79604 (1), M.87740 (1), M.104000 (1), M.104033 (1), M.116603 (1), M.127876 (3), M.156800 (1), M.161098 (1).

REDESCRIPTION: Shell up to 1.80 mm wide, thin and rather

fragile, wider than high (HWR 0.58–0.65), spire moderately elevated (22–31% SH), umbilicus wide (17–20% SW). Translucent, protoconch pale buff; teleoconch entirely traversed by irregular reddish-brown axial maculations, radial on spire, typically indented backwards on periphery, umbilical wall uniform reddish brown.

Protoconch moderately elevated, of about 1.20 convex whorls, 430 µm wide, sculptured with crisp spiral threads that number 15–17 on spire on last half-whorl, distinctly and irregularly wavy at nucleus, more nearly regular thereafter, each surmounted by low periostracal lamella, no radial sculpture in interspaces.

Teleoconch of up to 2.60 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by crisp spiral threads, and fine axial periostracal lamellae; spiral threads weakly beaded at intersections with axial lamellae, and about twice as widely spaced as lamellae outside umbilicus; spirals much stronger on base entering umbilicus and on umbilical wall than elsewhere, periostracal lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; lips thin, weakly and evenly thickened within.

DISTRIBUTION: Cape Reinga to North Cape, northern North Island (Fig. 27A). Known also as Holocene fossils in dunefields at Te Werahi (Brook 1999b).

BIOLOGY: Lives in the ground litter of coastal broadleaved shrublands, including *Phormium*-dominated coastal cliff communities, and in broadleaved forests to about 305 m elevation.

CONSERVATION STATUS: Listed as ‘declining’ by McGuinness (2001), and as ‘range restricted’ by Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007). Brook (2002b: 64) remarked ‘This species has a fragmented, relict distribution as a result of extensive habitat destruction caused by anthropic land clearance for gum-digging, pastoral farming and exotic forestry. The total population is probably still declining as a consequence of continued modification and loss of habitat, and there is a risk that some local populations could become extinct if historical trends continue.’ Our assessment is that, while some habitat degradation continues over part of the range, the wide distribution of *Allodiscus basiliratus* in the far north of Aupouri Peninsula provides some buffering against stochastic population disturbances. A rank of ‘range restricted’ according to the criteria of Molloy *et al.* (2002) is appropriate.

REMARKS: *Allodiscus basiliratus* is distinctive in the combination of small size, spirally lirated protoconch, elevated spire, banded colour pattern, and strong spiral lirae around the relatively wide umbilicus. Charopidae sp. 120 (Spencer *et al.* in press) is based on specimens (M.87740 and M.31965) that are a little larger relative to the number of whorls compared with a paratype, but there is smooth intergradation between these extremes.

The anatomy of *Allodiscus basiliratus* is not presently known, but see comments under *A. urquharti* Suter, 1894 below.

Allodiscus brooki new species

(Figs 19L, 27B, 28A–E)

Allodiscus sp. aff. *urquharti* McGuinness, 2001: 637.

Charopidae sp. 53 (NMNZ M.83043) Brook, 2002b: 87; Hitchmough *et al.*, 2007: 83; Spencer *et al.*, in press.

Charopidae sp. 3 (NMNZ M.83043) Hitchmough, 2002: 122.

TYPE MATERIAL: Holotype NMNZ M.180039, and paratypes M.175003 (38), AIM AK 73267 (2): North Island, S of Ahipara, Herekino N head, under flax on knoll above Waiatua Stream, 60 m (NZMS 260 N05/255593), 21 Apr. 2004, F.J. Brook.

MATERIAL EXAMINED: (5 lots) Type material (see above), M.83043 (2), M.155005 (1).

DESCRIPTION: Shell up to 1.82 mm wide, thin, wider than high (HWR 0.57–0.63), spire moderately elevated (21–33% SH), umbilicus wide (15–18% SW). Uniform translucent buff (fresh) or white.

Protoconch moderately elevated, of about 1.10 convex whorls, 430 µm wide, sculptured with fine, crisp, widely spaced spiral threads that number about 15–16 on spire, interspaces essentially smooth.

Teleoconch of up to 2.80 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by crisp spiral threads and considerably weaker axial riblets, the latter surmounted by periostracal lamellae that are more elevated than spirals; spiral threads finely beaded at intersections with axial lamellae, periostracal lamella at summit of each primary axial rib considerably stronger than others. Axial sculpture broadly sigmoidal. Aperture simple; lips thin, weakly and evenly thickened within.

DISTRIBUTION: Northwestern North Island, between Ahipara and Hokianga Harbour (Fig. 27B).

BIOLOGY: Litter-dweller of lowland shrublands and broad-leaved forests.

CONSERVATION STATUS: *Allodiscus brooki* was listed as of conservation concern, but ‘insufficiently known’ by McGuinness (2001). In subsequent assessments by Brook (2002b), Hitchmough (2002) and Hitchmough *et al.* (2007), the species was listed as ‘range restricted’. Despite extensive surveys in Northland, the species has rarely been collected and remains known only from a small area between Ahipara and Hokianga Harbour.

REMARKS: Compared with *Allodiscus urquharti* Suter, 1894, which it much resembles in gross facies, *A. brooki* differs principally in having stronger, more widely spaced primary axial ribs, and in that fresh specimens have more darkly pigmented shells. The two species are sympatric. *Allodiscus basiliratus* N. Gardner, 1967 and *A. hazelwoodi* n.sp. are also similar to *A. brooki* in size and shape, but are immediately separable by their axially banded colour patterns.

The anatomy of *Allodiscus brooki* is not presently known. ETYMOLOGY: After Fred J. Brook (Whangarei), who collected the type material, and in appreciation of his outstanding work on New Zealand terrestrial Mollusca. Noun in the genitive case.

Allodiscus hazelwoodi new species

(Figs 19M, 27C, 28F–J)

N. gen. (*Allodiscus?*) ‘Hokianga’ McGuinness, 2001: 592 (in part: ‘midden, South Kaipara Head’ = Charopidae sp. 115); Hitchmough, 2002: 126; Hitchmough *et al.*, 2007: 86.

TYPE MATERIAL: Holotype NMNZ M.181315: North Island, NE of Opononi, Mountain Road, litter under pūriri (NZMS 260 O06/520344), 28 Aug. 1998, B.F. Hazelwood. Paratype: Hokianga Harbour, E of Omapere, Waiotemarama Gorge Road, 28 Aug. 1998, B.F. Hazelwood, M.156978 (1).

MATERIAL EXAMINED (4 lots): Type material (see above), M.127822 (6), M.164194 (1).

DESCRIPTION: Shell up to 1.90 mm wide, thin and rather fragile, wider than high (HWR 0.59–0.63), spire moderately elevated (25–30% SH), umbilicus wide (19–20% SW). Translucent, protoconch pale buff; teleoconch entirely traversed by irregular reddish-brown axial maculations, radial on spire, typically indented backwards on periphery, umbilical wall uniform reddish brown.

Protoconch moderately elevated, of 1.10–1.20 convex whorls, 400 µm wide, sculptured with fine, crisp, widely spaced spiral threads that number 11 or 12 on spire, each surmounted by low periostracal lamella, interspaces essentially smooth.



Fig. 26 Shells of *Allodiscus* (*s. lat.*), *Granallodiscus*, *Hirsutodiscus*, *Costalodiscus*, *Pseudalldiscus* and *Canalldiscus* species. A, *Allodiscus pallidus* n.sp., W of Masterton, below footbridge crossing tributary of Atiwhakatu Stream, holotype, M.177447 (0.70 × 1.30 mm); B, *Allodiscus wairua* n.sp., Cape Maria van Diemen, Motuopao Island, holotype, M.183097 (1.55 × 2.18 mm); C, *Allodiscus erua* n.sp., N of Ohakune, Erua Bush, holotype, M.180042 (0.90 × 1.75 mm, SEM); D, *Granallodiscus abaxoides* n.sp., S of Collingwood, Parapara River valley, holotype, M.183101 (2.00 × 2.47 mm); E, *Allodiscus waitutu* n.sp., WSW of Tuatapere, Waitutu Forest, holotype, M.175117 (1.70 × 2.60 mm); F, *Granallodiscus mayhillae* n.sp., NW of Hamilton, Hakirimata Track, holotype, M.78739

Teleoconch of up to 2.75 convex whorls, sculptured throughout with prominent, close, regularly spaced primary axial ribs; these overlain by crisp spiral threads and fine axial periostracal lamellae; spiral threads very weakly beaded at intersections with axial lamellae, and about as widely spaced as lamellae outside umbilicus; spirals distinctly stronger on base entering umbilicus and on umbilical wall than elsewhere; periostracal lamella at summit of each primary axial rib considerably stronger than others. Axial sculpture shallowly and broadly sigmoidal. Aperture simple; lips thin, weakly and evenly thickened within.

DISTRIBUTION: Northwestern North Island, in the vicinity of Hokianga Harbour (Fig. 27C).

BIOLOGY: *Allodiscus hazelwoodi* is a ground-dwelling detritivore of lowland podocarp, *Agathis* and broadleafed forests.

CONSERVATION STATUS: *Allodiscus hazelwoodi* is 'range restricted' according to the criteria of Molloy *et al.* (2002).

REMARKS: Compared with *Allodiscus basiliratus* N. Gardner, 1967, which it most resembles in gross facies, *A. hazelwoodi* differs in attaining a larger size, and in having fewer spiral threads on the protoconch, more closely spaced spiral threads on the teleoconch, and much weaker spiral threads on the umbilical wall. The two species are allopatric (Figs 27A,C).

The anatomy of *Allodiscus hazelwoodi* is not presently known.

ETYMOLOGY: In honour of the late Bruce F. Hazelwood (Auckland), who collected much of the material used in this revision. Noun in the genitive case.

Allodiscus occidaneus new species

(Figs 19N, 27E, 28K–O)

?*Allodiscus* sp. Gardner & Goulstone, 1977: 5, text fig.;

Goulstone, 1983a: 7, text figs.

New genus, new species Goulstone, 1988: 9, text figs.

Charopidae sp. 62 (NMNZ M.115091) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.115091 and paratype M.183079: South Island, NNE of Greymouth, summit just

N of Ten Mile Creek, seaward side of road, 40 m (NZMS 260 J31/669735), 22 Dec. 1992, K. Mahlfeld. Additional paratypes: E of Punakaiki, Bullock Creek, 20 Jan. 1950, R.R. Forster, M.28963 (1); NE of Punakaiki, outside Fox River Cave, 23 Jan. 1982, D.J. Roscoe, M.70253 (1); NE of Charleston, Costello's Hill Scenic Reserve, 23 Dec. 1992, F.M. Climo, M.115082 (2); N of Blackball, Croesus Track, 2 Oct. 1982, D.J. Roscoe, M.156740 (1).

MATERIAL EXAMINED (36 lots): Type material (see above), M.25170 (1), M.30543 (1), M.57226 (1), M.77322 (1), M.77373 (1), M.77735 (2), M.79671 (1), M.89129 (1), M.89662 (1), M.89853 (1), M.96753 (1), M.97359 (1), M.97417 (1), M.100128 (1), M.102732 (1), M.103201 (1), M.115036 (2), M.123451 (1), M.123598 (1), M.124026 (2), M.124498 (1), M.124499 (2), M.124500 (1), M.129188 (1), M.156716 (1), M.156717 (1), M.156742 (1), M.156829 (1), M.156937 (1), M.159453 (1).

DESCRIPTION: Shell up to 2.40 mm wide, wider than high (HWR 0.66–0.73), spire weakly to moderately elevated (18–29% SH), thin; very narrowly umbilicate, umbilicus becoming partly occluded by inner lip (width <6.1% SW). Protoconch and teleoconch ground translucent white, teleoconch with yellowish-brown to reddish-brown pattern of axial bands that swing backwards to periphery then sharply and strongly forwards over base.

Protoconch moderately elevated, of 1.20 convex whorls, 470 µm wide, sculptured throughout with about 14–15 fine, crisp, widely spaced spiral threads, each surmounted by low, thin periostracal lamella.

Teleoconch of up to 2.80 evenly convex, evenly expanding whorls, smoothly curving into umbilicus. Sculptured throughout with prominent primary axial ribs that gradually increase in strength and especially spacing; and overlying much finer, closer spiral threads and fine axial periostracal lamellae that form a reticulate pattern, spirals extremely finely nodular at intersections; periostracal lamellae at summit and borders of each primary axial rib more prominent than interstitial lamellae, that at summit strongest. Spiral threads

(2.20 × 2.85 mm); G, *Granallodiscus granum* (L. Pfeiffer, 1857), Kapiti Island, M.2512 (2.50 × 3.50 mm); H, *Allodiscus undulatus* n.sp., SSW of Manapouri, NW of Borland Lodge, cavern, holotype, M.183103 (1.82 × 3.20 mm); I, *Hirsutodiscus rakiura* (Climo, 1971), Stewart Island, N of Oban, Garden Mound, M.157071 (1.90 × 2.75 mm); J, *Pseudallodiscus ponderi* Climo, 1971, E of Wellington, Lake Pounui, M.116520 (1.95 × 3.70 mm); K, *Costallodiscus pegasus* n.sp., Stewart Island, Port Pegasus, Scout Bay, holotype, M.29630 (2.70 × 4.50 mm); L, *Costallodiscus kaikoura* n.sp., Seaward Kaikoura Range, holotype, M.273933 (1.90 × 3.20 mm); M, *Costallodiscus parrishi* n.sp., SE of Cape Reinga, Tapotupotu Bush, holotype, M.99147 (1.95 × 3.55 mm); N, *Canallodiscus elliottae* (N. Gardner, 1968), Oparara Basin, Fenian Track, M.31960 (2.70 × 4.95 mm); O, *Canallodiscus fectoloides* (Dell, 1955), holotype, NW of Te Anau, beside Lake Te Au, CM M6433 (2.20 × 4.20 mm); P, *Canallodiscus karamea* n.sp., NE of Karamea, Honeycomb Hill cave system, holotype, M.183102 (2.90 × 4.88 mm).

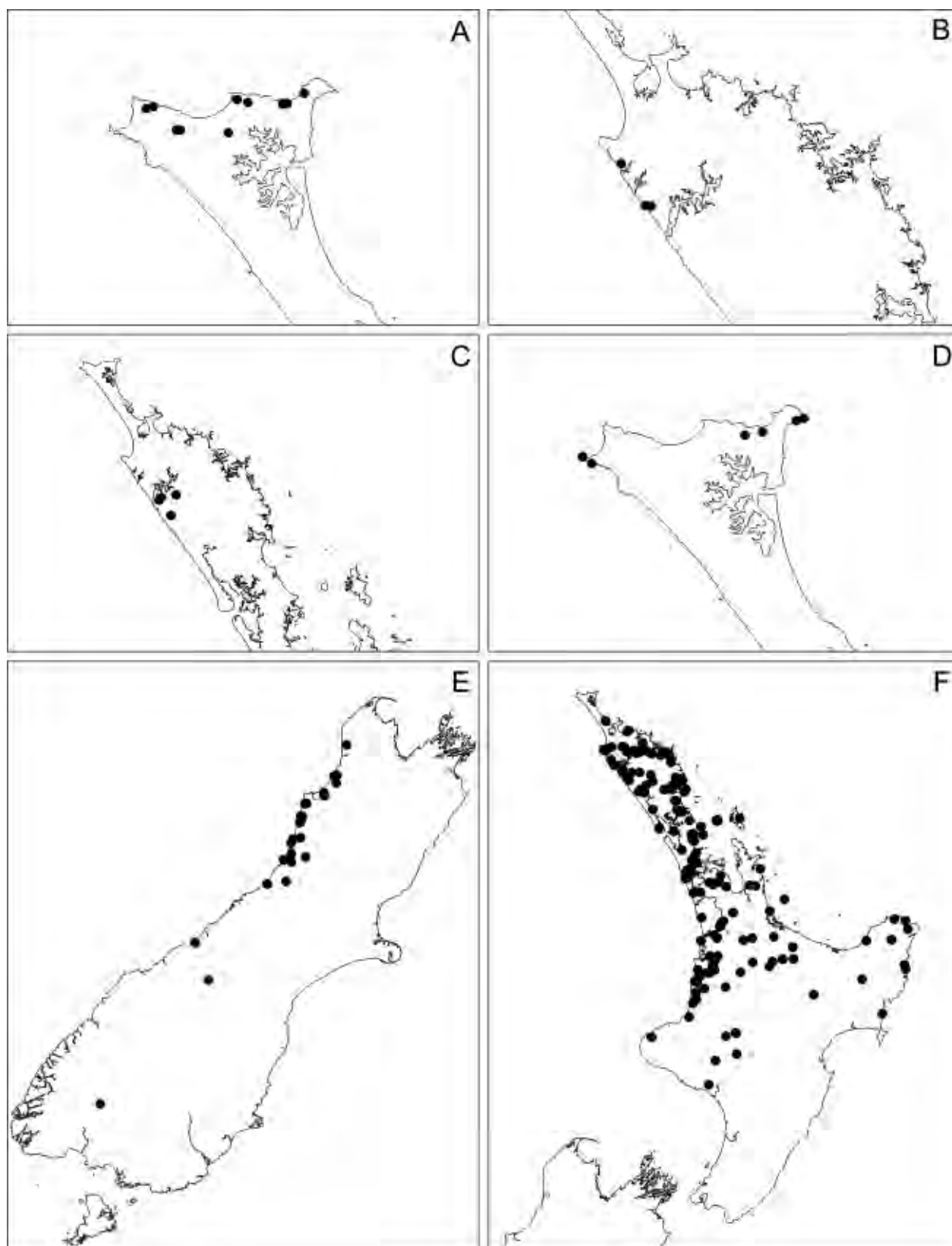


Fig. 27 Distributions of *Allodiscus* (*s. lat.*) species within New Zealand. A, *Allodiscus basiliratus* N. Gardner, 1967; B, *Allodiscus brooki* n.sp.; C, *Allodiscus hazelwoodi* n.sp.; D, *Allodiscus wairua* n.sp.; E, *Allodiscus occidentaneus* n.sp.; F, *Allodiscus urquharti* Suter, 1894.

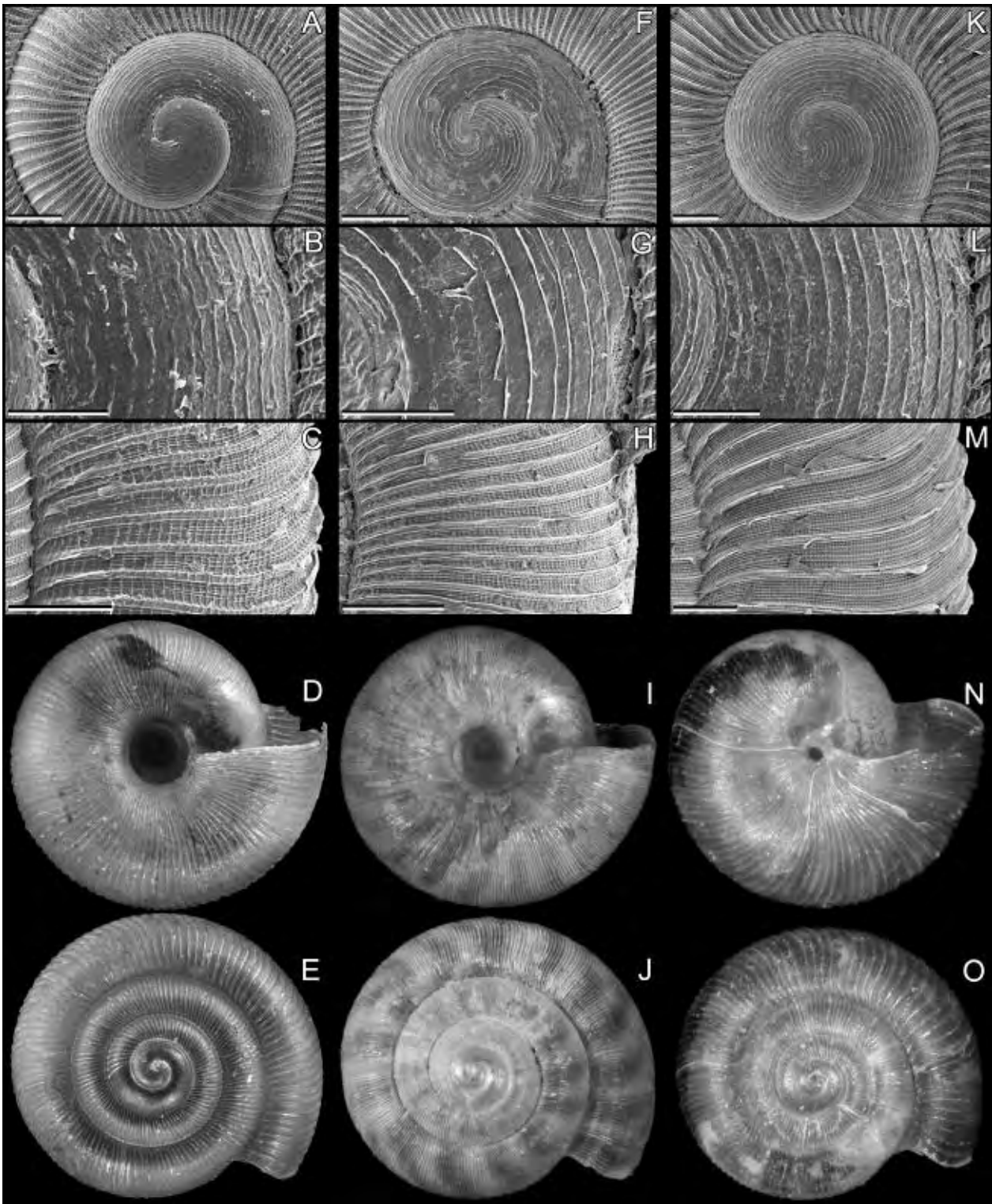


Fig. 28 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus brooki* n.sp., S of Ahipara, Herekino N head, holotype, M.180039 (A–C), and paratype, M.175003 (N, O, 1.10 × 1.65 mm); F–J, *Allodiscus hazelwoodi* n.sp., E of Omapere, Waiotemarama Gorge, paratype, M.156978 (F–H), and NE of Opononi, Mountain Road, holotype, M.181315 (I, J, 1.20 × 1.90 mm); K–O, *Allodiscus occidentaneus* n.sp., E of Punakaiki, Bullock Creek, paratype, M.28963 (K–M), and NNE of Greymouth, N of Ten Mile Creek, holotype, M.115091 (N, O, 1.35 × 1.95 mm). Scale bars 50 µm (B, G, L), 100 µm (A, C, F, H, K, M).

markedly stronger on surface entering umbilicus than elsewhere. Axial sculpture moderately sigmoidal. Aperture simple; outer lip weakly and evenly thickened within, inner lip strongly projected abaperturally and overhanging umbilicus.

