



A revision of the New Zealand click beetle genus *Amychus* Pascoe 1876 (Coleoptera: Elateridae: Denticollinae): with a description of a new species from the Three Kings Islands

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ABSTRACT

The New Zealand endemic click beetle genus *Amychus* Pascoe (Elateridae: Denticollinae: Ctenicerini) is revised. Three species are recognised: *A. candezei* Pascoe, *A. granulatus* (Broun) and *A. manawatawhi*, sp. nov. All species are described or redescribed from the adults. The larva of each species and the pupa of *A. candezei* are described for the first time. Lectotypes are designated for *A. candezei* Pascoe and *A. granulatus* (Broun). Keys to species for adults and larvae are given. The phylogenetic placement of the genus, biology and conservation of the species are discussed.

Key words: *Amychus candezei*; *Amychus granulatus*; *Amychus manawatawhi*; new species; lectotype; redescription; larval description; pupal description; distribution; biology; conservation

INTRODUCTION

The New Zealand elaterid fauna consists of 26 genera containing more than 132 native and mostly endemic species, and 3 adventive species (Klimaszewski and Watt 1997). Among these, the endemic genus *Amychus* Pascoe 1876 (Elateridae: Denticollinae: Ctenicerini) [Note: we are provisionally retaining a conservative taxonomy for family groups and not recognizing Gistel's (1848) nomenclature since many of his family-group taxa may be regarded as *nomen oblitum* (in prep.)] is highly distinctive due to its roughly textured bark-like dorsal surface, and unusually broad and depressed body form. Two species, *Amychus candezei* Pascoe 1876, and *A. granulatus* (Broun 1883), are included among the 17 New Zealand beetle species given legal protection under the Seventh Schedule of the Wildlife Act 1953 (Anonymous 1980). The aims of this revision are to clarify the taxonomic status of *Amychus* species based on examination of types and other material, to redescribe the existing species and describe *A. manawatawhi* sp. nov. In addition, the larva and pupa of *A. candezei* and the larva *A. granulatus* are described for the first time. This study also briefly discusses the problem of subfamily and tribal placement of *Amychus*.

MATERIALS AND METHODS

Material examined. *Amychus* specimens from the following collections were examined during this study: AMNZ: Auckland War Memorial Museum, Auckland, New Zealand; BMNH: The Natural History Museum, London, United Kingdom; CMNZ: Canterbury Museum, Christchurch, New Zealand; CNCI: Canadian National Collection of Insects, Ottawa, Canada; LUNZ: Entomology Research Museum, Lincoln University,

Canterbury, New Zealand; MNHN: Muséum National d'Histoire Naturelle, Paris, France; NZAC: New Zealand Arthropod Collection, Landcare Research, Auckland, New Zealand; MONZ: Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand; UMBB; Übersee-Museum, Bremen, Germany; USNM: Smithsonian National Museum of Natural History, Washington. USNM material was examined from photographs of specimens and their labels. Those specimens used for taxonomic analysis are listed under *Material Examined* for each species. Two-letter geographic area codes for specimen localities follow those defined by Crosby *et al.* (1998).

Citation of primary type labels. Type specimen details are shown with label data enclosed by quotation marks (“ ”), each label separated by a solidus (/) with a space on either side and with additional specimen or label information enclosed in square brackets ([]).

Dissections, preparations and illustrations. Genitalic structures and hindwings were dissected following the methodology of Calder (1996). Specimens were illustrated using a drawing tube attached to a Zeiss Stemi SV6 stereomicroscope. Scanning electron micrographs (SEM) were made using a Leica S440 microscope. Specimens used in scanning electron microscopy were sonicated in a detergent solution, air dried, and gold coated. Larval and pupal specimens were cleaned as needed by gentle brushing with a fine-tipped artist's brush. Photographs of these were taken with an Olympus C-5050 digital camera on an Olympus SZX12 stereomicroscope. Photographs were made primarily with a Nikon D200 and a 105 mm AF Micro Nikkor macrolens with manual settings and dual strobe flash.

Image editing was done with Adobe Photoshop, versions CS2 and CS3.

Terminology and measurements. Terminology used for adult and larval morphology follow Calder (1996), Lawrence (1991), Lawrence and Britton (1991), Kukalová-Peck and Lawrence (1993), and Calder *et al.* (1993). Measurements were made with ocular graticules on Zeiss Stemi SV6 or Olympus SZX12 stereomicroscopes. Measurements of adults are as follows: body length is given excluding the head (due to variability in the degree of head extension among specimens) and was measured by summing the pronotum length measured at the midline and the elytron length; body width was measured across the widest point of the elytra, usually at about the anterior third. Following Calder (1996) and Calder *et al.* (1993) an index of eye prominence (EI) was obtained by subtracting the interocular head (frons) width from the maximum width of the head across the eyes and dividing the result by the maximum head width. The pronotal index (PI) was obtained by dividing the length of the pronotum measured along the midline by the maximum width of the pronotum before the hind angles and multiplying the quotient by 100.

TAXONOMY

Genus *Amychus* Pascoe 1876

(Figs. 1–26)

Amychus Pascoe 1876: 49; Pascoe 1877: 416; Candèze 1891: 177; Schwarz 1901: 193; Schwarz 1906: 219; Schwarz 1907: 231; Hudson 1934: 81. Type species: *Amychus candezei* Pascoe 1876: 49 (by monotypy).

Psorochroa Broun, 1883: 301; Broun 1886: 773; Schwarz 1906: 219; Schwarz 1907: 232, Pl. 6, fig. 2; Hudson 1934: 81, 200 (synonymy). Type species: *Psorochroa granulata* Broun 1883: 301 (by monotypy).

Adult Diagnosis: Body broad, moderately convex to strongly flattened; integument dull, appearance bark-like, with a vestiture of orange to gold decumbent setae. Head prognathous. Mandibles bidentate. Antennae 11-segmented, subserrate from segment 4, short, reaching to about midlength of pronotum. Pronotum broad, moderately to strongly explanate, hind angles with sublateral carina. Mesocoxal cavity open to mesepimeron and mesepisternum. Tarsal claws simple, each claw with *c.* 4–8 lateral and dorsal, postbasal setae.

Adult Description: *Form.* Body (Figs. 1–3) elongate, oblong to parallel-sided; length (excluding head) 12.7 to 24.2 mm; relatively broad, 2.6–2.8 x longer (excluding head) than wide; moderately convex to strongly flattened. Integument dull, finely granulate; dorsum with numerous glossy pustules or pustules

absent. Vestiture of sparse to moderately dense orange to gold decumbent setae; dorsum with velvet-like indumentum generally covering posterior part of head, the margins and posterior part of disc of pronotum and almost all of the elytra. Colouration of integument orange-brown to dark brown with patches of dark brown to black on disc of pronotum; vestiture yellow-brown to dark brown, forming indistinct transverse bands or mottled patterns on elytra (less conspicuous in worn specimens or due to surface oils from fat deposits in some museum specimens); overall appearance of dorsal surface dull, bark-like.

Head: Head(Fig. 20) oval, prognathous, flattened anteriorly. Frontal carina incomplete medially. Frons with a weak triangular depression medially; punctate to foveolate, punctation less dense mesally; vestiture sparse. Eyes small, EI 0.2–0.3, finely faceted. Mouthparts prognathous. Mandibles(Fig. 21) bidentate, second tooth positioned medially on incisor edge, punctation dense and deep laterally. Labrum fully exposed at base, semicircular, wider than long, with a weak, longitudinal, anteromedial carina. Maxillary and labial palps(Figs. 25, 26) with terminal segment securiform. Antennae(Fig. 24) short, reaching to about midlength of pronotum, 11-segmented, subserrate from segment 4; sensory elements beginning on segment 4; antennomere 1 robust, 2.1 x longer than antennomere 2, antennomere 3 1.3 x longer than antennomere 2, antennomere 4 subequal in length to antennomere 2.