DISTRIBUTION: Western South Island (Fig. 27E).

BIOLOGY: *Allodiscus occidaneus* is a litter-dweller, known from lowland to montane scrubland and forests.

CONSERVATION STATUS: Widely distributed but not common. Our assessment is that *Allodiscus occidaneus* is not of immediate conservation concern.

REMARKS: *Allodiscus occidaneus* is highly distinctive in the combination of small size, elevated spire, progressively enlarging and separating primary axial ribs, very narrow umbilicus, spreading inner lip, and especially colour pattern.

The anatomy of *Allodiscus occidaneus* is not presently known.

ETYMOLOGY: Western (Latin), alluding to its geographical distribution. Noun in apposition.

Allodiscus urquharti Suter, 1894

(Figs 19O, 27F, 29A–E)

Allodiscus urquharti Hedley & Suter, 1893: 639 (nude name); Suter, 1894c: 489, pl. 22, figs 4–4d; Suter, 1913: 647, pl. 25, figs 16, 16a,b; Powell, 1937: 88; Powell, 1946: 92; Milligan & Sumich, 1954: 123; Powell, 1957: 117; Whitten, 1957: 3; Powell, 1962: 110; Climo, 1970: 312; Powell, 1976: 117; Goulstone, 1977a: 10, text fig.; Goulstone, 1977b: 17, text fig.; Goulstone, 1979a: 3; Goulstone, 1979b: Powell, 1979: 321; 25, text figs; Goulstone, 1980b: 5; Goulstone, 1980c: 1; Goulstone, 1981a: 6; Goulstone, 1981b: 9; Solem *et al.*, 1981: 477; Ballance, 1982: 34; Goulstone, 1982: 5; Mayhill, 1982: 13, text fig.; Mayhill & Broomfield, 1982: 7; Goulstone, 1983b: 28, text figs; Goulstone, 1990: 5, 31, text figs; Goulstone, 1991b: 6; Goulstone, 1991c: 9; Marshall, 1996: 40; Spencer & Willan, 1996: 40; Barker & Mayhill, 1999: 238; Brook & Goulstone, 1999: 130; Mahlfeld, 2000: appendix 1 & subseq.; Barker, 2006: 134.

Flammulina (Allodiscus) urquharti.—Pilsbry, 1893: 15; Suter, 1894b: 146 (nude name); Suter, 1894d: 253.

Endodonta (Charopa) alloia Webster, 1904: 108, text fig. 4.

Endodonta alloia.—Suter, 1913: 725, pl. 28, fig. 15.

'*Allodiscus*' *urquharti*.—Mayhill, 1994: 31, 60, text fig.

TYPE MATERIAL: *Allodiscus urquharti* – holotype NMNZ M.125195: North Island, Mt Pirongia, T. Urquhart.

Endodonta (Charopa) alloia – lectotype Climo (1970:

314) AIM AK 73263 and paralectotypes AK 70262 (1), AK 73264 (4): North Island, Waiuku. Climo (1970) selected the 'smallest of the two type specimens' as lectotype, indicating that he had not been advised of the existence of a second lot of four syntypes. Both original lots are labelled as type material in Powell's handwriting. The lot of two is clearly the lectotype and paralectotype, as it contains a handwritten note (on synonymy rather than type status) by Climo dated July 1969. The lot of four had evidently been segregated by Powell for his private collection, since amalgamated with Auckland Museum's collection.

MATERIAL EXAMINED (234 lots): Type material (see above), M.56044 (1), M.57444 (1), M.57509 (many), M.57694 (1), M.57895 (1), M.58207 (1), M.58288 (1), M.61821 (1), M.63293 (2), M.63483 (10), M.63532 (2), M.67997 (1), M.68167 (6), M.68191 (2), M.68391 (1), M.68568 (1), M.68723 (1), M.68924 (1), M.69109 (1), M.69945 (2), M.70502 (5), M.70641 (4), M.70778 (2), M.72346 (3), M.73323 (3), M.73972 (2), M.75556 (1), M.75870 (3), M.76173 (1), M.76443 (11), M.76576 (1), M.76580 (2), M.76629 (1), M.76818 (1), M.77352 (2), M.77458 (4), M.77809 (4), M.78128 (10), M.78305 (1), M.78566 (10), M.78759 (3), M.78772 (2), M.79394 (1), M.79510 (1), M.80057 (2), M.80234 (1), M.82384 (3), M.82620 (1), M.82829 (1), M.82919 (2), M.82933 (1), M.83131 (1), M.83212 (1), M.84777 (1), M.85131 (1), M.85203 (3), M.85403 (5), M.86110 (1), M.87610 (1), M.88394 (3), M.96552 (2), M.96584 (1), M.96680 (2), M.97076 (2), M.97111 (1), M.97289 (1), M.97318 (1), M.97660 (3), M.97740 (2), M.98207 (1), M.98806 (1), M.99154 (2), M.99593 (1), M.101612 (1), M.101629 (1), M.101672 (1), M.102722 (2), M.103062 (1), M.103654 (7), M.103881 (1), M.104262 (1), M.104347 (1), M.104467 (3), M.104500 (3), M.104533 (many), M.113645 (1), M.113652 (2), M.113679 (1), M.113741 (1), M.114271 (1), M.115951 (1), M.124537 (1), M.124538 (1), M.124539 (1), M.124540 (1), M.124541 (6), M.124542 (1), M.124544 (many), M.124577 (2), M.124742 (7), M.124928 (9), M.127835 (1), M.127842 (3), M.128663 (1), M.128692 (3), M.156704 (1), M.156705 (1), M.156706 (4), M.156707 (many), M.156708 (1), M.156709 (3), M.156710 (2), M.156711 (2), M.156712 (6), M.156713 (4), M.156714 (1), M.156715 (2), M.156739 (3), M.156940 (1), M.162285 (1), M.162905 (2), M.163175 (1), M.163176 (1), M.163372 (4), M.163438 (1), M.163478 (2), M.163498 (4), M.163536 (1), M.163606 (3), M.163668 (2), M.163772 (6), M.163864 (1), M.163899 (3), M.163945 (2), M.163974 (5), M.164008 (1), M.164019 (1), M.164690

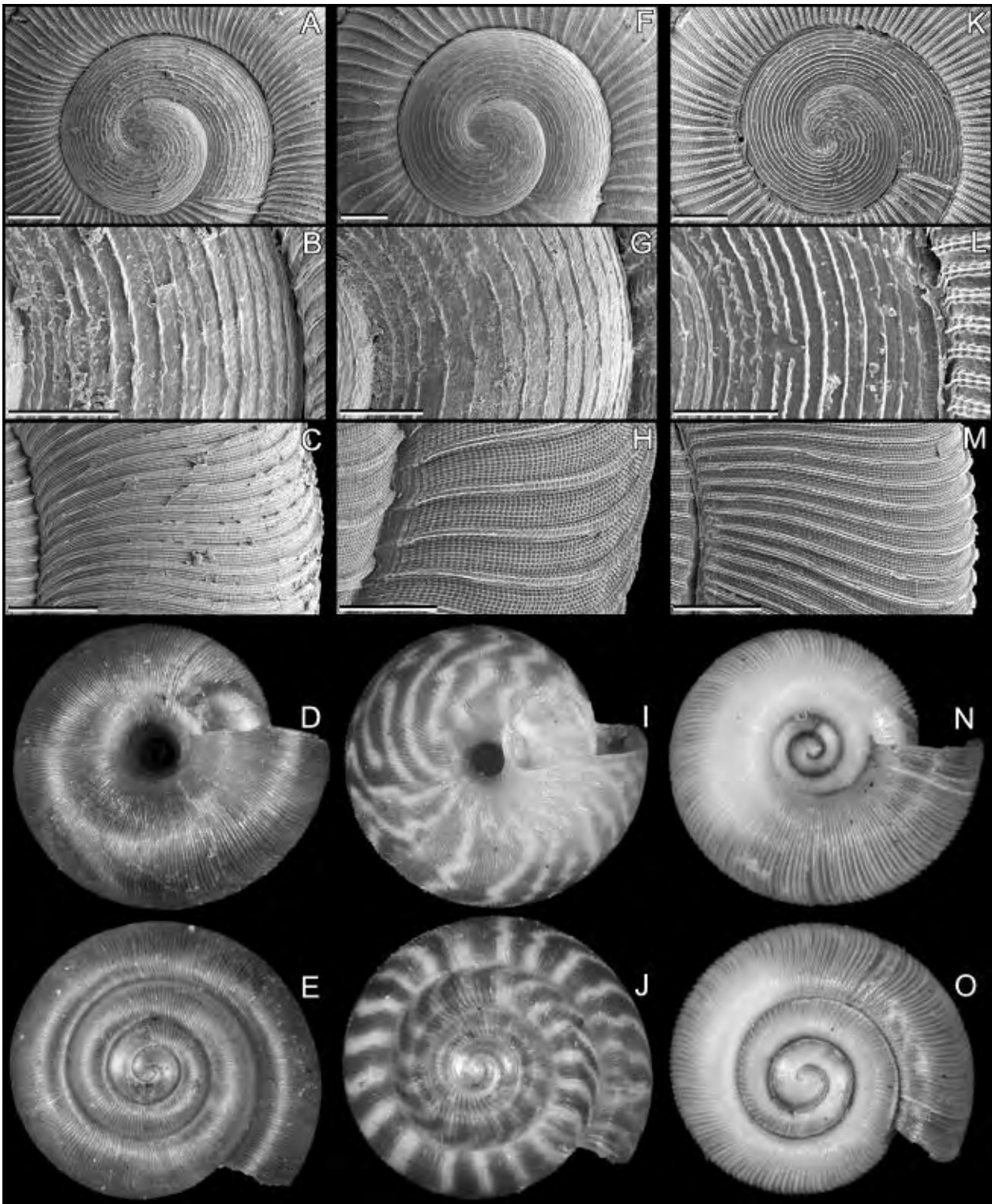


Fig. 29 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus urquharti* Suter, 1894, Ngaruawahia, Hakirimata Track, M.168590 (D, E, 1.15 × 1.70 mm); F–J, *Allodiscus wairua* n.sp., Cape Maria van Diemen, Motuopao Island, paratype, M.89825 (F, G), holotype, M.183097 (I, J, 1.55 × 2.18 mm), and SE of Cape Reinga, Tapotupotu Bay, M.161068 (H); K–O, *Allodiscus pallidus* n.sp., W of Masterton, below footbridge crossing tributary of Atiwhakatu Stream, holotype, M.177447 (0.70 × 1.30 mm). Scale bars 50 µm (B, G, L), 100 µm (A, C, F, H, K, M).

(1), M.164875 (1), M.164912 (1), M.164948 (2), M.165004 (2), M.165061 (1), M.165099 (1), M.165106 (1), M.165165 (2), M.165184 (2), M.165187 (1), M.165232 (2), M.165253 (1), M.165500 (1), M.165566 (1), M.165797 (1), M.165828 (1), M.165920 (1), M.165989 (1), M.166021 (1), M.166815 (1), M.167106 (1), M.167138 (1), M.167303 (2), M.167333 (3), M.167349 (1), M.167593 (3), M.167715 (1), M.167744 (1), M.167816 (1), M.167929 (1), M.168008 (3), M.168052 (1), M.168163 (2), M.168181 (1), M.168192 (2), M.168347 (1), M.168547 (4), M.168590 (many), M.168759 (15), M.168872 (7), M.168963 (3), M.169341 (1), M.169347 (10), M.169356 (5), M.169363 (1), M.169437 (1), M.169443 (1), M.169456 (1), M.169484 (1), M.169509 (2), M.169523 (1), M.169575 (3), M.169585 (1), M.169605 (5), M.169619 (1), M.169638 (1), M.169653 (1), M.169671 (13), M.169709 (4), M.169786 (3), M.169836 (1), M.169852 (2), M.169879 (1), M.169884 (1), M.169906 (3), M.169916 (1), M.169930 (1), M.169942 (2), M.169974 (3), M.169978 (1), M.169996 (1), M.169999 (1), M.170138 (2), M.170139 (1), M.175037 (many), M.175052 (6), M.175053 (1), M.175144 (1), M.175214 (1), M.175243 (1), M.175291 (5), M.175366 (3), M.176007 (1), M.176010 (1), M.176035 (16), M.176037 (1), M.176045 (10), M.176128 (1), M.176167 (1), M.176168 (6), M.176169 (3), M.176170 (4), M.176171 (1).

REDESCRIPTION: Shell up to 1.95 mm wide, thin, low and broad (HWR 0.60–0.69), spire moderately to strongly elevated (28–38% SH), moderately umbilicate (17.0–20.5% SW). Protoconch colourless. Teleoconch ground colour evidently pale buff, but largely overlain by broad axial bands of translucent reddish brown.

Protoconch of 1.00–1.25 convex whorls, moderately elevated, 370–470 µm wide, sculptured with fine, crisp, widely spaced spiral threads that number about 15 on spire on last half-whorl, each surmounted by low periostracal lamella; interspaces essentially smooth.

Teleoconch of up to 2.70 convex whorls, sculptured throughout with prominent, fine, regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and weaker, more closely spaced axial threads, the latter surmounted by crisp periostracal lamellae, intersections very finely nodular, spiral threads stronger on umbilical wall than elsewhere; periostracal lamella at summit of each primary axial rib strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, rim thin, weakly thickened within.

DISTRIBUTION: North Island, north of a line from a

position between Gisborne and Mahia to Wanganui, including islands off the East Coast (Fig. 27F).

BIOLOGY: *Allodiscus urquharti* is broadly distributed geographically and environmentally. It occurs from near sea-level to above 720 m elevation. Habitat includes coastal broadleaved shrublands and forests, and lowland to lower montane podocarp, *Agathis* and mixed broadleaved/podocarp forests. The species occurs in leaf litter on the ground, and can be found among rock rubble, under logs and on ledges of limestone escarpments.

CONSERVATION STATUS: *Allodiscus urquharti* is not threatened owing to its wide distribution.

REMARKS: *Allodiscus urquharti* is distinctive in the combination of small, uniformly pigmented shell, rather wide umbilicus and crowded primary axial ribs. *Allodiscus brooki* n.sp. is superficially similar but has stronger, more widely spaced primary axial ribs, and a more darkly pigmented shell. *Allodiscus basiliratus* N. Gardner, 1967 and *A. hazelwoodi* n.sp. are immediately separable by their axially banded colour patterns.

Climo (1970) reduced *Endodonta (Charopa) alloia* Webster, 1904 to synonymy with *Allodiscus urquharti* Suter, 1894, an action with which we concur.

Suter (1894c, 1913: 647) described the jaw and radula. His description (Suter 1913) of the dentition comprises 'Radula with the formula 18 + 1 + 18; 3 to 4 laterals. Central tooth with small rounded reflection and a sharp mesodont. Laterals bicuspid, with short cutting-points. Marginals with 3 to 4 cutting-points, the inner second point is longest; last marginal with 3 cutting-points.' The description of the central tooth is ambiguous, but the implied unicuspid condition is seen in *Allodiscus worthyi* n.sp. among *Allodiscus* for which information on the radular dentition is known. Climo (1969b: 3) stated that '*Allodiscus urquharti* Suter, 1894 and *A. basiliratus* Gardner, 1967, both with a large [c]audal papilla, have an epiphallus on the penis. These two species, distinguished from the other species of *Allodiscus* also by their small size and wide umbilicus, represent a new endodontid genus to be described in a future paper.' Unfortunately, Climo did not provide additional details.

Allodiscus wairua new species

(Figs 26B, 27D, 29F–J)

Allodiscus adriana.— Gardner, 1967a: 219 (not of Hutton, 1883).

Allodiscus cf. *basiliratus*.— Goulstone *et al.*, 1993: 15, text figs.

TYPE MATERIAL: Holotype NMNZ M.183097 and paratypes M.89825 (3), AIM AK 73281 (1): North Island, Cape Maria van Diemen, Motuopao Island (NZMS 260 M02/777480), 27 Sep. 1988, G.R. Parrish. Additional paratypes: SE of Cape Reinga, Tapotupotu Bay, 2 Sep. 1969, O.J. Marston, M.89767 (2), Apr. 1965, N.W. Gardner, M.161068 (2).

MATERIAL EXAMINED (13 lots): Type material (see above), M.38229 (1), M.54266 (1), M.56351 (2), M.76591 (2), M.87817 (5), M.88666 (4), M.99425 (6), M.161857 (1).

DESCRIPTION: Shell up to 2.20 mm wide, thin and rather fragile, wider than high (HWR 0.63–0.70), spire moderately to strongly elevated (26–40% SH), umbilicus of moderate width (9.6–13.0% SW). Protoconch translucent, colourless; teleoconch white and entirely traversed by irregular reddish brown axial maculations, radial on spire, strongly zigzag on sides and base, umbilical wall uniform reddish brown.

Protoconch moderately elevated, of 1.20–1.25 convex whorls, 470–480 μ m wide, sculptured with fine, crisp, widely spaced spiral threads that number 14–16 on spire on last half-whorl, distinctly and irregularly wavy at nucleus, regular thereafter, each surmounted by low periostracal lamella, interspaces essentially smooth.

Teleoconch of up to 3.10 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by crisp, squarely reticulating spiral and axial threads, intersections nodular; spiral threads more strongly developed on wall of umbilicus than elsewhere; periostracal lamellae at summit of each primary axial rib strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, lips thin, weakly and evenly thickened within.

DISTRIBUTION: Northern North Island, between Cape Maria van Diemen and North Cape (Fig. 27D).

BIOLOGY: *Allodiscus wairua* occurs in the leaf litter of coastal shrublands and forests.

CONSERVATION STATUS: *Allodiscus wairua* is confined to the northern Aupouri Peninsula and thus must be afforded the rank of 'range restricted' according to the criteria of Molloy *et al.* (2002).

REMARKS: *Allodiscus wairua* is superficially similar to *A. basiliratus* N. Gardner, 1967 (sympatric) in shape, size and colour pattern, but has fewer spiral threads on the protoconch, and more widely spaced primary axial ribs and considerably stronger interstitial spiral and axial threads on the teleoconch.

The anatomy of *Allodiscus wairua* is not presently known.
ETYMOLOGY: After the type locality. Noun in apposition.

Group G (*pallidus*)

DIAGNOSIS: Shell small (maximum width 1.35 mm), low (HWR 0.44–0.50), spire weakly elevated (13.5–18.7% SH). Widely umbilicate (width 27–29% SW). Protoconch small (width 430 μ m), sculptured with 13–14 crisp spiral threads, summit of each with a low periostracal lamella, interspaces wider than each spiral.

REMARKS: The single species representing this group is extremely distinctive in the combination of minute size, uniform white shell and broad umbilicus, and seems unlikely to be congeneric with any other species discussed herein, with the possible exception of Charopidae sp. 199 (Figs 38M–O, see below).

Allodiscus pallidus new species

(Figs 26A, 29K–O, 30A)

TYPE MATERIAL: Holotype NMNZ M.177447: North Island, W of Masterton, moss on banks below footbridge crossing tributary of Atiwhakatu Stream (NZMS 260 S26/165319), 13 Jul. 2004, T.H. Worthy. Paratypes: Haurangi Forest, SE of Lake Ferry, Oct. 1985, P.C. Mayhill, M.85297 (2); E of Wellington, between Wainuiomata and Orongorongo rivers, 16 Jan. 1993, K. Mahlfeld, M.115310 (1); Wellington, South Karori Road, 13 Jul. 1993, F.M. Climo, M.115713 (2), AIM AK 73277 (1).

MATERIAL EXAMINED (22 lots): Type material (see above), M.68762 (1), M.85328 (1), M.85556 (1), M.97099 (1), M.97140 (1), M.101350 (1), M.103574 (1), M.103738 (1), M.103957 (1), M.104626 (1), M.104715 (1), M.105954 (1), M.121629 (1), M.127945 (1), M.128708 (3), M.161304 (2), M.161502 (1).

DESCRIPTION: Shell up to 1.35 mm wide, wider than high (HWR 0.44–0.50), thin, spire weakly elevated (13.5–18.7% SH), umbilicus wide (27–29% SW). Uniform translucent white.

Protoconch weakly elevated, of about 1.20 convex whorls, 430 μ m wide, sculptured with 12–14 fine, crisp, widely spaced spiral threads, each surmounted by low periostracal lamella, interspaces essentially smooth.

Teleoconch of up to 1.80 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine spiral threads and weaker axial threads, the latter surmounted by periostracal lamellae,

spiral threads finely beaded at intersections with axials, lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, rim thin, weakly and evenly thickened within.

DISTRIBUTION: North Island from vicinity of Mamaku to Wellington, and northern South Island as far south as Buller Gorge (Fig. 30A).

BIOLOGY: *Allodiscus pallidus* is a litter-dweller of lowland to montane broadleafed/podocarp and *Nothofagus* forests, and subalpine scrub to about 1150 m elevation.

CONSERVATION STATUS: *Allodiscus pallidus* is widely distributed and, while not common, is considered not of immediate conservation concern.

REMARKS: *Allodiscus pallidus* is highly distinctive in the combination of minute size, weakly elevated spire, spirally lirate protoconch, wide umbilicus and uniform translucent white shell. *Allodiscus pallidus* occurs in three widely disjunct clusters of populations; we are unable to detect any differences between them in shell morphology.

The anatomy of *Allodiscus pallidus* is not presently known.

ETYMOLOGY: Pale (Latin), alluding to the translucent white shell. Adjective in the nominative case.

Group H (*undulatus*)

DIAGNOSIS: Shell small (maximum width 2.10–3.70 mm), low (HWR 0.51–0.65), spire weakly elevated (12.0–25.7% SH). Widely or narrowly umbilicate (width 3.5–21.4% SW), or umbilicus a narrow chink. Protoconch small to medium sized (width 170–900 µm), sculptured with crisp spiral threads that are obliquely cut at margins of low, broad, rounded radial undulations, interspaces wider than each spiral.

REMARKS: *Allodiscus erua* n.sp., *A. undulatus* n.sp. and *A. waitutu* n.sp. are extremely distinctive among New Zealand landsnails in that the spiral threads on the protoconch are sharply interrupted at intersections with margins of low, broad radial undulations (Figs 31B,G,L). Another (undescribed) species with protoconch similar to that of *Allodiscus erua* is Charopidae sp. 171 (Figs 38J–L, see below). Similar protoconch sculpture is characteristic of *Radiodiscus* Pilsbry & Ferris, 1906 (type species *Radiodiscus millecostatus* Pilsbry & Ferris, 1906; Arizona) (Solem 1977: figs 7, 8), *Microcharopa* Solem, 1982 (*Microcharopa mimula* Solem, 1982; Fiji) (Solem 1982: fig. 4), and *Rotadiscus* Pilsbry, 1926

(*Helix bermanni* L. Pfeiffer, 1866; Central America) (Solem 1982: 70), the latter type genus of Rotadiscinae Baker, 1927, currently grouped as a subfamily of Charopidae (Bouchet & Rocroi 2005, and references therein).

Allodiscus erua new species

(Figs 26C, 30E, 31A–E)

Charopidae sp. 54 (NMNZ M.72132) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.180042 and paratype M.72132: North Island, N of Ohakune, Erua Forest, 1000 m (NZMS 260 S20/184167), Jan. 1980, P.C. Mayhill. **MATERIAL EXAMINED** (2 lots): Type material (see above).

DESCRIPTION: Shell up to 2.10 (est.) mm wide, wider than high (HWR 0.51–0.52), thin, spire very weakly elevated (12–13% SH), umbilicus wide (18.5–21.4% SW). Teleoconch translucent white with irregular reddish-brown wavy axial bands.

Protoconch weakly elevated, of 0.90–1.10 convex whorls, 170–200 µm wide, sculptured with 18–20 fine, crisp, widely spaced spiral threads, each surmounted by low axial lamella, obliquely and sharply interrupted at margins of very low, broad, rounded prosocline radial undulations on last quarter-whorl, interspaces essentially smooth.

Teleoconch of up to 2.20 convex whorls, sculptured throughout with prominent, regularly spaced, sigmoidal primary axial ribs; these overlain by weak spiral threads and weaker collabral growth lines, the latter surmounted by periostracal lamellae, spiral threads very finely beaded at intersections with axials, lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest; spiral threads distinctly stronger around umbilicus. Axial sculpture broadly and moderately sigmoidal. Aperture simple, rim thin, weakly and evenly thickened within.

DISTRIBUTION: Central North Island, Erua Forest (Fig. 30E).

BIOLOGY: *Allodiscus erua* occurs in the litter of montane broadleafed/podocarp forest.

CONSERVATION STATUS: *Allodiscus erua* is presently known from two specimens from a single locality. It is probably more broadly distributed in broadleafed/podocarp forests in the central North Island, but further survey work is required to establish its range and conservation status properly. The species should be ranked 'data deficient' pending further search effort.

REMARKS: *Allodiscus erua* is highly distinctive in the combination of small size, weakly elevated spire, broad umbilicus, and protoconch sculpture of crisp spiral threads that are interrupted at intersections with very low radial undulations on the last quarter-whorl.

The anatomy of *Allodiscus erua* is not presently known.

ETYMOLOGY: After the type locality, Erua Forest. Noun in apposition.

Allodiscus undulatus new species

(Figs 26H, 30D, 31F–J)

Allodiscus planulatus.– Dell, 1954: 139 (not of Hutton, 1883); Goulstone, 1980a: 3, 8, text fig. (not of Hutton).

Allodiscus cf. *smithi*.– Dell, 1954: 139 (not of Suter, 1894).

Allodiscus ‘crinkled protoconch’ Mayhill, 1985: 5, text fig.

Allodiscus ‘crinkley’ Mason, 1988: 90 (in part = *A. waitutu* n.sp.).

Charopidae sp. 67 (NMNZ M.81622) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.183103 and paratype M.85598: South Island, SSW of Manapouri, NW of Borland Lodge, limestone cavern (NZMS 260 C44/812800), Feb. 1986, P.C. Mayhill. Additional paratypes: NW of Borland Lodge, Jan. 1989, P.C. Mayhill, M.146400 (6), AIM AK 73287 (2), Jan. 1994, P.C. Mayhill, M.146450 (7), Jan. 2001, P.C. Mayhill, M.146457 (3); Borland Saddle, Feb. 1986, P.C. Mayhill, M.146307 (1); Waterloo Track, Takitimu North, Feb. 1985, P.C. Mayhill, M.81622 (6).

MATERIAL EXAMINED (44 lots): Type material (see above), M.22575 (1), M.28806 (2), M.29957 (2), M.30632 (1), M.31147 (many), M.32851 (2), M.37842 (3), M.79934 (2), M.82093 (1), M.82136 (1), M.82765 (3), M.85289 (1), M.85606 (1), M.87557 (many), M.89653 (many), M.100197 (3), M.116784 (1), M.123174 (1), M.123292 (1), M.128607 (1), M.146296 (1), M.146319 (4), M.146450 (7), M.146475 (1), M.146540 (many), M.146628 (1), M.146640 (4), M.146693 (3), M.156830 (8), M.156939 (1), M.157016 (1), M.157620 (many), M.175067 (1), M.175070 (many), M.175120 (1), M.175132 (1).

DESCRIPTION: Shell up to 3.70 mm wide, wider than high (HWR 0.55–0.60), thin, spire weakly to moderately elevated (17–27% SH), umbilicus narrow (3.5–7.2% SW). Protoconch translucent, colourless; teleoconch translucent white with irregular yellowish-brown wavy axial bands.

Protoconch weakly elevated, of 1.30–1.40 convex whorls, 800–900 µm wide, sculptured with 22–25 fine, crisp spiral threads, interspaces broader than each thread, essentially

smooth, threads cut at margins of low, broad, rounded radial undulations.

Teleoconch of up to 2.80 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by weak spiral threads and much weaker collabral growth lines, the latter surmounted by periostracal lamellae, spiral threads finely beaded at intersections with axials, lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, rim thin, outer lip weakly thickened within, inner lip rapidly and strongly thickened within.

DISTRIBUTION: Southern South Island, and Codfish Island near Stewart Island (Fig. 30D).

BIOLOGY: *Allodiscus undulatus* occurs in broadleaved and *Nothofagus* forests from near sea-level to about 800 m elevation. It is primarily associated with litter and woody debris on the forest floor. In areas with limestone outcrops, the species is not uncommon among rock rubble and on rock faces, including those in dimly lit areas near cave entrances.

CONSERVATION STATUS: *Allodiscus undulatus* is rather widely distributed and not uncommon. Our assessment is that the species is of no immediate conservation concern.

REMARKS: *Allodiscus undulatus* is extremely distinctive among previously described charopids from the New Zealand region in its protoconch sculpture of crisp spiral threads that are cut at intersections with low radial undulations. The radial undulations on the protoconch are stronger and more extensive than in the allopatric species *Allodiscus erua* n.sp.

The anatomy of *Allodiscus undulatus* is not presently known.

ETYMOLOGY: Wavy (Latin), with reference to the distinctive protoconch sculpture. Adjective in the nominative case.

Allodiscus waitutu new species

(Figs 26E, 30B, 31K–O)

Allodiscus ‘crinkley’ Mason, 1988: 90 (in part = *A. undulatus* n.sp.).

TYPE MATERIAL: Holotype NMNZ M.175117: South Island, Waitutu Forest, WSW of Tuatapere, E of Trig V (NZMS 260 C46/600303), 15 May 1985, G.M. Mason. Paratypes: Waitutu Forest, 18 May 1985, G.M. Mason, M.175127 (1), 16 May 1985, G.M. Mason, M.175131 (1).

MATERIAL EXAMINED (5 lots): Type material (see above), M.146349 (2), M.157950 (1).

DESCRIPTION: Shell up to 2.75 mm wide, wider than high

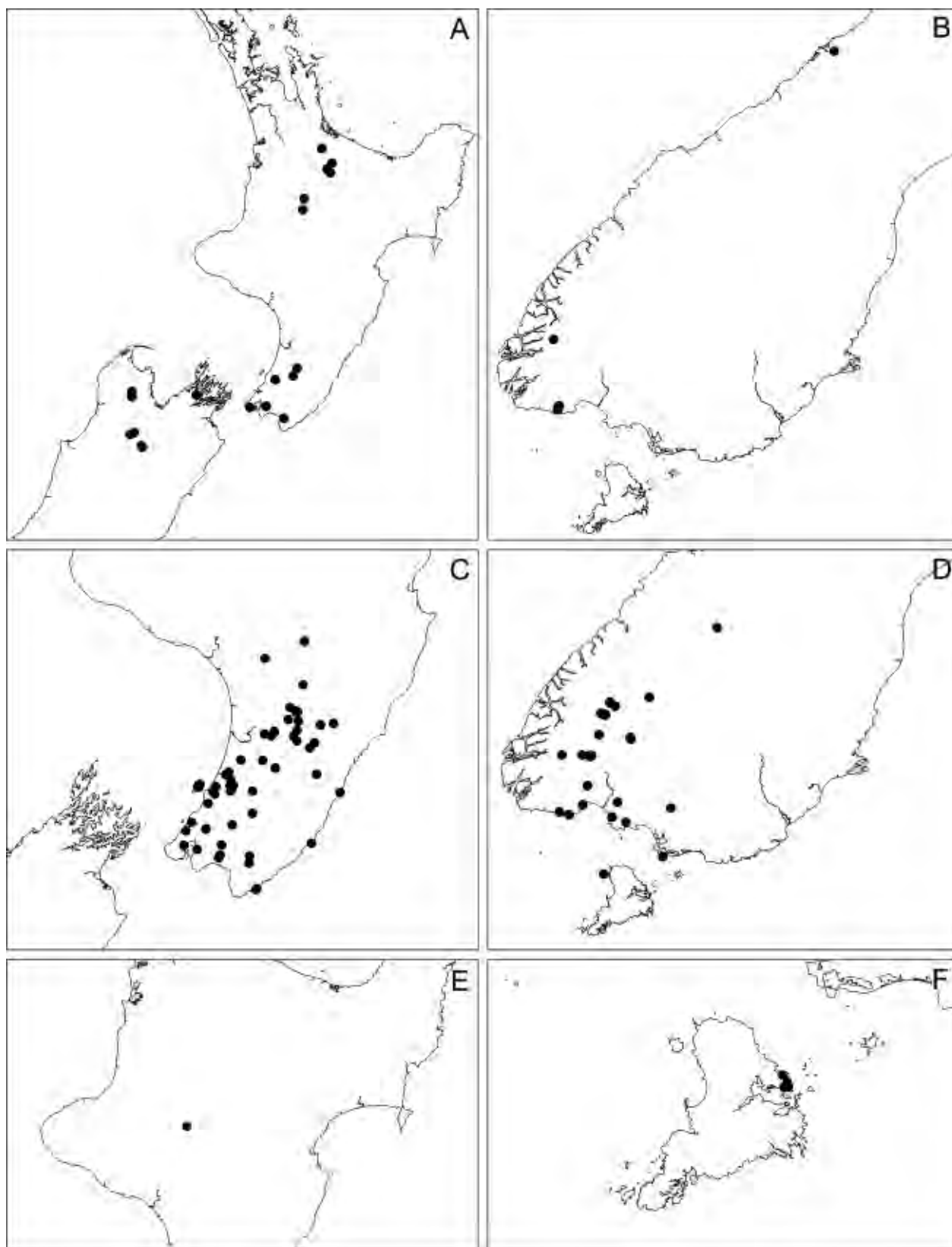


Fig. 30 Distributions of *Allodiscus* (s. lat.), *Hirsutodiscus* and *Pseudallodiscus* species within New Zealand. A, *Allodiscus pallidus* n.sp.; B, *Allodiscus waitutu* n.sp.; C, *Pseudallodiscus ponderi* Climo, 1971; D, *Allodiscus undulatus* n.sp.; E, *Allodiscus erua* n.sp.; F, *Hirsutodiscus rakiura* (Climo, 1971).

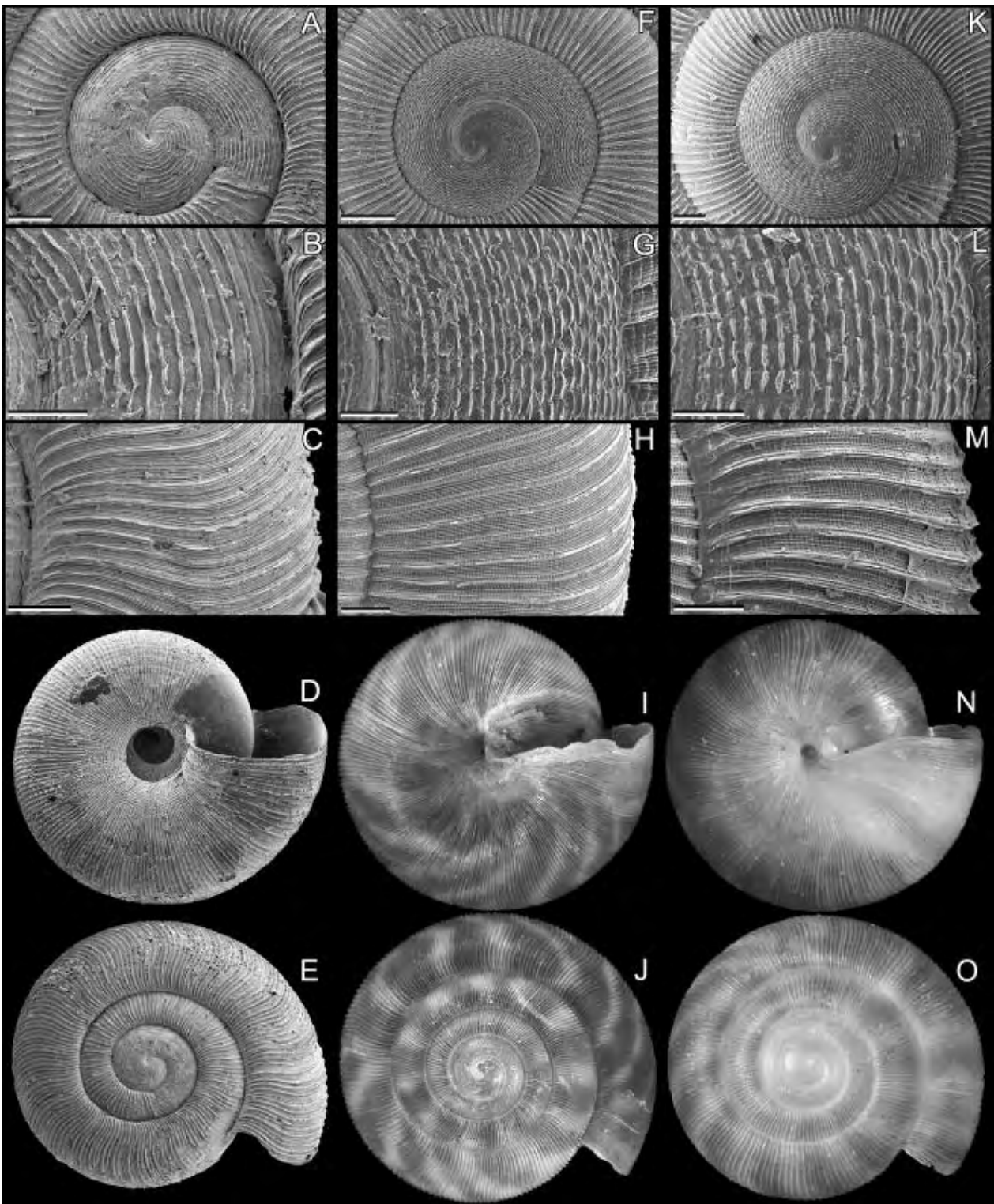


Fig. 31 Shells of *Allodiscus* (*s. lat.*) species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Allodiscus erua* n.sp., N of Ohakune, Erua Bush, holotype, M.180042 (0.90 × 1.75 mm). F–J, *Allodiscus undulatus* n.sp., SSW of Manapouri, NW of Borland Lodge, cavern, paratype, M.85598 (F–H), and holotype, M.183103 (1.82 × 3.20 mm); K–O, *Allodiscus waitutu* n.sp., WSW of Tuatapere, Waitutu Forest, holotype, M.175117 (K–M), and Waitutu Forest, paratype, M.175131 (N, O, 1.70 × 2.73 mm). Scale bars 50 µm (B, G, L), 100 µm (A, C, H, K, M), 200 µm (F).

(HWR 0.64–0.65), thin, spire rather strongly elevated (25.3–25.7% SH), minute umbilicus partly overhung by inner lip. Protoconch translucent, colourless; teleoconch translucent white with irregular reddish-brown wavy axial bands.

Protoconch weakly elevated, of 1.25–1.35 convex whorls, 730 µm wide, sculptured with 23–25 fine, crisp spiral threads, interspaces broader than each thread, essentially smooth, threads cut at margins of low, rounded radial undulations.