Thorax: Prothorax wider than long; pronotal index 67–83; sides arcuate to weakly sinuate, not explanate to strongly explanate; disc flattened to convex. Pronotum with a weakly impressed median longitudinal depression, obsolete anteriorly, faint to obsolete posteriorly; anterior angles strongly produced extending beyond midpoint of eyes; lateral margins entirely carinate; base with two short sublateral carinae and incisions, notched in front of scutellum; hind angles prominent, broad, carinate, weakly convergent to weakly divergent. Prosternal suture straight, marginate along hypomeran border. Prosternum rounded anteriorly, projecting to form a chin piece, marginate around procoxal cavities. Hypomeron sparsely punctate with punctures shallow to moderately deep, densely punctate anteriorly with punctures separated by less than their diameter. Prosternal spine(Fig. 22) moderate to long, proportion posterior to procoxae 1.0–1.7 x procoxal cavity width; extending horizontally to weakly deflexed dorsally behind procoxae, without a ledge immediately behind procoxae, with subapical tooth. Scutellum broadly rounded anteriorly; anterior margin well defined sharply angulate and steeply declivous to prescutum; vestiture sparse. Mesosternal cavity deep, with glossy median groove extending to floor; cavity opening broadly ovate (viewed ventrally), extending posteriorly to about the anterior 1/3rd to 2/5th of mesocoxal cavity; sides moderately steeply declivous. Mesosternum (viewed laterally) weakly declivous anteriorly, horizontal posteriorly; posterior margin steeply declivous, forming a distinct depression at the junction with the metasternum. Mesocoxal cavity open to mesepimeron and mesepisternum. Metasternum with distinct discrimen extending the length of metasternum. Elytra 2.6–2.7 x length of pronotum; sides weakly curved to parallel-sided anteriorly, tapering from about posterior 3/5th; apex narrowly rounded; disc moderately convex to flattened; weakly sculptured to strongly tuberculate; striae weakly to moderately impressed, weakly to moderately punctate, with punctures widely separated; vestiture sparse. Hind wings brachypterous (at most reaching to apex of elytra) (Fig. 6) to micropterous (Figs. 4–5); if brachypterous about 3.0 x as long as wide; wedge cell absent; apex of wing without sclerotisations; without transverse apical fold in repose; venation as in Fig. 6; venation varies in some specimens as follows: Radial cell (R) sometimes with 1–3 internal cross veins or partial cross veins in proximal area; MP₃ extended proximally to join base of MP₁₊₂ to form cell; MP₁₊₂–MP₃ cross vein sometimes branched and forming small triangular cell. Legs robust. Tibiae with two short apical spurs. Tarsi simple; laterally compressed; distal margins oblique in lateral view; densely pilose ventrally. Tarsal claws (Fig. 23) grooved laterally; each claw with *ca.* 4–8 lateral and dorsal, postbasal setae.

Abdomen: Abdomen with ventrites 1–4 connate, ventrite 5 tapering to a narrowly arcuate apex, ventrites with sparse to dense punctation laterally and apically, punctures shallow to deep. Female segment 8 with narrow membrane connecting sternite and tergite. Sternite 8 spiculum elongate, spiculum 0.6–0.7 x length of sternite; apex narrowly arcuate. Male tergite 9 deeply notched at midline.

Female genitalia: Ovipositor (Fig. 10) stout; elongate, about 0.5–0.6 x length of abdomen (measured medially). Coxites divided into two parts; with subapical palpiform styli. Paraprocts elongate, 2.9–3.7 x length of coxites, 0.7–0.8 x length of ovipositor. Vagina (Fig. 11) elongate; anterior end enlarged; without sclerotised structures. Collateral glands formed as weakly developed outgrowths anterior to common oviduct. Bursa copulatrix tubular, elongate, U-shaped posteriorly, narrowing anteriorly; without sclerotised armature. Two spermathecae present; posterior spermatheca long, weakly curved; anterior spermatheca moderately long, coiled and weakly sclerotised apically. Tubular extension elongate, running from apex of bursa to a complex, multi-armed spermathecal gland. There are no evident differences in structure between species.

Male genitalia: Aedeagus (Figs. 7–9) 3.4–4.8 x long as wide. Median lobe almost straight in profile; apex narrowly rounded, extending beyond apices of parameres. Basal struts 0.26–0.28 x length of median lobe. Parameres articulated with median lobe, convergent apically; apex simple; apical angle narrowly rounded, with a group of *c.* 9–16 latero-apical setae. Basal piece distinctly separate; 0.21–0.28 x length of aedeagus.