Teleoconch of up to 2.75 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by weak spiral threads and much weaker collabral growth lines, the latter surmounted by periostracal lamellae, spiral threads finely beaded at intersections with axials, lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, rim thin, outer lip weakly thickened within, inner lip rapidly and strongly thickened within.

DISTRIBUTION: Southern South Island (Fig. 30B).

BIOLOGY: *Allodiscus waitutu* has been collected from leaf litter in lowland forests.

CONSERVATION STATUS: *Allodiscus waitutu* is rare. The wide dispersion of sites at which collections have been made suggests the species is widely distributed in southwest South Island. The habitat in this region is well represented in the public conservation estate, but present information prevents a robust assessment of the conservation status of *Allodiscus waitutu*. We propose a rank of ‘data deficient’, pending further survey.

REMARKS: *Allodiscus waitutu* resembles *A. undulatus* n.sp. in its highly distinctive protoconch sculpture, but differs in attaining a smaller size (width up to 2.75 mm, versus 3.70 mm), in being smaller relative to the number of whorls, in having a smaller protoconch (width 730 µm, versus 800–900 µm), and in details of colour and colour pattern. A single specimen from the Saltwater Forest, northeast of Okarito (M.157950), several hundred kilometres north of the type locality, is indistinguishable from the type material.

The anatomy of *Allodiscus waitutu* is not presently known.

ETYMOLOGY: After the type locality, Waitutu Forest. Noun in apposition.

Genus *Granallogiscus* new genus

Type species: *Granallogiscus mayhillae* n.sp.; Recent, New Zealand.

Allodiscus as applied by various authors. (Not *Allodiscus* Pilsbry, 1892a: 56. Type species *Helix dimorpha* Reeve, 1852, by original designation; Charopidae.)

Charopa as applied by various authors. (Not *Charopa* Albers & Martens, 1860: 87. Type species *Helix coma* Gray, 1843, by original designation; Charopidae.)

Flammulina as applied by Suter (1894d). (Not *Flammulina* Martens, 1873: 12. Type species *Vitrina zebra* Le Guillou, 1842, by subsequent designation of Pilsbry, 1893; Charopidae.)

Phenacohelix as applied by Hedley & Suter (1893). (Not *Phenacohelix* Suter, 1892a: 270. Type species *Helix pilula* Reeve, 1852, by subsequent designation of Pilsbry, 1894.)

Psyra as applied by various authors. (Not *Psyra* Hutton, 1883b: 532. Type species *Helix venulata* L. Pfeiffer, 1857, by original designation and monotypy; Charopidae.) (Not *Psyra* Stal, 1876, in Orthoptera.)

Fruticicola as applied by various authors to New Zealand material. (Not *Fruticicola* Held, 1838: 914. Type species *Helix fruticum* Müller, 1774, by subsequent designation of Herrmannsen, 1846; Bradybaenidae.)

Gerontia as applied by various authors. (Not *Gerontia* Hutton, 1882: 281. Type species *Gerontia pantherina* Hutton, 1882, by monotypy; Charopidae.)

Helix as applied by various authors to New Zealand material. (Not *Helix* Linnaeus, 1758: 768. Type species *Helix pomatia* Linnaeus, 1758, ICZN Opinion 94, 1926; Helicidae.)

Nanina as applied by various authors to New Zealand material. (Not *Nanina* Gray, 1834: 58. Type species *Helix citrina* Linnaeus, 1758, by subsequent designation of Herrmannsen, 1847. Synonym of *Xesta* Albers, 1850 in Ariophantidae.) (Not *Nanina* Risso, 1826.)

Thalassia as applied by various authors to New Zealand material. (Not *Thalassia* Albers & Martens, 1860: 59. Type species *Helix subrugata* Reeve, 1852, by original designation. Synonym of *Nitor* Gude, 1911 in Helicarionidae.) (Not *Thalassia* Chevrolat, 1834 in Coleoptera.)

DIAGNOSIS: Shell small (maximum width 3.20–3.80 mm), high (HWR 0.65–0.76), spire strongly elevated (25–37% SH). Narrowly umbilicate (width 4.2–6.4% SW), or anomphalous. Protoconch medium sized (width 600–770 µm), sculptured with numerous crowded, crisp spiral threads

surmounted by minute conical spines. Spire axially banded, bands transforming to a diagonal chequer-board pattern that extends over side and base.

Aulcopod, able to withdraw completely into the shell. Foot long, narrow, projecting behind shell in crawling animal; with distinct pedal grooves; truncated posteriorly, with a caudal pit below a short horn. Jaw stegognathic. Radula with a tricuspid central tooth, and bicuspid lateral teeth. Reproductive system hermaphroditic, gonad with two clusters of acini; female and male pallial gonoducts fused to spermoviduct condition; bursa copulatrix on a long duct that is dilated at origin from oviduct; epiphallus not externally differentiated from vas deferens; penis long, comprising a bulkier, cylindrical proximal part with apical penial retractor muscle and vas deferens insertion, and a slender, short distal part running to atrium; proximal penis dominated internally by a large, fleshy stimulator arising from the lateral wall below the opening of the vas deferens; penis invested with a thin muscular sheath.

REMARKS: Specimens commonly identified as *Allodiscus granum* (L. Pfeiffer, 1857) in collections prove to be a mixture of three species, two of which are here described as new species. Their protoconchs are all similarly sculptured, and extremely distinctive among New Zealand Punctoidea. All other shell characters are accordant with taxa here referred to Charopidae, as is the anatomy (F.M. Climo, pers. comm., 2006). We know of no other charopid with a similar combination of characteristics, and introduce a new genus for the group. The type species of *Hirsutodiscus* Climo, 1971 (see below) is superficially similar, but differs markedly in having an essentially smooth protoconch, and in having rows of periostracal hairs on the teleoconch.

The anatomical aspects of the generic diagnosis are drawn from information provided by Hutton (1884a) (reproduced by Suter 1913) and Climo (1969b) for material presumed referable to *Allodiscus granum*, but may have been based in part on *A. abaxoides* n.sp. and/or *A. mayhillae* n.sp. (see synonymies, below).

ETYMOLOGY: Combination of *granum* (Latin = grain), alluding to the granular sculpture on the spiral threads on the protoconch, with generic name *Allodiscus*.

Granallodiscus abaxoides new species

(Figs 26D, 32A–E, 33A)

Charopa miranda.— Hutton, 1884a: 180, pl. 9, fig. W, pl.

11, fig. S (in part of Hutton, 1883 + *G. mayhillae* n.sp.);

Hutton, 1884b: 202 (in part of Hutton + *G. mayhillae*).

Phenacobelix granum.— Hedley & Suter, 1893: 642 (not of Pfeiffer, 1857 + *G. mayhillae*).

Flammulina (Allodiscus) miranda.— Suter, 1894d: 252 (in part of Hutton + *G. mayhillae*).

Allodiscus granum.— Suter, 1913: 641 (in part of Pfeiffer + *G. mayhillae*); ?Elliott, 1966: 62; Powell, 1979: 320 (in part of Pfeiffer + *G. mayhillae*).

Flammulina (Phenacobelix) granum.— Suter, 1894d: 249 (not of Pfeiffer + *G. mayhillae*).

Allodiscus (Allodiscus) granum.— Climo, 1969b: 34 (in part + *G. mayhillae*).

Rotadiscid *granum* cf. Worthy & Holdaway, 1994: 391 (not of Pfeiffer, 1857).

Allodiscus sp. A Worthy & Roscoe, 2003: 48, 58.

TYPE MATERIAL: Holotype NMNZ M.183101 and paratypes M.108722 (11), AIM AK 73285 (2): South Island, S of Collingwood, Parapara River valley, gully by W end of old bridge (NZMS 260 M25/821528), 13 Apr. 1985, D.J. Roscoe. Additional paratypes: Green Island, Wharariki Beach, 19 Mar. 1973, F.M. Climo, M.38834 (1); Fossil Point Stream, N of Collingwood, 7 Mar. 1978, F.M. Climo, M.57723 (2); Muddy Creek, Whanganui Inlet, 31 Aug. 1993, F.M. Climo, M.116388 (6); Parapara River, 22 Aug. 1978, F.M. Climo, M.57939 (10), 16 Jan. 1987, F.M. Climo, M.86409 (3); Parapara Inlet, 13 Feb. 1982, D.J. Roscoe, M.106325 (2); Karamea, 25 Dec. 1980, D.J. Roscoe, M.121169 (6).

MATERIAL EXAMINED (240 lots): Type material (see above), M.4072 (11), M.4098 (1), M.4101 (2), M.4105 (2), M.14177 (2), M.23581 (1), M.23582 (1), M.28868 (1), M.28899 (1), M.29065 (1), M.29669 (1), M.30077 (1), M.30299 (1), M.30305 (3), M.30307 (2), M.30308 (many), M.30309 (1), M.30310 (3), M.30312 (1), M.30313 (1), M.30533 (3), M.30536 (2), M.30541 (6), M.30545 (4), M.30546 (1); M.30547 (2), M.36982 (1), M.37287 (1), M.37872 (1), M.37928 (1), M.38205 (1), M.38656 (3), M.47510 (2), M.55532 (1), M.55891 (2), M.56161 (1), M.56888 (3), M.56970 (1), M.57222 (1), M.58001 (17), M.61651 (5), M.61886 (5), M.62931 (1), M.63022 (2), M.63053 (2), M.63070 (3), M.69846 (1), M.70387 (1), M.70408 (2), M.72742 (2), M.73073 (3), M.73123 (1), M.73527 (2), M.73993 (1), M.75344 (11), M.75755 (5), M.75940 (2), M.76468 (4), M.76675 (12), M.77325 (many), M.77444 (9), M.77857 (6), M.79206 (many), M.79722 (18), M.79859 (1), M.80849 (8), M.80861 (1), M.80973 (5), M.81007 (4), M.81056 (1), M.81126 (3), M.81894 (1), M.82345 (2), M.86378 (8), M.86398 (3), M.86466 (3), M.86542 (many),

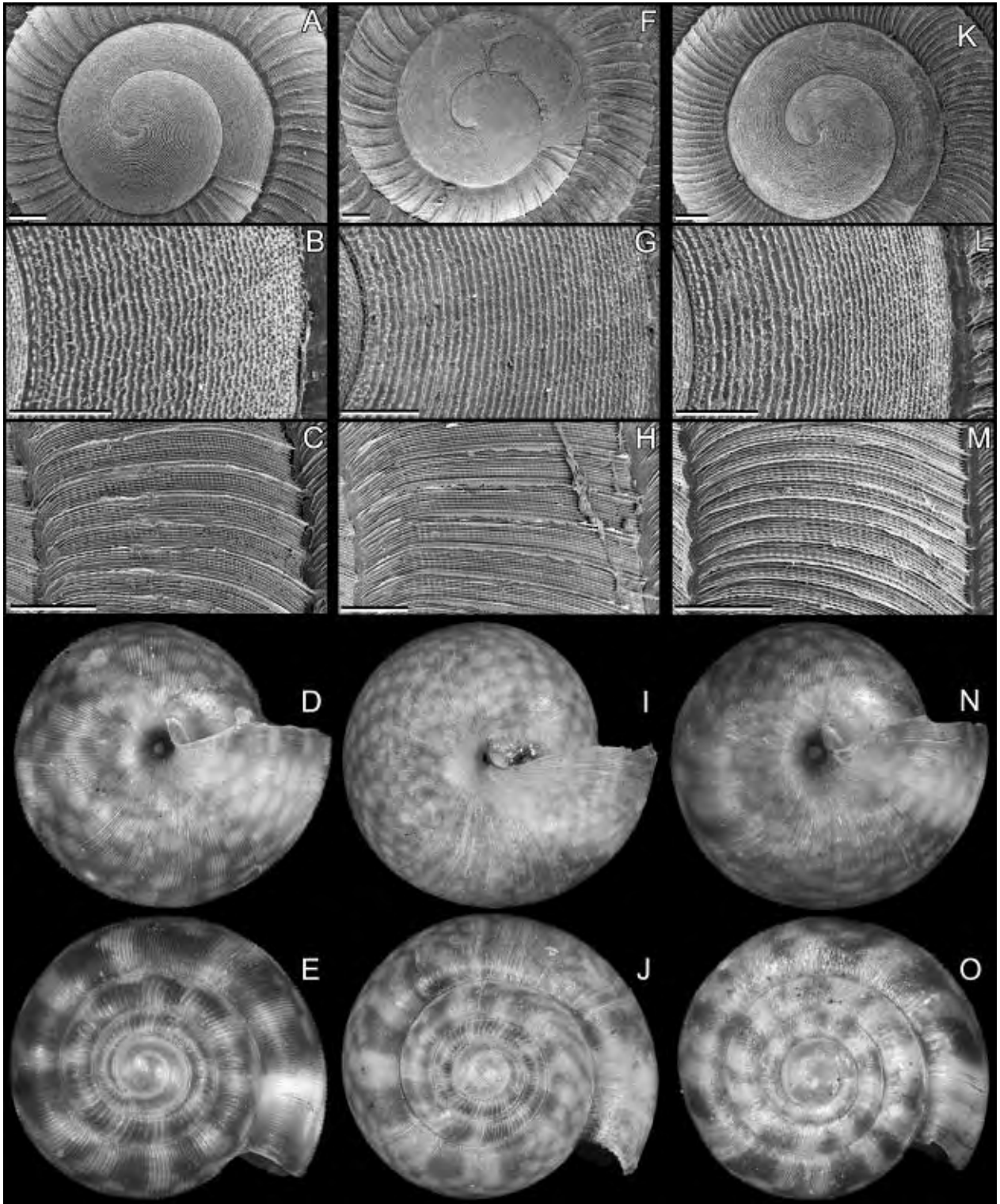


Fig. 32 Shells of *Granallodiscus* species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Granallodiscus abaxoides* n.sp., S of Collingwood, Parapara River valley, paratype, M.108722 (A–C), and holotype, M.183101 (D, E, 2.00 × 2.47 mm); F–J, *Granallodiscus granum* (L. Pfeiffer, 1857), E of Kumara, Turiwhate Falls (F–H), and Kapiti Island, M.2512 (I, J, 2.50 × 3.50 mm); K–O, *Granallodiscus maybillae* n.sp., NW of Hamilton, Hakirimata Track, paratype, M.168543 (K–M), and holotype, M.78739 (N, O, 2.20 × 2.85 mm). Scale bars 50 µm (B, G, L), 100 µm (A, C, F, H, K, M).

M.86600 (1), M.86603 (1), M.88828 (1), M.88921 (1), M.89019 (2), M.89092 (many), M.89274 (1), M.96783 (2), M.97352 (12), M.97409 (many), M.98780 (1), M.98992 (3), M.99592 (1), M.99615 (1), M.99911 (1), M.100314 (1), M.101033 (2), M.101211 (1), M.101271 (4), M.101684 (1), M.101887 (1), M.102014 (2), M.102629 (1), M.102899 (2), M.103017 (1), M.103104 (2), M.103240 (6), M.103294 (7), M.103637 (1), M.103741 (4), M.104654 (4), M.104895 (3), M.105503 (4), M.105533 (1), M.105707 (18), M.105773 (1), M.105785 (1), M.105925 (1), M.105986 (3), M.106193 (1), M.106323 (2), M.106392 (2), M.106472 (2), M.106541 (1), M.106798 (2), M.106836 (1), M.106856 (1), M.107033 (7), M.107055 (5), M.107214 (1), M.107390 (1), M.107932 (4), M.108057 (1), M.108280 (3), M.108313 (7), M.108519 (1), M.108656 (3), M.108769 (18), M.109482 (many), M.109621 (2), M.109632 (2), M.109657 (4), M.109772 (7), M.109800 (many), M.109974 (3), M.113976 (1), M.115108 (3), M.115117 (5), M.115133 (3), M.116304 (6), M.116426 (3), M.120300 (8), M.120372 (1), M.120432 (1), M.120466 (10), M.120490 (7), M.120588 (3), M.120770 (1), M.120943 (3), M.120963 (1), M.121039 (1), M.121181 (11), M.121227 (2), M.121264 (5), M.121287 (5), M.121744 (1), M.122081 (3), M.122110 (2), M.122327 (1), M.122514 (1), M.122619 (2), M.123449 (4), M.123502 (many), M.123510 (1), M.123532 (3), M.123550 (3), M.123596 (3), M.123694 (1), M.123738 (3), M.123765 (12), M.123846 (2), M.123885 (1), M.123953 (8), M.124012 (2), M.124518 (7), M.124551 (1), M.125602 (1), M.126657 (1), M.127854 (1), M.127977 (20), M.128628 (1), M.128684 (3), M.128724 (2), M.128727 (1), M.128729 (1), M.128730 (1), M.129230 (1), M.129638 (20), M.154803 (1), M.156770 (1), M.156773 (1), M.156774 (2), M.156832 (10), M.156840 (16), M.159013 (2), M.159028 (1), M.159881 (3), M.159945 (1), M.161235 (1), M.161375 (1), M.161415 (4), M.161449 (2), M.161455 (1), M.161474 (1), M.161569 (3), M.161737 (16), M.162370 (2), M.162383 (2), M.162434 (1), M.162514 (2), M.162542 (2), M.162575 (3), M.162623 (1), M.166176 (1), M.170120 (3), M.170122 (2), M.170225 (1), M.170226 (2), M.170228 (2), M.175155 (1), M.175247 (1), M.175283 (2), M.175391 (3).

DESCRIPTION: Shell up to 3.20 mm wide, wider than high (HWR 0.70–0.76), spire strongly elevated (25–37% SH), thin, narrowly umbilicate (4.2–6.4% SW). Protoconch and teleoconch ground translucent white, teleoconch with reddish-brown to yellowish-brown pattern; maculations of irregular width and spacing on spire above insertion; fine

diagonal chequer-board pattern on sides and base below insertion.

Protoconch relatively strongly elevated, of 1.25 convex whorls, 600–670 µm wide, sculptured throughout with numerous fine, crisp, densely crowded spiral threads surmounted by minute, irregular conical spines.

Teleoconch of up to 3.20 convex, rather evenly expanding whorls; spire whorls strongly convex; sides broadly convex, smoothly curving around periphery over base, more tightly rounded where entering umbilicus. With exception of narrow, more or less smooth subsutural channel, sculptured throughout with prominent primary axial ribs; these overlain by much finer, closer spiral threads and fine axial periostracal lamellae that form a reticulate pattern, spirals finely nodular at intersections; periostracal lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Primary axial ribs widely and rather regularly spaced on first 1.75–1.80 whorls, then finer, more crowded and imparting a silken texture, transition rapid. Spiral threads strongest on surface entering umbilicus, absent from narrow subsutural zone that extends beyond subsutural channel, broader, more widely spaced and less crisply defined on adapical third of spire whorls than elsewhere. Axial sculpture weakly sigmoidal. Aperture simple; outer lip weakly and evenly thickened within, inner lip thicker.

DISTRIBUTION: Central North Island from Kaimai Range to as far south as the vicinity of Mt Taranaki, and western South Island as far south as about Greymouth (Fig. 33A). Known also from Quaternary deposits in cave systems of Karamea (M.72742, M.97352).

BIOLOGY: *Granallodiscus abaxoides* is distributed widely both geographically and environmentally. The species occurs in a broad range of ecosystem types, from coastal flax shrublands, lowland broadleaved, podocarp/broadleaved and *Nothofagus* forests and shrublands, and montane *Nothofagus* forests, to subalpine tussock grasslands at elevations up to 1800 m. It occurs in leaf litter on the ground, under logs, and in rock rubble and crevices on rocky escarpments and cave entrances.

CONSERVATION STATUS: *Granallodiscus abaxoides* is broadly distributed and not uncommon. The species is thus not of immediate conservation concern.

REMARKS: *Granallodiscus abaxoides* closely resembles *G. granum* (L. Pfeiffer, 1857) and *G. mayhillae* n.sp. (see below), and the three have been confused hitherto (see respective synonymies). *Granallodiscus abaxoides* most closely

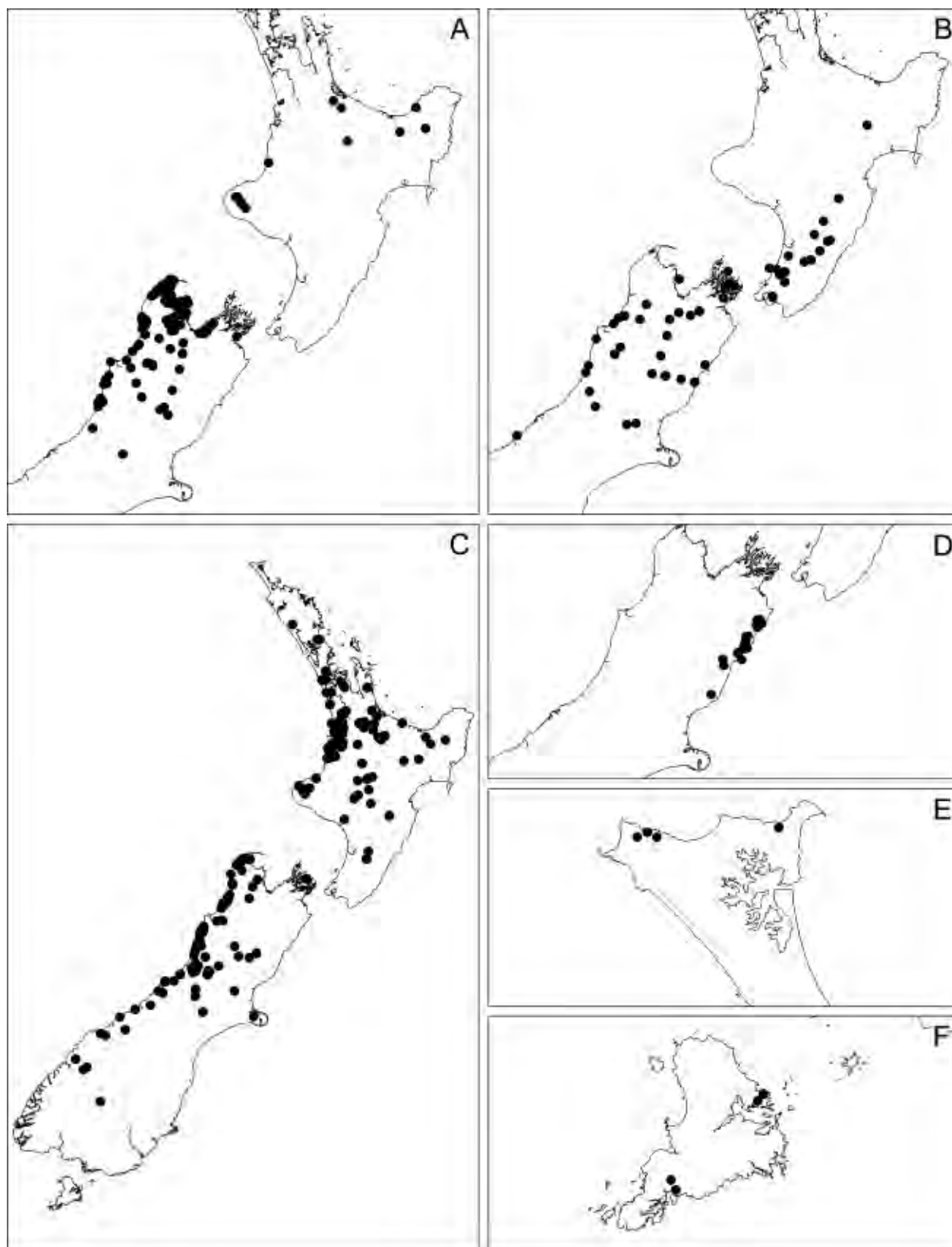


Fig. 33 Distributions of *Granallogdiscus* and *Costallogdiscus* species within New Zealand. A, *Granallogdiscus abaxoides* n.sp.; B, *Granallogdiscus granum* (L. Pfeiffer, 1857); C, *Granallogdiscus mayhillae* n.sp.; D, *Costallogdiscus kaikoura* n.sp.; E, *Costallogdiscus parrishi* n.sp.; F, *Costallogdiscus pegasus* n.sp.

resembles *G. granum* in that the primary axial ribs are at first widely then closely spaced, but differs in having a smaller protoconch (width 600–670 µm, versus 700–770 µm), in being smaller relative to the number of whorls, and in that the primary axial ribs are distinctly stronger (less silken) after the first half of the second teleoconch whorl. All three species are locally sympatric.

See remarks under *Granallodiscus granum* for comments on anatomy.

ETYMOLOGY: Abacus, arithmetical board (Greek), alluding to the colour pattern. Noun in apposition.

***Granallodiscus granum* (L. Pfeiffer, 1857) new combination**

(Figs 26G, 32F–J, 33B)

Helix granum Pfeiffer, 1857: 107; Pfeiffer, 1859: 20; Martens, 1873: 12.

Helix (Thalassia) granum.—Hector, 1873: 5.

Nanina (Thalassia) granum.—Pfeiffer & Clessin, 1881: 46.

Helix granum.—Hutton, 1880: 20.

Charopa miranda Hutton, 1883a: 476 (in part = *G. mayhillae* n.sp.); Hutton, 1884a: 180, pl. 9, fig. W, pl. 11, fig. S (in part = *G. mayhillae*); Freeman *et al.*, 1996: 31.

Psyra miranda.—Hutton, 1884b: 202 (in part *G. mayhillae*); Suter, 1892a: 272.

?*Helix granum*.—Hutton, 1884a: 170, pl. 9, fig. L (indeterminable from reference).

?*Fruticicola pilula* var. *granum*.—Hutton, 1884b: 194 (indeterminable from reference).

?*Charopa (Thalassia) iota granum*.—Tryon, 1886: 212 (indeterminable from reference).

Gerontia (Allodiscus) miranda.—Pilsbry, 1892b: 68, pl. 22, figs 40–42.

Allodiscus mirandus.—Hedley & Suter, 1893: 639; Suter, 1893: 152.

Flammulina (Allodiscus) miranda.—Pilsbry, 1893: 15; Suter, 1894b: 146; Suter, 1894d: 252 (in part = *G. mayhillae* + *G. abaxoides* n.sp.); Suter, 1901: 209.

Allodiscus granum.—Suter, 1913: 641, pl. 9, figs 3a,b (in part = *G. mayhillae* + *G. abaxoides*); Powell, 1937: 88; Powell, 1946: 92; Powell, 1957: 117; Powell, 1962: 110; ?Gardner, 1975: 119; Powell, 1976: 117; Goulstone, 1978: 6, text fig.; Powell, 1979: 320 (in part = *G. mayhillae* + *G. abaxoides*); ?Goulstone, 1980b: 5; ?Goulstone, 1981b: 9; ?Goulstone, 1984: 1; Spencer & Willan, 1996: 40.

Allodiscus (Allodiscus) granum.—Climo, 1969b: 34, figs 2a, 3, 12k, 19a–c, 23a,f, 25a (in part + *G. abaxoides* + *G. mayhillae*).

Allodiscus (Allodiscus) miranda.—Climo, 1969b: 36, figs 2a, 3, 23g, 25a.

Allodiscus miranda.—Goulstone, 1985: 7, text fig. 4 (probably in part = *G. mayhillae* + *G. abaxoides*).

Rotadiscid *granum*? Worthy & Holdaway, 1995: 365.

NOT *Phenacohelix granum*.—Hedley & Suter, 1893: 642 (= *G. mayhillae* + *G. abaxoides*).

NOT *Flammulina (Phenacohelix) granum*.—Suter, 1894b: 145 (= *G. mayhillae* + *G. abaxoides*); Suter, 1894d: 249 (= *G. mayhillae* + *G. abaxoides*).

NOT *Allodiscus granum*.—Whitten, 1957: 2 (= *G. mayhillae*); Parkinson, 1974: 174 (= *G. abaxoides* and/or *G. mayhillae*); Goulstone, 1981a: 6 (= *G. mayhillae*); Barker & Mayhill, 1999: 238 (= *G. mayhillae*).

TYPE MATERIAL: *Helix granum* – neotype (here selected) the lectotype of *Charopa miranda* CM M12780 (see below): South Island, Greymouth, R. Helms = SE of Greymouth, Arthur's Pass, Turiwhate Falls rest area (see below).

Charopa miranda – lectotype (here selected: 3.73 × 2.80 mm) CM M12780, and 1 paralectotype CM M239: South Island, Greymouth, R. Helms. Type locality here selected as SE of Greymouth, Arthur's Pass, Turiwhate Falls rest area. The other paralectotypes (4, CM M12785) are *G. mayhillae* n.sp. (see below).

MATERIAL EXAMINED (66 lots): Type material (see above), M.2512 (6), M.14402 (2), M.22322 (5), M.24654 (1), M.25281 (1), M.25286 (4), M.25306 (1), M.25308 (1), M.25527 (1), M.29936 (1), M.30302 (2), M.30544 (1), M.30550 (1), M.36350 (3), M.37020 (1), M.37857 (1), M.46877 (5), M.46881 (3), M.76877 (3), M.79946 (1), M.89239 (1), M.89878 (2), M.92677 (1), M.98659 (1), M.98847 (1), M.99055 (1), M.103573 (1), M.103611 (many), M.104098 (1), M.104185 (11), M.105467 (1), M.108002 (many), M.108079 (3), M.109687 (8), M.115239 (1), M.115273 (1), M.115286 (4), M.115352 (1), M.120344 (3), M.120576 (1), M.120604 (3), M.120845 (4), M.121017 (1), M.122391 (2), M.122437 (1), M.122736 (2), M.122791 (5), M.128712 (10), M.128715 (15), M.128717 (4), M.156771 (2), M.156775 (1), M.159002 (1), M.159941 (1), M.161063 (1), M.161697 (8), M.162817 (2), M.164584 (5), M.164613 (1), M.169380 (1), M.170117 (1), M.170118 (3), M.170119 (3).

REDESCRIPTION: Shell up to 3.80 mm wide, wider than high (HWR 0.65–0.76), spire strongly elevated (26–34% SH), thin, very narrowly umbilicate or anomphalous (< 5% SW). Protoconch and teleoconch ground translucent white, teleoconch with yellowish-brown pattern;

maculations of irregular width and spacing on spire above insertion; fine diagonal chequer-board pattern on sides and base below insertion.

Protoconch relatively strongly elevated, of 1.25 convex whorls, 700–770 µm wide, sculptured throughout with numerous fine, crisp, densely crowded spiral threads surmounted by minute, irregular, sharp conical spines.

Teleoconch of up to 3.30 convex, rather evenly expanding whorls; spire whorls strongly convex; sides broadly convex, smoothly curving around periphery over base, more tightly rounded where entering umbilicus. With the exception of the narrow, more or less smooth subsutural channel, sculptured throughout with prominent primary axial ribs; these overlain by much finer, closer spiral threads and fine axial periostracal lamellae that form a reticulate pattern, spirals finely nodular at intersections; periostracal lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Primary axial ribs widely and regularly spaced on first 1.30–1.50 whorls, then much finer, more crowded and imparting a silken texture, transition rapid. Spiral threads strongest on surface entering umbilicus, absent from narrow subsutural zone that extends beyond subsutural channel, broader, more widely spaced and less crisply defined on adapical third of spire whorls than elsewhere. Axial sculpture weakly sigmoidal. Umbilicus fully open or invaded by inner lip at maturity. Aperture simple; outer lip weakly and evenly thickened within, inner lip thicker.

DISTRIBUTION: Southeastern North Island and northern South Island (Fig. 33B).

BIOLOGY: *Granallodiscus granum* is widely distributed geographically and environmentally. It has been recorded between elevations of 10 m and 1800 m, with habitat correspondingly ranging from lowland broadleaved shrublands and forests, montane broadleaved/podocarp and *Nothofagus* forests, to subalpine scrub and tussocklands. The species is a ground-dweller, occurring predominately in leaf litter but also recorded from moss, under logs and boulders, and from rock crevices.

CONSERVATION STATUS: Being widely distributed and not uncommon, our assessment is that *Granallodiscus granum* is not of immediate conservation concern.

REMARKS: As indicated by their respective synonymies, *Granallodiscus granum* of authors is here considered to include two additional species, *G. abaxoides* n.sp. and *G. mayhillae* n.sp., which are locally sympatric (they are differentiated from *G. granum* in their respective 'Remarks' sections).

The six syntypes of *Charopa miranda* comprise two species, only one of which (2 specimens) agrees with Hutton's (1884a) description in having 'rather distant ... ribs, which get closer and after the third whorl are very close', and it is from these that we have selected the lectotype. *Charopa miranda* has traditionally been interpreted as a junior synonym of *Helix granum* (e.g. Powell 1979; Suter 1913), the type material of which, however, cannot be traced (not at BMNH, J. Ablett, pers. comm., 2006), and it is quite unrecognisable from the original description (Pfeiffer 1857). The dimensions of the lectotype of *Charopa miranda* are closely accordant with Pfeiffer's given dimensions for *Helix granum* (3.90 × 2.80 mm and 4.00 × 3.00 mm; height/width ratios 0.72 and 0.75, respectively). To maintain stability, we have selected the lectotype of *Charopa miranda* as the neotype of *Helix granum*, thus ensuring that synonymy is absolute and unequivocal. *Granallodiscus granum* does not live in the immediate vicinity of Greymouth, however, and we have selected Turiwhate Falls rest area, Arthur's Pass, some 30 km southeast of Greymouth, where a form identical to the lectotype of *G. miranda* occurs (e.g. M.89239).

The jaw and radular dentition descriptions by Hutton (1884a) under *miranda* Hutton, 1883 and *Helix granum* may equally apply to *granum* Pfeiffer, 1857, *abaxoides* n.sp. and *mayhillae* n.sp., as we have been unable to locate Hutton's dissected material. The *granum sensu* Climo (1969b) comprised a complex of these three species. However, his descriptions of the reproductive anatomy and radular dentition were evidently based on material he collected from Ashley Gorge, Canterbury (M.30550), which we have confirmed as *Granallodiscus granum*. The radular formula given is 9–15 + 8–9 + 1 + 8–9 + 9–15. Central tooth tricuspid, the mesocone extending about three-quarters the length of the basal plate, flanked either side by a subobsolete accessory cusp. Lateral teeth initially indistinctly tricuspid with subobsolete endocone, but becoming bicuspid by suppression of this endocone; mesocone prominent, extending to the foot of the basal plate. Marginal teeth with 3–4 cusps, claw-like. Reproductive system characterised by the bursa copulatrix duct narrow at origin in oviduct, broadening somewhat basally, then tapering gradually to slender, long duct to bursa sac; vagina moderately long, stout; penis long, comprising a bulkier, cylindrical proximal part and a slender, short distal part running to atrium; proximal penis with penial retractor muscle and vas deferens inserting independently at weakly bifurcated apex region, which internally is lined with a finely papillate epithelium; the remainder of the proximal penis

dominated internally by a large, fleshy stimulator arising from the lateral wall below the opening of the vas deferens.

***Granallodiscus mayhillae* new species**

(Figs 26F, 32K–O, 33C)

Charopa miranda Hutton, 1883a: 476 (in part); Hutton, 1884a: 180 (in part).

Psyra miranda.– Hutton, 1884b: 202 (in part).

Phenacohelix granum.– Hedley & Suter, 1893: 642 (not of Pfeiffer, 1857, in part = *G. abaxoides* n.sp.).

Flammulina (Allodiscus) miranda.– Suter, 1894d: 252 (not of Hutton, in part = *G. abaxoides*).

Allodiscus granum.– Suter, 1913: 641 (in part of Pfeiffer + *G. abaxoides*); Whitten, 1954: 15 (not of Pfeiffer); Whitten, 1957: 2 (not of Pfeiffer); Goulstone & Gardner, 1976: 4, text fig. (not of Pfeiffer); Goulstone, 1977b: 17, text fig. (not of Pfeiffer); Spencer, 1977: 7 (not of Pfeiffer); Goulstone, 1979b: 25, text figs (not of Pfeiffer); Powell, 1979: 320 (in part of Pfeiffer + *G. abaxoides*); Goulstone, 1980c: 1 (not of Pfeiffer); ?Goulstone, 1981a: 6 (not of Pfeiffer); Goulstone, 1983a: 6, text figs (not of Pfeiffer); Goulstone, 1991b: 6 (not of Pfeiffer); Barker & Mayhill, 1999: 238 (not of Pfeiffer); Mahlfeld, 2000: appendix 2 (not of Pfeiffer).

Flammulina (Phenacohelix) granum.– Suter, 1894d: 249 (not of Pfeiffer, in part = *G. abaxoides*).

Allodiscus (Allodiscus) granum.– Climo, 1969b: 34 (in part of Pfeiffer + *G. abaxoides*).

Allodiscus cf. *granum*.– Mayhill, 1982: 12, text fig. (not of Pfeiffer); Mayhill, 1994: 31 (not of Pfeiffer).

Allodiscus aff. *granum*.– Solem *et al.*, 1981: 478.

Allodiscus miranda.– Parkinson, 1970: 139 (not of Hutton); Mayhill & Broomfield, 1982: 8 (not of Hutton); Goulstone, 1990: 31, text figs (not of Hutton); Mahlfeld, 2000: appendix 3 (not of Hutton); Hazelwood *et al.*, 2002: 30 (not of Hutton).

Allodiscus 'miranda'.– Mayhill, 1994: 58, text fig. (not of Hutton, 1883).

TYPE MATERIAL: Holotype NMNZ M.78739 and paratypes M.168543 (6), AIM AK 73286 (1): North Island, NW of Hamilton, Hakirimata Track, 200 m (NZMS 260 S14/006967), Aug. 1982, P.C. Mayhill. Additional paratypes: Hakirimata Track, 1982, P.C. Mayhill, M.168603 (-50), Sep. 1983, P.C. Mayhill, M.168760 (9).

MATERIAL EXAMINED (210 lots): Type material (see above), paralectotypes of *Charopa miranda* CM M12785 (4); M.4085 (5), M.13420 (2), M.13434 (1), M.14038 (1),

M.22301 (1), M.23583 (1), M.23584 (2), M.24029 (1), M.24447 (4), M.28824 (1), M.28892 (3), M.29100 (1), M.29108 (2), M.29919 (1), M.29946 (1), M.30298 (8), M.30300 (1), M.30301 (3), M.30306 (1), M.30311 (6), M.30314 (8), M.30316 (1), M.30364 (1), M.30537 (1), M.30538 (1), M.30540 (4), M.30542 (7), M.30548 (1), M.30549 (1), M.30894 (1), M.31241 (4), M.36388 (12), M.39064 (3), M.39104 (3), M.39134 (2), M.39170 (6), M.39205 (3), M.39263 (5), M.39304 (4), M.45666 (2), M.45741 (many), M.45797 (3), M.45885 (1), M.47214 (7), M.47577 (5), M.47614 (2), M.47761 (1), M.48082 (1), M.48290 (2), M.51880 (2), M.51923 (1), M.55178 (2), M.55547 (3), M.55587 (1), M.55689 (2), M.55958 (1), M.55989 (1), M.56551 (1), M.56793 (4), M.56841 (2), M.57393 (1), M.57583 (2), M.57747 (1), M.57886 (2), M.58215 (2), M.61538 (2), M.68090 (1), M.68939 (2), M.69149 (1), M.69341 (6), M.69862 (1), M.70130 (1), M.70286 (2), M.70306 (1), M.70640 (5), M.72312 (4), M.72473 (2), M.72589 (2), M.72993 (many), M.73951 (1), M.73994 (many), M.76309 (1), M.76679 (10), M.77482 (2), M.77622 (1), M.77745 (many), M.77817 (2), M.78435 (2), M.78574 (20), M.78739 (1), M.79069 (2), M.79692 (1), M.79749 (1), M.80000 (1), M.80943 (14), M.81044 (9), M.81631 (1), M.81908 (6), M.81965 (1), M.82589 (7), M.82637 (1), M.83033 (1), M.85392 (1), M.89238 (3), M.92647 (1), M.92718 (1), M.92943 (3), M.96733 (many), M.97119 (1), M.97374 (3), M.97764 (1), M.97806 (1), M.98312 (1), M.98373 (6), M.98600 (2), M.98710 (1), M.98731 (1), M.99750 (1), M.99922 (1), M.100727 (22), M.101246 (5), M.101734 (4), M.102647 (1), M.102689 (2), M.102719 (2), M.102794 (1), M.103114 (4), M.103145 (4), M.103193 (6), M.103394 (1), M.103707 (1), M.104069 (1), M.104766 (1), M.105300 (2), M.105536 (8), M.105626 (many), M.105844 (9), M.106245 (2), M.106285 (4), M.106416 (4), M.106607 (3), M.106968 (1), M.107020 (2), M.107042 (1), M.107117 (3), M.107882 (6), M.107916 (18), M.107984 (5), M.108138 (18), M.108230 (30), M.109789 (15), M.114497 (1), M.114584 (3), M.115046 (9), M.115093 (1), M.115192 (4), M.115212 (30), M.116079 (1), M.116774 (1), M.120276 (1), M.120724 (1), M.121221 (2), M.121238 (3), M.121745 (4), M.123621 (2), M.123638 (1), M.123783 (2), M.124172 (2), M.124516 (2), M.124524 (1), M.124525 (1), M.124927 (1), M.128661 (1), M.146850 (2), M.156777 (4), M.156780 (1), M.156782 (1), M.156825 (20), M.156827 (2), M.156831 (2),

M.156835 (8), M.156838 (2), M.156842 (many), M.157479 (1), M.157499 (2), M.157941 (1), M.157966 (2), M.159428 (2), M.159452 (1), M.159597 (1), M.159600 (1), M.159654 (1), M.159813 (1), M.159895 (1), M.161272 (2), M.165698 (1), M.165991 (1), M.168214 (1), M.168882 (3), M.170124 (1), M.170125 (2), M.177463 (1), M.177464 (1), M.177537 (8).