Pupa Description: See pupal description for *A. candezei*, below.

Larva Description: Body elateriform, subcylindrical, shallowly convex dorsally; maximum length ca. 27.5 mm, width 4.5 mm (final instar); dorsum orange-yellow with brown highlights, mandibles black; pleural and ventral areas pale yellow. Spiracular atria subparallel; ecdysial scar adnate to atrial margin.

Head. Head (Fig. 16) with frons pedunculate; frontal sutures lyriform, broadly truncate at cervical margin. Mandibles strongly arcuate, attenuate; with large, stout retinaculum at midlength. Antenna (Fig. 17) 3-segmented, integument darkly sclerotized; segment 1 with 3 large setae at midlength, one dorsolateral, two ventrolateral; segment 2 with one conical apical sensorium; segment three with 5 minute apical setae. Stemma present. Frons with nasale unidentate, slightly widened subapically, with 5 large basal setae each side; paranasalar lobe with 2 large anterior setae and 1 posterior seta; postero-frontal setae one each side. Cranial setation: dorsal anteroepicranial 2, ventral anteroepicranial 1, dorsal lateroepicranial 2, ventral lateroepicranial 1, dorsal epicranial depression with 6–7 large and 1–3 small, ventrosulcus 10–11. Stipes with single anterolateral seta. Labial palpus with 2 setae on basal segment. Prementum with 4 setae. Postmentum subrectangular, with setal sockets of both anterior and posterior pair surrounded by sclerotization. Cardio triangular, longitudinally oriented, with single seta. Gula with a single central seta.

Thorax. Thorax with nota sparsely set with large, shallow, setiform punctures. Pronotum with 4 anterolateral and 5 posteriolateral setae. Meso- and metanota lacking anterior and lateral setae, posterior setae 3–4. Presternum 4-partite, lateral portion with single anterolateral setae, posterior portion with 2 setae. Episternum with 2 large setae each side. Legs with each segment heavily spined laterally and along ventral margins; trochanter and femur each with 2–3 large ventral setae; tarsungulus claw-like, with two basal setae.

Abdomen. Abdominal terga 1–8 (Fig. 18) with numerous small, shallow, and finely setate punctures, on terga 1–7 each puncture adjacent to a transversely undulating, moderately sclerotized carinula that partially forms the puncture margin, punctures and carinulae becoming obsolescent in posterior third of each tergite; anterolateral carina with short branches, each a series of undulating carinulae, with anterior branch reaching less than halfway to ecdysial suture; posterolateral margin with 6–12 large setae. Tergite 9 (Fig. 19) with disc depressed, coarsely wrinkled, striate, and coarsely punctured, with 2 large setae near anterior margin; circumdiscal ridge shallow, undulate, 4-tuberculate dorsolaterally, with anterior pair low, indistinct; base of urogomphus (Fig. 19) with large acuminate dorsal tubercle; urogomphus broadly obtuse at apex, with short blunt preapical tubercle; terminal emargination angularly oval, with narrow gap between urogomphal apices. Pleurites 2-partite, sparsely setate. Sternites 5-partite, sparsely setate. Segment 8 spiracle anterad of midlength. Pygopodium tubular, with narrow ring sclerite.

Included species. Three species are included: *A. candezei*, *A. granulatus*, and *A. manawatawhi*, sp. nov.

Distribution. Restricted to the New Zealand archipelago: Three Kings Islands (TH), 60 km northwest of Cape Reinga at the northern tip of the North Island of New Zealand; some islands of the Marlborough Sounds and Cook Strait (SD) in the north east of the South Island; North Canterbury (NC) in the east of the South Island (a single subfossil specimen); and the Chatham Islands (CH) *c.* 870 km east of New Zealand.

Remarks. Hudson (1934) erroneously synonymised the species *Amychus candezei* and *Psorochroa granulata* (see *Remarks* for *A. candezei*) but, in doing so, correctly synonymised the genera *Amychus* and *Psorochroa*. The synonymy of *Amychus* and *Psorochroa* is supported by this revision.