DESCRIPTION: Shell up to 3.35 mm wide, wider than high (HWR 0.69–0.76), spire strongly elevated (25–36% SH), thin, narrowly umbilicate (<4.4% SW), partly overhung by inner lip. Protoconch and teleoconch ground translucent white, teleoconch with reddish-brown to yellowish-brown pattern; maculations of irregular width and spacing on spire above insertion; fine diagonal chequer-board pattern on sides and base below insertion.

Protoconch relatively strongly elevated, of 1.25 convex whorls, 660–700 µm wide, sculptured throughout with about 20 fine, crisp, densely crowded spiral threads surmounted by minute, irregular, sharp conical spines.

Teleoconch of up to 3.40 convex, rather evenly expanding whorls; spire whorls strongly convex; sides broadly convex, smoothly curving around periphery over base, more tightly rounded where entering umbilicus. With the exception of the narrow, more or less smooth subsutural channel, sculptured throughout with fine, close primary axial ribs that impart a silken texture; and much finer, closer, spiral threads and axial periostracal lamellae that form a reticulate pattern, spirals finely nodular at intersections; periostracal lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Primary axial ribs slightly but distinctly stronger and more widely spaced on first 2 whorls than on subsequent whorls. Spiral threads strongest on surface entering umbilicus, absent from narrow subsutural zone that extends beyond subsutural channel, broader, more widely spaced and less crisply defined on adapical third of spire whorls than elsewhere. Axial sculpture weakly sigmoidal. Aperture simple; outer lip weakly and evenly thickened within, inner lip thicker.

DISTRIBUTION: North and South Islands (Fig. 33C).

BIOLOGY: *Granallogiscus mayhillae* is widely distributed both geographically and environmentally. The species occurs in leaf litter, under stones and rotten logs, in rock rubble and on ledges of escarpments in habitats ranging from coastal and other lowland broadleaved shrublands and forests, and montane broadleaved and *Nothofagus* forests, to subalpine tussocklands and scrublands to about 1100 m elevation.

CONSERVATION STATUS: *Granallogiscus mayhillae* is widely

distributed and not uncommon. Our assessment is that the species is not of immediate conservation concern.

REMARKS: Compared with *Granallogiscus granum* (L. Pfeiffer, 1857), *G. mayhillae* differs in being smaller relative to the number of whorls, and in having much finer and closer primary axial ribs on the first 1.5 teleoconch whorls, and slightly but distinctly coarser primary axial ribs (less silken) on subsequent whorls. Compared with *Granallogiscus abaxoides* n.sp., *G. mayhillae* differs principally in having finer and more closely spaced primary axial ribs on the first two teleoconch whorls. All three species are locally sympatric.

Cumber (1961) mistakenly interpreted *Phenacohelix granum sensu* Hedley & Suter (1893) as a synonym of *Phenacohelix pilula* (Reeve, 1852).

See remarks under *Granallogiscus granum* for comments on anatomy.

ETYMOLOGY: Named in honour of the outstanding collector, the late Pauline Mayhill, who personally collected more of the material under study here than any other individual. Noun in the genitive case.

Genus *Hirsutodiscus* Climo, 1971

Hirsutodiscus Climo, 1969b: 61 (as subgenus of *Allodiscus* Pilsbry, 1892) (not available: ICZN Article 8).

Hirsutodiscus Climo, 1971a: 98 (as subgenus of *Allodiscus* Pilsbry, 1892). Type species (by original designation): *Allodiscus (Hirsutodiscus) rakiura* Climo, 1971; Recent, Stewart Island, New Zealand.

DIAGNOSIS: Shell small (maximum width 3.15 mm), high (HWR 0.73–0.76), spire strongly elevated (32–33% SH). Very narrow umbilicus overhung by inner lip. Protoconch medium sized (width 570–630 µm), essentially smooth. Teleoconch with rows of periostracal spines; axially banded on spire, bands transforming to a diagonal chequer-board pattern that extends over side and base.

Aulcopod, able to withdraw completely into the shell. Foot long, narrow, projecting behind shell in crawling animal; with distinct pedal grooves; truncated posteriorly, with a caudal pit below a short horn. Jaw stegognathic. Radula with tricuspid central tooth and bicuspid lateral teeth. Reproductive system hermaphroditic, gonad with two clusters of acini; spermoviduct condition with female and male pallial gonoducts fused; bursa copulatrix on a long duct that is dilated at origin from atrium; epiphallus not externally differentiated from vas deferens; penis simple, with apical attachment of retractor muscle, and subapical insertion of

vas deferens; penis invested with a thin muscular sheath.

REMARKS: The distinctive combination of shell characters, notably the smooth protoconch and the presence of periostracal hairs, suggest that *Hirsutodiscus rakiura* (Climo, 1971) is not closely related to any of the species treated herein. Its true relationships, however, are unknown.

Anatomical aspects of the generic diagnosis have been drawn from the information provided by Climo (1969b, 1971a).

***Hirsutodiscus rakiura* (Climo, 1971) new combination**

(Figs 26I, 30F, 34A–E)

Allodiscus (*Hirsutodiscus*) *rakiura* Climo, 1969b: 61, figs 1B, 11A–C, 20F–G (not available: ICZN Article 8); Climo, 1971a: 98, figs 1C,D, 2A–C; Powell, 1976: 117; Powell, 1979: 321; Spencer & Willan, 1996: 40; Marshall, 1996: 39; Schileyko, 2001: 1018, fig. 1335.

TYPE MATERIAL: Holotype NMNZ M.22460 and paratypes M.22461 (2): Stewart Island, Baker Park, 4 Feb. 1968, F.M. Climo.

MATERIAL EXAMINED (6 lots): Type material (see above), M.21981 (1), M.25284 (1), M.61977 (1), M.157071 (4).

REDESCRIPTION: Shell up to 3.15 mm wide, wider than high (HWR 0.73–0.76), spire strongly elevated (32–33% SH), thin, very narrow umbilicus overhung by inner lip. Protoconch colourless and translucent; teleoconch ground translucent white, colour pattern of reddish-brown maculations of irregular width and spacing on spire above suture, which transform to diagonal chequer-board pattern extending over sides and base, evanescent over inner third of base.

Protoconch moderately elevated, of 1.30–1.40 convex whorls, 570–630 µm wide, glossy, essentially smooth.

Teleoconch of up to 3.30 convex, rather evenly expanding whorls; spire whorls strongly convex; sides broadly convex, smoothly curving around periphery over base, more tightly rounded where entering narrow umbilicus. Sculptured throughout with fine, close primary axial ribs, and much finer, closer spiral threads and thin axial periostracal lamellae that form a reticulate pattern, axial lamellae commencing from adapical third thread (thus effectively forming narrow sutural channel), spirals finely nodular at intersections; periostracal lamellae at summit and borders of each primary axial stronger than interstitial lamellae, that at summit strongest and produced as short hairs in 9 or 10 rather evenly spaced rows over spire, periphery and base. Spiral threads strongest on surface entering umbilicus, broader, more widely spaced and less crisply defined on adapical third

of spire whorls than elsewhere. Axial sculpture weakly sigmoidal. Aperture simple; outer lip weakly and evenly thickened within, inner lip thicker.

DISTRIBUTION: Stewart Island (Fig. 30F).

BIOLOGY: *Hirsutodiscus rakiura* occurs in the litter of low-land broadleaved/podocarp forests.

CONSERVATION STATUS: *Hirsutodiscus rakiura* has been overlooked in previous assessments of the conservation status of New Zealand landsnails. The species is evidently confined to northeastern Stewart Island, and thus must be regarded as ‘range restricted’ according to the criteria of Molloy *et al.* (2002).

REMARKS: *Hirsutodiscus rakiura* is unique among taxa under consideration here in combining a smooth protoconch, periostracal hairs, and a chequer-board colour pattern on the sides and base.

The radular dentition and the reproductive system of *Hirsutodiscus rakiura* were described and illustrated by Climo (1969b, 1971a). The radular formula was given as 13–14 + 5–6 + 1 + 5–6 + 13–14. Central tooth tricuspid. Lateral teeth bicuspid by suppression of the endocone. Marginal teeth multicuspid. Reproductive system characterised by bursa copulatrix on a long duct that is dilated at origin from atrium; vagina absent; penis cylindrical, modestly dilated medially, tapering apically to attachment of the retractor muscle, and with subapical insertion of the vas deferens; penis invested with a thin muscular sheath.

Genus *Pseudallodiscus* Climo, 1971

Pseudallodiscus Climo, 1969b: 63 (not available: ICZN Article 8).

Pseudallodiscus Climo, 1971a: 99. Type species (by original designation): *Pseudallodiscus ponderi* Climo, 1971; Recent, New Zealand.

DIAGNOSIS: Shell small (maximum width 3.5 mm), wider than high (HWR 0.53), spire weakly elevated (14% SH). Narrow umbilicus partially overhung by columellar reflection. Protoconch moderate in size (width 740 µm), sculptured with weak, opisthocyrt-prosocline, anastomosing axial riblets, each surmounted by periostracal blade, and fine spiral threads. Teleoconch with prominent, weakly sigmoidal primary axial ribs, interspersed with secondary axial riblets, overlaid by fine spiral threads.

Radular formula 13 + 12 + 1 + 12 + 13; central tooth tricuspid, central cusp projecting about halfway down basal

plate; lateral teeth bicuspid by suppression of inner cusp; marginal teeth multicuspid.

Hermaphroditic reproductive system characterised by bilobate gonad; the duct of the bursa copulatrix broad at base and gradually narrowing to reservoir; a large diverticulate process on the vagina; and long, club-shaped penis, with apical insertion of the vas deferens and attachment of the penial retractor muscle.

REMARKS: The type species of *Pseudallodiscus*, *Pseudallodiscus ponderi* Climo, 1971, is highly distinctive among New Zealand charopids in combining teleoconch facies and a chequer-board colour pattern that are extremely similar to those of species here referred to *Allodiscus* (*s. lat.*) groups B (*tullia*) and C (*climoi*), with a protoconch sculpture of axial riblets. Three additional species with shell facies like those of *Pseudallodiscus ponderi* are described below, these differing from *P. ponderi* in being uniform buff or having a colour pattern of wavy axial bands, and in that the axial riblets on the protoconch are stronger and non-anastomosing, while the spiral threads are considerably finer and crisper. We consider that two groups are involved here, which have independently acquired axial protoconch sculpture through heterochronic predisplacement of axial sculpture, quite possibly from common ancestors of species here referred to *Allodiscus* (*s. lat.*) groups B (*tullia*), C (*climoi*) or E (*tessellatus*).

Pseudallodiscus spelaeus Climo, 1971 was transferred to *Mocella* Iredale, 1915 by Climo (1981), with whom we concur. Above, we have assigned *Pseudallodiscus tataensis* Climo, 1971 to *Allodiscus* Group D. With these transfers, *Pseudallodiscus* is secondarily monotypic and we have taken the opportunity to redefine the genus.

***Pseudallodiscus ponderi* Climo, 1971**

(Figs 26J, 30C, 34F–J)

Psyra adriana.—Suter, 1892a: 272 (not of Hutton, 1883).

Allodiscus adriana.—Hedley & Suter, 1893: 639 (in part of Hutton); Suter, 1913: 637 (in part of Hutton + *A. tessellatus* Powell, 1941).

Flammulina (*Allodiscus*) *adriana*.—Suter, 1894b: 146 (in part of Hutton); Suter, 1894d: 252 (in part of Hutton).

Pseudallodiscus ponderi Climo, 1969a: 64, figs 1B, 10A–C, 21A–E (not available: ICZN Article 8); Climo, 1971a: 101, figs 3A–C, 4A–E; Powell, 1976: 117; Powell, 1979: 322; Marshall, 1996: 39; Spencer & Willan, 1996: 41; Schileyko, 2001: 1018, fig. 1336.

TYPE MATERIAL: Holotype NMNZ M.22455: North Island, Wellington, Silverstream, Keith George Memorial Park

(NZMS 260 R27/777053), *Nothofagus* litter, 14–18 Oct. 1967, F.M. Climo & W.F. Ponder. Paratype (formerly M.22456) lost.

MATERIAL EXAMINED (85 lots): Type material (see above), M.22239 (2), M.23350 (1), M.24653 (2), M.24732 (1), M.24733 (1), M.24735 (2), M.24736 (1), M.24747 (1), M.24962 (7), M.25171 (1), M.25186 (2), M.25226 (1), M.25249 (2), M.25415 (3), M.29682 (2), M.31517 (1), M.31518 (4), M.31519 (4), M.31520 (3), M.31521 (3), M.31522 (2), M.31523 (2), M.31524 (1), M.31525 (1), M.32004 (1), M.32013 (1), M.37798 (5), M.46991 (1), M.47147 (4), M.47802 (3), M.47851 (15), M.47910 (1), M.48042 (2), M.48478 (5), M.48490 (1), M.48598 (20), M.48645 (1), M.51755 (3), M.52051 (2), M.56237 (5), M.56267 (2), M.56303 (5), M.56474 (7), M.56937 (11), M.61866 (1), M.68035 (3), M.68106 (1), M.69011 (12), M.69918 (2), M.72239 (2), M.72926 (3), M.73366 (1), M.75548 (20), M.75678 (1), M.78840 (1), M.79754 (3), M.79816 (4), M.79848 (3), M.85044 (1), M.85492 (1), M.88611 (6), M.88733 (2), M.88742 (9), M.88757 (2), M.88799 (3), M.92632 (2), M.98072 (5), M.98418 (3), M.101434 (3), M.101770 (1), M.102951 (6), M.104214 (1), M.106723 (1), M.115777 (3), M.116140 (2), M.116520 (1), M.120313 (1), M.120359 (5), M.169683 (2), M.169988 (1), M.170146 (1), M.170151 (4), M.170186 (1), M.175253 (1).

REDESCRIPTION: Shell up to 3.7 mm wide, wider than high (HWR 0.53), thin, spire weakly elevated (14% SH); umbilicus very narrow, partly occluded by inner lip (width <5% SW). Protoconch uniform pale translucent buff. Teleoconch translucent pale buff, with narrow sutural zone of yellowish-brown maculations that rapidly transform to chequer-board tessellations that extend over periphery and base.

Protoconch weakly elevated, of about 1.20 convex whorls, 740 µm wide, sculptured with weak, weakly opisthocyrt-prosocline, anastomosing axial riblets, each surmounted by a periostracal blade, and with *c.* 30 low, rounded, crowded spiral threads. Teleoconch of up to 2.30 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and weaker axial threads, each of the latter surmounted by a periostracal lamella that is more prominent than spiral threads, spiral threads finely beaded at intersections with axials, lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal.

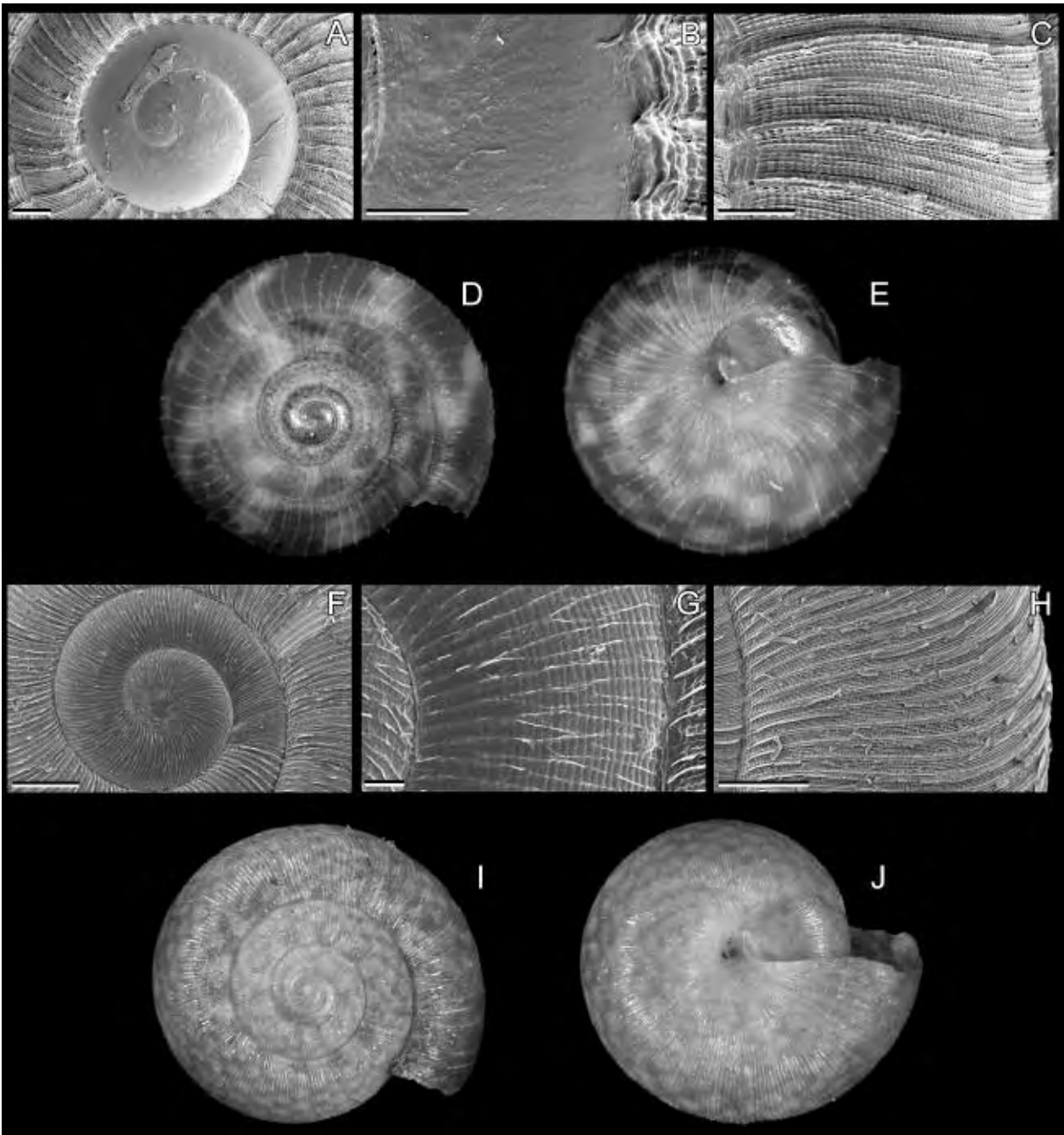


Fig. 34 Shells of *Hirsutodiscus* and *Pseudallodiscus* species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Hirsutodiscus rakiura* (Climo, 1971), Stewart Island, N of Oban, Garden Mound, M.157071 (D, E, 1.90 × 2.75 mm); F–J, *Pseudallodiscus ponderi* Climo, 1971, E of Otaki, Pokuhou Hill, M.72926 (F, G), and E of Wellington, Lake Pounui, M.116520 (1.95 × 3.70 mm). Scale bars 30 µm (G), 50 µm (B), 100 µm (A, C, F), 200 µm (H).

Aperture simple, rim thin, outer lip weakly and evenly thickened within, inner lip rapidly and rather strongly thickened within.

DISTRIBUTION: Southern North Island, and Kapiti Island (Fig. 30C).

BIOLOGY: *Pseudallodiscus ponderi* is a litter-dwelling detritivore of broadleaved shrublands, *Nothofagus* forests and mixed broadleaved/podocarp forests, from near sea-level to above 1300 m elevation.

CONSERVATION STATUS: *Pseudallodiscus ponderi* is widely distributed and not uncommon. Our assessment is that the species is not of immediate conservation concern.

Genus *Costallogiscus* new genus

Type species: *Costallogiscus kaikoura* n.sp. Recent, north-eastern South Island, New Zealand.

DIAGNOSIS: Shell small (maximum width 3.55–4.50 mm), wider than high (HWR 0.52–0.61), spire weakly elevated (10.5–25% SH). Narrow umbilicus partially occluded by inner lip or fully open, overhung by columellar reflection, or fully invaded by inner lip. Protoconch 560–1100 µm wide, sculptured with crisp, weakly prosocline axial riblets and with fine, crisp spiral threads. Teleoconch with prominent, shallowly sigmoidal primary axial ribs, and weak (mostly periostracal) secondary axial riblets overlain by fine spiral threads.

REMARKS: The three species we refer below to *Costallogiscus* resemble *Pseudallodiscus ponderi* Climo, 1971 in having axial sculpture on the protoconch, but differ in that the axial riblets on the protoconch are stronger and non-anastomosing, in that the spiral threads on the protoconch are considerably finer and crisper, and in that the teleoconch is uniform buff or has a colour pattern of wavy axial bands. We consider that two groups are involved here, in which axial protoconch sculpture has evolved independently through heterochronic predisplacement of axial sculpture, quite possibly from one or two of the groups with spiral protoconch sculpture.

ETYMOLOGY: Combination of *costa* (Latin = rib) and generic name *Allodiscus*.

Costallogiscus kaikoura new species

(Figs 26L, 33D, 35A–E)

Charopidae sp. 57 (NMNZ M.32416) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.273933 and paratypes M.166536 (3): South Island, Seaward Kaikoura Range, George Stream, 500 m (NZMS 260 P30/754003), Jan. 1988, P.C. Mayhill. Additional paratypes: NE of Kaikoura, roadside 1.5 km W of Mt Alexander, 6 Sep. 1980, D.J. Roscoe, M.121013 (2); W of Kaikoura, N of Charwell River fork, 4 Apr. 1983, D.J. Roscoe, M.124093 (2); NW of Kaikoura, Fyffe Palmer Scenic Reserve, Mar. 1989, P.C. Mayhill, M.164561 (1); SW of Ward, Sawcut Gorge, Isolation Creek, Apr. 1988, P.C. Mayhill, M.166491 (4).

MATERIAL EXAMINED (23 lots): Type material (see above), M.24734 (5), M.31056 (3), M.32416 (8), M.69700 (12), M.69715 (10), M.85845 (1), M.93094 (1), M.96835 (1), M.100026 (1), M.107301 (2), M.107401 (2), M.108368 (3), M.108381 (2), M.114364 (1), M.121008 (1), M.124093 (2), M.166507 (2).

DESCRIPTION: Shell up to 3.60 mm wide, wider than high (HWR 0.56–0.61), thin, spire weakly elevated (10.5–25.0% SH); umbilicus very narrow (width 4.20–4.90% SW). Protoconch translucent pale buff; teleoconch translucent pale buff with pale wavy yellowish-brown bands extending over spire and base.

Protoconch weakly elevated, of 0.90–1.10 convex whorls, 560–620 µm wide, crisply sculptured throughout with fine, weakly prosocline axial riblets, each surmounted by a prominent periostracal blade, and fine, crisp, widely spaced interstitial spiral threads.

Teleoconch of up to 3.20 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and weaker axial threads, the latter surmounted by periostracal lamellae, spiral threads very finely beaded at intersections with axials, lamellae at summit and borders of each primary axial rib stronger than lamellae at summits of interstitial axial threads, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, rim thin, outer lip weakly and evenly thickened within, inner lip rapidly and rather strongly thickened within.

DISTRIBUTION: Northeastern South Island (Fig. 33D).

BIOLOGY: *Costallogiscus kaikoura* is a litter-dweller, predominantly in mixed broadleaved shrublands and mixed broadleaved/podocarp forests from near sea-level to about 760 m elevation.

CONSERVATION STATUS: *Costallogiscus kaikoura* is rather widely distributed and not uncommon in the Kaikoura area in northeastern South Island. Our assessment is that the species is not of immediate conservation concern.

REMARKS: This and the following two species are immediately separable from *Pseudallodiscus ponderi* Climo, 1971, which also has an axially ribbed protoconch, in having stronger axial and spiral sculpture on the protoconch, and in lacking a pronounced chequer-board colour pattern on the teleoconch whorls.

ETYMOLOGY: After the type locality. Noun in apposition.

Costallogiscus parrishi new species

(Figs 26M, 33E, 35F–J)

Allodiscus sp. Goulstone *et al.*, 1993: 16, text figs.

Allodiscus sp. 'Te Paki' Brook, 1999b: 389, 390; McGuinness, 2001: 637.

Charopidae sp. 165 (NMNZ M.99147) Brook, 2002b: 94; Hitchmough *et al.*, 2007: 34; Spencer *et al.*, in press.

Charopidae sp. 5 (NMNZ M.99147) Hitchmough, 2002: 47.

TYPE MATERIAL: Holotype NMNZ M.99147: North Island, SE of Cape Reinga, Tapotupotu Bush (NZMS 260 M02/840510), 19 Mar. 1988, G.R. Parrish. Paratypes: Tom Bowling Bay, W of Matakana Pā site, Apr. 1983, P.C. Mayhill, M.79605 (1); SE of Cape Reinga, Tapotupotu Bay, O.J. Marston, M.76590 (1).

MATERIAL EXAMINED (4 lots): Type material (see above), M.99192 (1).

DESCRIPTION: Shell up to 3.55 mm wide, wider than high (HWR 0.52–0.56), thin, spire moderately elevated (25% SH); umbilicus very narrow, partly occluded by inner lip (width <2.8% SW). Uniform pale translucent buff.

Protoconch weakly elevated, of about 1.30 convex whorls, 1000 µm wide, crisply sculptured with fine, rather regularly spaced, weakly prosocline radial riblets traversed by finer, more closely spaced spiral threads, the spirals wavy on first half-whorl then normalising.

Teleoconch of up to 2.50 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs and weaker axial threads; these overlain by fine, crisp spiral threads, finely beaded at intersections with axials; lamellae at summit and borders of each primary axial rib stronger than interstitial lamellae, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, rim thin, outer lip weakly and evenly thickened within, inner lip rapidly and rather strongly thickened within.

DISTRIBUTION: Between Cape Maria van Diemen and North Cape, northern North Island (Fig. 33E). Known also from fossils in Holocene dunes at Te Werahi (Brook 1999b).

BIOLOGY: Litter-dwelling detritivore of broadleaved and podocarp/broadleaved forests.

CONSERVATION STATUS: The conservation status of *Costallogiscus parrishi* has been progressively refined as information has become available. McGuinness (2001) considered the species of potential conservation concern but 'insufficiently known'. Brook (2002b) ranked the species as 'range restricted (data poor)'. Hitchmough (2002) and Hitchmough *et al.* (2007) listed the species as 'nationally endangered', with which we concur. Despite extensive collecting in the northern Aupouri Peninsula over the past 50–60 years, *Costallogiscus parrishi* is known only from five extant populations (Brook 2002b; present study) in remnant forest patches. The species is never abundant.

As noted by Brook (2002b), fossil evidence suggests this species was formerly much more widely distributed on northern Aupouri Peninsula. That *Costallogiscus parrishi* is presently known only from remnant forest patches, and not from the extensive areas of secondary shrublands, suggests the populations are relictual in forest habitat that has survived historical land clearance and fire.

REMARKS: *Costallogiscus parrishi* is extremely distinctive in the combination of axially ribbed protoconch, very narrow umbilicus and lack of a colour pattern. It differs from *Costallogiscus kaikoura* n.sp., from the northeastern South Island, in lacking an obvious colour pattern, and in having a much larger protoconch, and stronger, more widely spaced spiral threads on the teleoconch.

The anatomy of *Costallogiscus parrishi* is not presently known.

ETYMOLOGY: After Richard Parrish of Whangarei, who collected the holotype and other material. Noun in the genitive case.

Costallogiscus pegasus new species

(Figs 26K, 33F, 35K–O)

Charopidae sp. 58 (NMNZ M.47453) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.29630: Stewart Island, Port Pegasus, Scout Bay, (NZMS 260 D49/095250), 21 Feb. 1972, F.M. Climo. Paratypes: Stewart Island, N of Halfmoon Bay, Garden Mound, Sep. 1958, F. Hausman, M.47453 (1); Stewart Island, Garden Mound, 14 Jan. 1979, B.F. Hazelwood, M.68264 (1); W of Halfmoon Bay, Fern Gully, 2 Mar. 1976, D.J. Roscoe, M.179694 (1).

MATERIAL EXAMINED (6 lots): Type material (see above), M.29600 (1), M.102913 (1).

DESCRIPTION: Shell up to 4.50 mm wide, wider than high (HWR 0.60 – paratype), thin, spire moderately elevated

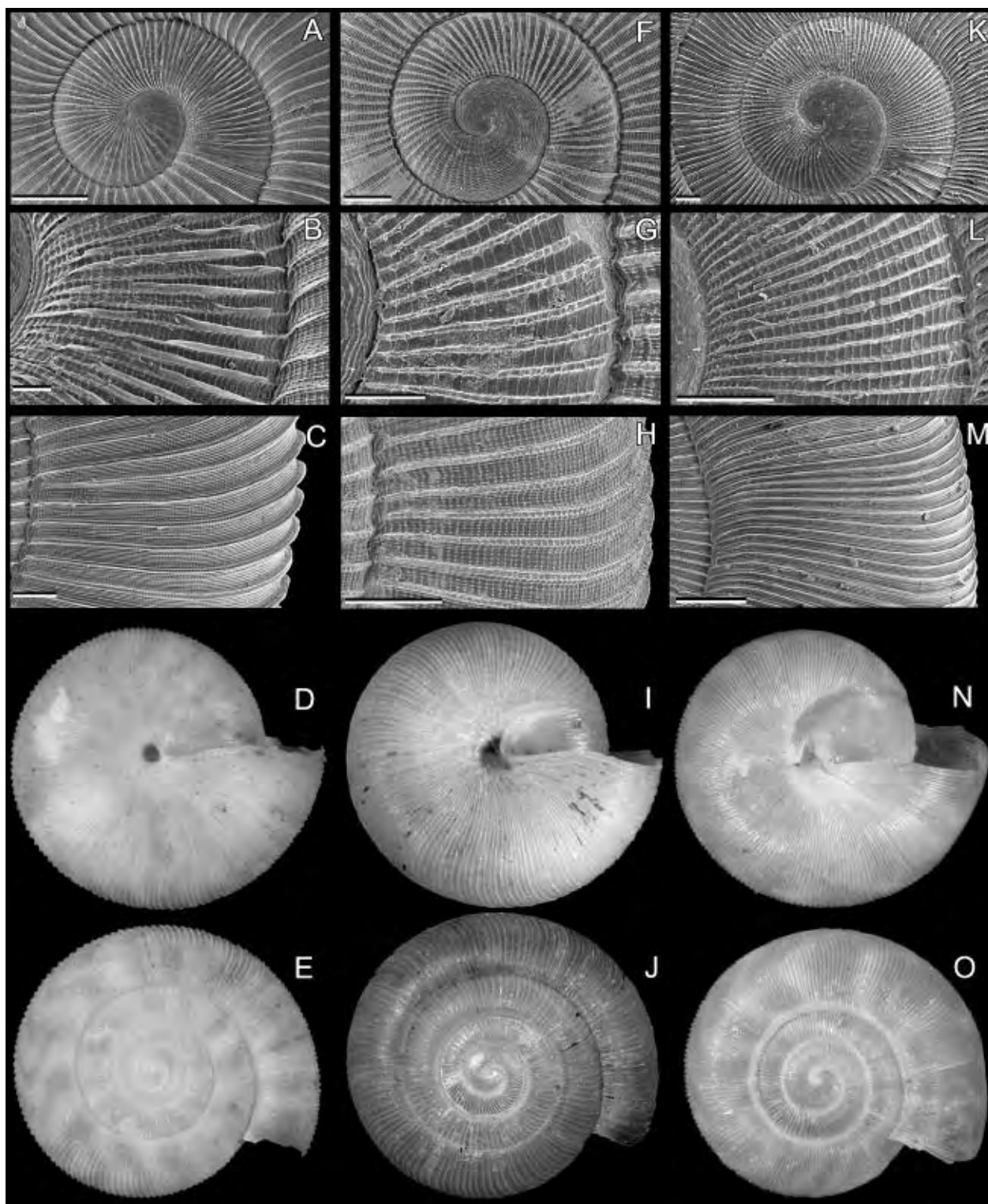


Fig. 35 Shells of *Costallogdiscus* species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Costallogdiscus kaikoura* n.sp., SW of Ward, Isolation Creek valley, paratype, M.166491 (A, B), and Seaward Kaikoura Range, George Stream valley, paratype, M.166536 (C), and holotype, M.273933 (D, E, 1.90 × 3.20 mm); F–J, *Costallogdiscus parrishi* n.sp., SE of Cape Reinga, Tapotupotu Bush, holotype, M.99147 (1.95 × 3.55 mm); K–O, *Costallogdiscus pegasus* n.sp., holotype, Stewart Island, Port Pegasus, Scout Bay, M.29630 (2.70 × 4.50 mm). Scale bars 30 μm (B), 100 μm (C, G, K, L), 200 μm (A, F, H, M).

(0.17% SH – paratype); umbilicus very narrow, fully invaded by inner lip. Protoconch uniform pale translucent buff; teleoconch translucent white or pale buff with wavy yellowish-brown bands extending over spire and base.

Protoconch weakly elevated, of about 1.30 convex whorls, 900–1100 µm wide, first quarter-whorl more or less smooth, subsequent whorl sculptured with fine, rather regularly spaced, weakly prosocline radial riblets traversed by finer, more closely spaced spiral threads; axials each surmounted by low, erect periostracal lamella.

Teleoconch of up to 2.50 convex whorls, sculptured throughout with prominent, regularly spaced primary axial ribs and weaker axial threads; these overlain by fine, crisp spiral threads and weaker axial threads, the latter surmounted by periostracal lamellae that are more prominent than spirals, very finely beaded at intersections with axials; lamellae at summit and borders of each primary axial rib stronger than lamellae at summits of interstitial axial threads, that at summit strongest. Axial sculpture shallowly and broadly sigmoidal. Aperture simple, rim thin, outer lip weakly and evenly thickened within, inner lip rapidly and rather strongly thickened within.

DISTRIBUTION: Stewart Island (Fig. 33F).

BIOLOGY: *Costallogiscus pegasus* is a ground-dwelling detritivore in litter and under woody debris in lowland mixed broadleaved/podocarp forests.

CONSERVATION STATUS: While broadly distributed in Stewart Island, *Costallogiscus pegasus* is evidently uncommon. Further survey work is needed to establish its conservation status properly.

REMARKS: Compared with *Costallogiscus kaikoura* n.sp., *C. pegasus* differs principally in having a larger protoconch (width 900–1100 µm, versus 560–620 µm), in lacking an umbilicus, and in having more crowded primary axial sculpture on the teleoconch. From *Costallogiscus parrishi* n.sp. it differs in having a pronounced colour pattern, and far more numerous and crowded primary axial ribs and interstitial spiral threads on the teleoconch.

ETYMOLOGY: After the type locality. Noun in apposition.

Genus *Canallogiscus* new genus

Type species: *Phelussa elliottae* Gardner, 1968. Recent, South Island, New Zealand.

Allodiscus as applied by various authors. (Not *Allodiscus* Pilsbry, 1892a: 56. Type species *Helix dimorpha* Reeve, 1852, by original designation; Charopidae.)

Phacussa as applied by Powell (1976, 1979). (Not *Phacussa* Hutton, 1883. Type species *Zonites* (?) *helmsii* Hutton, 1882, by subsequent designation of Pilsbry, 1894; Charopidae.)

Phelussa as applied by Gardner (1968). (Not *Phelussa* Iredale, 1915: 479. Unnecessary replacement name for *Phacussa* Hutton, 1883. Type species *Zonites* (?) *helmsii* Hutton, 1882, by subsequent designation of Pilsbry, 1894; Charopidae.)

DIAGNOSIS: Shell medium sized (maximum width 4.60–5.16 mm), low (HWR 0.45–0.63), spire weakly to moderately elevated (5.8–18% SH). Narrowly umbilicate (5.4–13% SW). Protoconch of medium to large size (width 570–630 µm), sculptured throughout with rounded, irregularly wavy, spiral threads, interspaces about as wide as each spiral or narrower. Teleoconch with narrow sutural channel that defines position of sutural notch at apertural rim; axial costae strongly opisthocline on spire.

Radular dentition comprising tricuspid central tooth, with long mesocone flanked either side by a small accessory cusp; lateral teeth bicuspid by suppression of the endocone; marginal teeth essentially unicuspid, with elongate sabre-like mesocone, occasionally with subobsolete endocone.

REMARKS: We erect a new genus for *Allodiscus fectoloides* Dell, 1955, *Phacussa elliottae* N. Gardner, 1968, and a third species from the northwestern South Island (described below). These New Zealand species closely resemble *Danielleilona marycolliverae* Stanisic, 1993, the northeastern Australian type species of *Danielleilona* Stanisic, 1993, in gross shell morphology (see Stanisic 1993). They differ, however, primarily in having more markedly wavy spiral threads on the protoconch, considerably finer and more closely spaced primary axial sculpture on the teleoconch, and in the radula (described by Gardner (1968) for *Pseudallodiscus elliottae*) possessing bicuspid rather than strongly tricuspid lateral teeth, and unicuspid, sabre-like rather than multicuspid marginal teeth. *Helix alveolus* Gassies, 1881 (currently placed in *Andrefrancia* Solem, 1960) from Prony, New Caledonia (NMNZ M.207677, topotypes, ex Suter collection), is similar to the New Zealand species in gross shell morphology and is thus possibly related.

While recognising some conchological similarities to *Allodiscus*, Gardner (1968) assigned his new taxon *elliottae* to *Phelussa* Iredale, 1915 (an unnecessary new name for *Phacussa* Hutton, 1883) on the basis of the unicuspid, aculeate marginal teeth. Powell (1979) maintained the

association with *Phacussa*. However, the three species here assigned to *Canallogdiscus* differ markedly from *Phacussa* species in having a spirally lirated protoconch, strongly opisthocline axials on the teleoconch, and a sutural channel and associated sutural notch at the apertural rim.

Presently, the only aspect of the anatomy known for *Canallogdiscus* is the radula described by Gardner (1968).

ETYMOLOGY: Combination of *canalis* (Latin = channel), alluding to the distinctive sutural channel of its species, and generic name *Allodiscus*.

***Canallogdiscus elliottae* (N. Gardner, 1968) new combination**

(Figs 26N, 36A–E, 37B)

Phelussa elliottae Gardner, 1968: 161, figs 7–9.

Allodiscus (Allodiscus) fectoloides.–Climo, 1969b: 29, figs 1A, 6E, 25A (in part of Dell, 1955 + *C. karamea* n.sp.).

Phacussa elliottae.–Powell, 1976: 117; Powell, 1979: 315.

TYPE MATERIAL: Holotype AIM AK 71318 and paratype NMNZ M.31960: South Island, Oparara Basin, Fenian Track, in collapsed *Powelliphanta* shells, Jan. 1966, B.F. Elliott.

MATERIAL EXAMINED (13 lots): Type material (see above), M.30567 (1), M.32907 (1), M.55603 (1), M.57971 (1), M.79191 (3), M.79727 (1), M.82521 (1), M.88849 (6), M.89106 (2), 89316 (1), M.96744 (1).

REDESCRIPTION: Shell up to 5.16 mm wide, thin, low and broad (HWR 0.45–0.54), spire weakly elevated (5.8–13.2% SH), narrowly umbilicate (12–13% SW). Protoconch translucent, pale buff; teleoconch translucent pale buff, overlain with more or less uniform pale yellowish brown.

Protoconch of 1.25 convex whorls, weakly elevated, 770 µm wide, sculptured with low, rounded, closely spaced, irregularly wavy spiral threads that number about 17 on spire on last half-whorl.

Teleoconch of up to 2.30 convex whorls, suture deeply and narrowly channelled, rim sharply angulate and overhanging suture; sculptured throughout with prominent, widely and regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and periostracal lamellae, spirals at intersections finely nodular; periostracal lamella at summit of each primary axial rib considerably stronger than interstitial lamellae. Axial sculpture strongly sigmoidal, markedly opisthocline on spire. Aperture with shallow notch occupying sutural channel, outer and inner lips thin at rims, weakly thickened and simple within.

DISTRIBUTION: Northwestern South Island, Oparara Basin,

Kahurangi National Park, and vicinity (Fig. 37B).

BIOLOGY: The only specimens recorded alive have been taken from inside empty *Powelliphanta* shells, which we assume they were using as a source of calcium.

CONSERVATION STATUS: *Canallogdiscus elliottae* has been overlooked in previous assessments of the conservation status of New Zealand landsnails. The species is ‘range restricted’ according to the criteria of Molloy *et al.* (2002).

REMARKS: Compared with *Canallogdiscus fectoloides* (Dell, 1955), which has similar gross facies, *C. elliottae* differs in attaining a larger size (width up to 5.16 mm, versus 4.60 mm), in being larger relative to the number of whorls, in having a larger protoconch (width 770 µm versus 630–730 µm), and in lacking a colour pattern.

Climo (1969b) regarded *Canallogdiscus fectoloides* and *C. elliottae* as conspecific.

Gardner (1968) described the radular dentition. Other aspects of the anatomy of *Canallogdiscus elliottae* are not presently unknown.

***Canallogdiscus fectoloides* (Dell, 1955) new combination**

(Figs 26O, 36F–J, 37A)

Allodiscus fectoloides Dell, 1955: 1139; Powell, 1957: 117;

Powell, 1962: 110; Powell, 1976: 117; Powell, 1979: 319;

Roscoe, 1992: 7; Freeman *et al.*, 1996: 31; Spencer & Willan, 1996: 40.

Allodiscus (Allodiscus) fectoloides.–Climo, 1969b: 29, figs 1a, 6e, 25a (in part = *C. elliottae* Gardner, 1968 + *C. karamea* n.sp.).

TYPE MATERIAL: Holotype CM M6433: beside Lake Te Au, NW of Te Anau, Jan. 1953, R.R. Forster. Paratype: M.6152 (1), beside Lake Hankinson, Middle Fiord, Lake Te Anau, 240 m, 14 Feb. 1953, G.W. Ramsay.

MATERIAL EXAMINED (7 lots): Type material (see above), M.82441 (1), M.85032 (1), M.127980 (1), M.146199 (1), M.146229 (2).

REDESCRIPTION: Shell up to 4.60 mm wide, thin, low and broad (HWR 0.50–0.54), spire weakly to moderately elevated (10–25% SH), narrowly umbilicate (9.4–11.3% SW). Protoconch pale yellowish brown, translucent; teleoconch ground translucent white, with yellowish-brown subsutural band of irregular maculations that transform to diagonal chequer-board pattern that extends around periphery to umbilical rim.

Protoconch of 1.20–1.30 convex whorls, weakly elevated, 630–730 µm wide, sculptured with low, rounded, closely spaced, irregularly wavy spiral threads that number about

12 on spire on first three-quarter-whorl, becoming obsolete thereafter.

Teleoconch of up to 2.75 convex whorls, suture deeply and narrowly channelled, rim sharply angulate and overhanging suture; sculptured throughout with prominent, widely and regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and periostracal lamellae, spirals finely nodular at intersections; periostracal lamella at summit of each primary axial rib much stronger than interstitial lamellae. Axial sculpture strongly sigmoidal, markedly opisthocline on spire. Aperture with a narrow notch occupying sutural channel, outer and inner lips thin at rims, weakly thickened and simple within.

DISTRIBUTION: Southwestern South Island (Fig. 37A).

BIOLOGY: *Canallodiscus fectoloides* occurs in leaf litter of broadleaved and *Nothofagus* forests and subalpine shrublands, with elevation records from 180 m to 1210 m.

CONSERVATION STATUS: *Canallodiscus fectoloides* is known from five localities in Fiordland. The species is likely more widely distributed in the region but further survey is required to establish the species' range properly. Our assessment is that the species is not of immediate conservation concern owing to security of the habitat.

REMARKS: Among the three New Zealand species here referred to *Canallodiscus*, *C. fectoloides* most closely resembles *C. karamea* n.sp. in having a chequer-board-like colour pattern (see below).

The anatomy of *Canallodiscus fectoloides* is not presently known.

Canallodiscus karamea new species

(Figs 26P, 36K–O, 37C)

Allodiscus (*Allodiscus*) *fectoloides*.—Climo, 1969b: 29, figs 1a, 6e, 25a (in part of Dell, 1955 + *C. elliottae* Gardner, 1968).

Charopidae sp. 59 (NMNZ M.38289) Spencer *et al.*, in press.

TYPE MATERIAL: Holotype NMNZ M.183102 and paratypes M.79195 (6), AIM AK 73288 (1): South Island, NE of Karamea, Honeycomb Hill cave system, opposite Frog Tunnel (NZMS 260 L27/420092), 6 Nov. 1983, P.R. Millener. Additional paratype: S of Karamea, beside Wanga-peka Road, 27 Dec. 1980, D.J. Roscoe, M.127648 (1).

MATERIAL EXAMINED (8 lots): Type material (see above), M.32862 (1), M.38289 (1), M.97396 (1), M.123504 (1).

DESCRIPTION: Shell up to 4.90 mm wide, thin, low and broad (HWR 0.52–0.63), spire weakly elevated (14–18% SH), very narrow umbilicus (5.4–8.2% SW) partly

overhung by edge of inner lip. Protoconch pale yellowish brown, translucent; teleoconch ground translucent white, yellowish-brown subsutural band of irregular maculations that transform to diagonal chequer-board pattern that extends around periphery to umbilical rim.

Protoconch of 1.25–1.30 convex whorls, weakly elevated, 770–830 µm wide, sculptured with low, rounded, closely spaced, irregularly wavy spiral threads that number about 17 on last half-whorl.

Teleoconch of up to 3.15 convex whorls, suture deeply and narrowly channelled, rim sharply angulate and overhanging suture; sculptured throughout with prominent, widely and more or less regularly spaced primary axial ribs; these overlain by fine, crisp spiral threads and periostracal lamellae, spirals finely nodular at intersections; periostracal lamella at summit of each primary axial rib considerably stronger than interstitial lamellae. Axial sculpture strongly sigmoidal, markedly opisthocline on spire. Aperture with a deep notch occupying sutural channel, outer and inner lips thin at rims, weakly thickened and simple within.

DISTRIBUTION: Northwestern South Island (Fig. 37C).

BIOLOGY: *Canallodiscus karamea* occurs in lowland to montane forests. It has been collected from under rotting logs. Climo (1969b) reported the gut content to comprise insect remains. This, coupled with the sabre-like marginal teeth of the radula, suggest a carnivorous feeding behaviour.

CONSERVATION STATUS: *Canallodiscus karamea* is known from five localities in the Karamea area of northwestern South Island. The species is likely to be more widely distributed in the area but further survey is required to establish the species' range properly. Our assessment is that *Canallodiscus karamea* is not of immediate conservation concern owing to security of the habitat.

REMARKS: *Canallodiscus karamea* resembles *C. fectoloides* (Dell, 1955) in colour pattern but differs in having more widely spaced primary axial ribs and much stronger spiral threads on the teleoconch, and in having a deeper sutural notch at the aperture and a narrower umbilicus. It differs from *Canallodiscus elliottae* N. Gardner, 1968 in having a colour pattern, a narrower umbilicus, a much deeper sutural notch at the aperture, and more widely spaced primary axial ribs and stronger spiral sculpture on the teleoconch.

ETYMOLOGY: After the Karamea area, where the type locality is situated. Noun in apposition.



Fig. 36 Shells of *Canallodiscus* species. Protoconch, protoconch sculpture detail, teleoconch sculpture detail, and whole shell ventral and dorsal views (sequentially). A–E, *Canallodiscus elliottae* (N. Gardner, 1968), Oparara Basin, Fenian Track, M.31960 (2.70 × 4.95 mm); F–J, *Canallodiscus fectoloides* (Dell, 1955), Lake Te Anau, beside Lake Hankinson, paratype, M.6152 (F–H), and holotype, NW of Te Anau, beside Lake Te Au, CM M6433 (I, J, 2.20 × 4.20 mm); K–O, *Canallodiscus karamea* n.sp., NE of Karamea, Honeycomb Hill cave system, paratype, M.79195 (K–M), and holotype, M.183102 (N, O, 2.90 × 4.88 mm). Scale bars 100 µm (B, F, G, L), 200 µm (C, H, K, M), 300 µm (A).

Taxa of uncertain status

Charopidae sp. 60

(Figs 38A–C)

Allodiscus 'cf. [sic] *turbotti*'—McGuinness, 2001: 587

Allodiscus 'aff. *turbotti*'—Hitchmough *et al.*, 2007: 128

Charopidae sp. 60 (NMNZ M.100283) Spencer *et al.*, in press.

REMARKS: The voucher specimen from Breaksea Sound lacks spiral sculpture on the protoconch, and is evidently not congeneric with any of the taxa described herein. For want of a taxonomic placement, it seems more appropriately referred to *Phenacohelix* Suter, 1892 (*s. lat.*).

CONSERVATION STATUS: Recorded as having 'limited or disjunct distribution' (McGuinness 2001) and as 'data deficient' (Hitchmough *et al.* 2007).

Charopidae sp. 115

(Figs 38D–F)

N. gen. (*Allodiscus*?) 'midden, South Kaipara Head' McGuinness, 2001: 592 (in part: 'Hokianga' record = *Allodiscus hazelwoodi* n.sp.).

Charopidae sp. 115 (NMNZ M.89827), 'south Kaipara Head' [= NW of Helensville] Spencer *et al.*, in press.

NOT n. gen. (*Allodiscus*?) 'Hokianga' Hitchmough, 2002, 126; Hitchmough *et al.*, 2007: 86 (= *A. hazelwoodi*).

REMARKS: Owing to the regrettable failure to cite voucher material in early conservation lists, two distinct *Allodiscus s. lat.* taxa became confused under Charopidae sp. 115, as indicated in the synonymy. Among known species, the two specimens from northwest of Helensville (M.89827) resemble *Allodiscus camelinus* n.sp. in gross facies, including size (adult width up to 5.20 mm), but differ principally in that the protoconch is more extensively covered with fine axial riblets on the first half-whorl and has finer spiral threads on the last quarter-whorl, and in that the axial riblets on the teleoconch are more widely spaced and flexuous.

CONSERVATION STATUS: The indications 'range restricted' (Hitchmough 2002; Hitchmough *et al.* 2007) and 'limited or disjunct distribution' (McGuinness 2001) are appropriate for both Charopidae sp. 115 and *Allodiscus hazelwoodi* n. sp.

Charopidae sp. 122

(Figs 38G–I)

Allodiscus 'Mount Peel' n.sp. McGuinness, 2001: 587; Hitchmough, 2002: 121; Hitchmough *et al.*, 2007: 128.

Charopidae sp. 122 (NMNZ M.84431) Spencer *et al.*, in press.

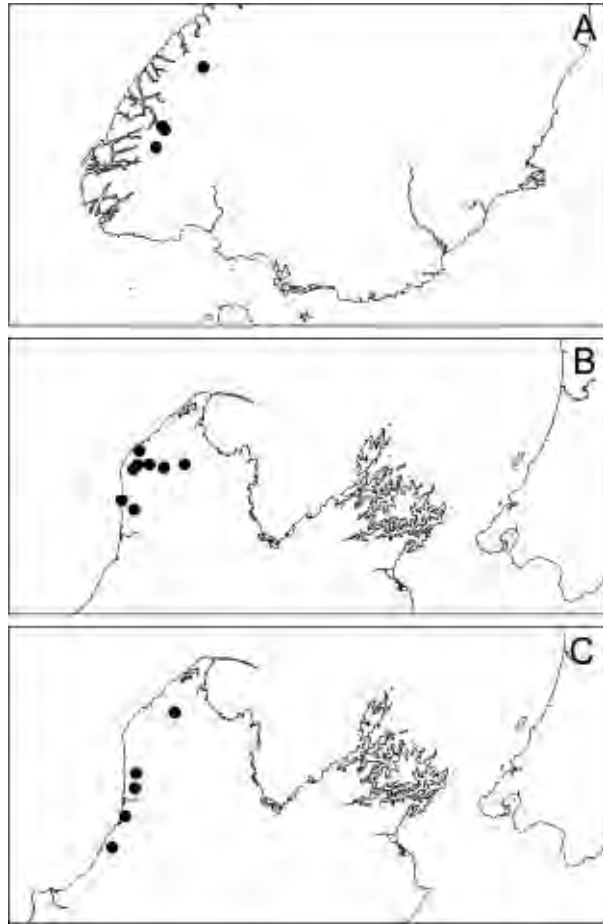


Fig. 37 Distributions of *Canallodiscus* species in New Zealand. A, *Canallodiscus fectoloides* (Dell, 1955); B, *Canallodiscus elliottae* (N. Gardner, 1968); C, *Canallodiscus karamea* n.sp.

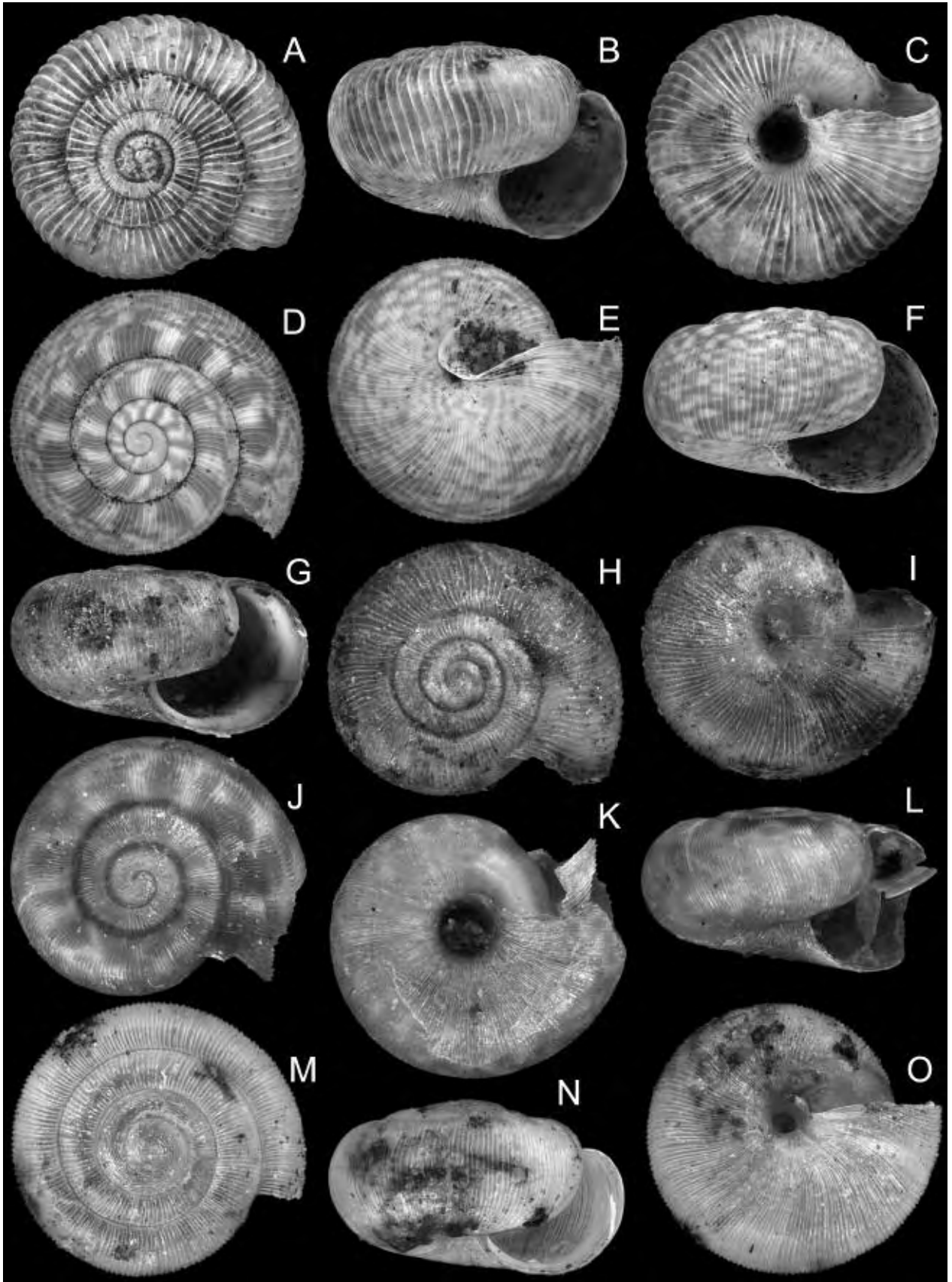
REMARKS: The voucher specimen from Mt Peel (M.84431) is a teratological specimen of *Allodiscus (s. lat.) adriana* (Hutton, 1883) or a related (undescribed) species, which has grown abnormally following injury in early ontogeny (first teleoconch whorl).

CONSERVATION STATUS: None. Although indicated as being of 'limited or disjunct distribution' (McGuinness 2001), 'range restricted' (Hitchmough 2002) and 'data deficient' (Hitchmough *et al.* 2007), the voucher specimen is evidently a teratological specimen of *Allodiscus adriana* (which is not of immediate conservation concern) or a similar undescribed species currently interpreted as part of the variation of that taxon.

Charopidae sp. 171

(Figs 38J–L)

N. gen. (*Allodiscus*?) McGuinness, 2001: 592; Hitchmough, 2002: 126; Hitchmough *et al.*, 2007: 86.



REMARKS: The single specimen from Judd Ridge, Tararua Range, is highly distinctive in the combination of small protoconch (width 450 µm) sculptured with crisp, finely obliquely cut spiral threads (as in the Group H species *Allodiscus erua* n.sp.), fine, crowded, sigmoidal axial riblets on the teleoconch, and narrow umbilicus. The specimen is probably subadult (width 1.60 mm: 2 teleoconch whorls) and further material is required before the taxon can be formally described.

CONSERVATION STATUS: Listed as having 'limited or disjunct distribution' (McGuinness 2001), and as 'range restricted' (Hitchmough 2002; Hitchmough *et al.* 2007).

Charopidae sp. 199

(Figs 38M–O)

Allodiscus 'minute-white' n.sp. McGuinness, 2001: 587;

Hitchmough, 2002: 121; Hitchmough *et al.*, 2007: 128.

REMARKS: The single specimen from Ohakune, central North Island, has a minute (width 1.55 mm), uniform translucent white, narrowly umbilicate shell. The protoconch (width 600 µm) is sculptured with crisp spiral threads surmounted by prominent periostracal blades. Although the specimen is extremely distinctive, we prefer to await the discovery of further specimens before naming this species. It may be related to *Allodiscus pallidus* n.sp.

CONSERVATION STATUS: Listed as having 'limited or disjunct distribution' (McGuinness 2001), 'range restricted' (Hitchmough 2002) and 'data deficient' (Hitchmough *et al.* 2007).

Discussion

In *The New Zealand inventory of biodiversity* (Spencer *et al.* in press), 891 species and subspecies of terrestrial pulmonates were recorded from New Zealand, of which 461 species (51.7%) were undescribed. In the present contribution we identify a total of 60 species previously assigned to genus *Allodiscus*, of which we recognise 42 as new. This rate of discovery of taxa new to science suggests the estimates of total and undescribed faunal richness in the checklist are highly conservative. Indeed, if the ratio of new to total species of 0.7 observed in this group of charopids is generally applicable, then richness in the New Zealand landsnail

fauna is likely in excess of 1270, thus approaching the estimates of 1350 to 1400 species (inclusive of cyclophorideans) provided by Barker's (2005) rarefaction analyses.

At the supra-specific level, we recognise *Allodiscus* Pilsbry, 1892, *Pseudallodiscus* Climo, 1971 and *Hirsutodiscus* Climo, 1971 as valid genera, and describe as new *Granallodiscus* (for *Helix granum* L. Pfeiffer, 1857 and two new species), *Costallodiscus* (for three new species) and *Canallodiscus* (for *Allodiscus fectoloides* Dell, 1955, *Phelussa elliottae* Gardner, 1968 and a new species). In addition to *Allodiscus s. str.*, we recognise several informal groups in *Allodiscus s. lat.* that are likely to warrant genus-group status but whose formal establishment must await supporting data from morphological and molecular genetic studies.

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Fig. 38 Charopidae voucher specimens. A–C, Charopidae sp. 60, Breaksea Sound, M.100283 (2.40 × 3.55 mm); D–F, Charopidae sp. 115, South Kaipara Head, midden, M.89827 (3.10 × 4.80 mm); G–I, Charopidae sp. 122, Mt Peel, M.84431 (2.05 × 3.60 mm); J–L, Charopidae sp. 171, Tararua Range, Judd Ridge, M.14396 (0.95 × 1.65 mm); M–O, Charopidae sp. 199, Ohakune, M.154802 (0.95 × 1.50 mm).

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