General biology. *Amychus* adults are nocturnal and have commonly been collected from on tree trunks at night where they tend to favour gnarled, knot-holed trees that presumably offer refugia during the day. Beetles have also been found under logs, rocks and low growing vegetation, and by pitfall trapping. Adults were found feeding on sap oozing from tree trunks (Marris 1996, Marris unpublished data) and on algae and lichens on tree trunks (Meads 1990). Collection records show *A. granulatus* specimens were collected in all months except June and October and *A. candezei* has been collected over the summer months and in July. Few records exist for *A. manawatawhi* due to the inaccessibility of the Three Kings Islands, and these are limited to November, December and April. Thus, adult beetles are probably present throughout the year and individually long lived.

Larvae attributed to *A. candezei* were associated with a pupa and adults through the elimination of other candidate elaterids and their known larvae and pupae from the small and well documented Chatham Islands beetle fauna (Emberson 1998, 2002). Both larvae and the pupa were collected within the habitat and close proximity of adults. The larvae of *A. granulatus* and *A. manawatawhi* were collected from small island localities where, like *Amychus candezei*, there is a limited elaterid fauna and thus few possibilities for adult associations along with the same basic morphological features shared with *A. candezei* larvae.

Amychus larvae have been collected from in rotten wood, in soil at the base of tussock grasses and from litter. Elaterid larvae, especially denticolline and agrypnine species, are usually predaceous or omnivorous (e.g., Lawrence *et al.* 1999, Johnson 2002), and the predaceous habit is apparently true for *Amychus* larvae. Two larvae of *A. candezei* were reared through four moults on sections of yellow mealworm larvae (*Tenebrio molitor* L.) over three years but died before pupating (Marris, unpublished data). Only one pupa is known from the genus, a specimen of *A. candezei* collected from in soil at the base of tussock grasses.

Amychus species are restricted to offshore islands which, with the exception of Chatham Island, are free of introduced mammalian predators. Subfossil evidence shows that *A. granulatus* was also once present on the South Island mainland (Worthy and Holdaway 1996, see *Remarks* for *A. granulatus*) but became extinct there presumably due primarily to predation by rodents. The beetles are found in habitats including mature forest, coastal scrub and sward. The subfossil record of *A. granulatus* from near Waikari, c. 20 km inland from the east coast of the South Island, shows that this species was not restricted to its present maritime range.

A Key to Adult *Amychus* Species

- 1 Elytra strongly tuberculate, especially humerally and laterally; dorsum with numerous strongly raised glossy dome-like pustules; Marlborough Sounds/Cook Strait *A. granulatus* (Broun)
- Elytra without prominent tubercles; dorsum with numerous weakly raised glossy pustules or pustules absent 2
- 2 Dorsum with numerous weakly raised glossy pustules; prothorax with sides not explanate; elytra transversely convex at mid length; Chatham Islands *A. candezei* Pascoe
- Dorsum lacking glossy pustules (occasionally with a few faintly raised glossy pustules restricted to prothorax); prothorax with sides strongly explanate; elytra flattened medially at mid length, lateral ½ declivous; Three Kings Islands *A. manawatawhi* sp. nov.

A Key to Larval *Amychus* Species

1. Frons broadly lyriform, with posterior portion widest, and strongly arcuate margins; tergal punctures obsolescent in posterior third of length; Chatham Islands *A. candezei* Pascoe
- Frons narrowly lyriform, with shallowly arcuate margins; tergal punctures distinct, extending to near posterior margin 2
2. Frons with posterior portion moderately arcuate initially then subparallel to cranial margin; tergite 9 with dorsolateral tubercles low in relief, obtuse, and indistinct anteriorly; Marlborough Sounds/Cook Strait

- *A. granulatus* (Broun)
 - Frons with posterior portion shallowly arcuate to cranial margin; tergite 9 with dorsolateral tubercles distinctly elevated anteriorly; Three Kings Islands *A. manawatawhi* sp. nov.

***Amychus candezei* Pascoe**

(Figs. 1, 4, 7, 12–19)

Amychus candezei Pascoe 1876: 49; Pascoe 1877: 416; Hudson 1934: 81.

Amychus schauinslandi Schwarz 1901: 194; Emberson 1998: 38

Amychus rotundicollis Schwarz 1901: 196; Emberson 1998: 38

Psorochroa schauinslandi (Schwarz); Schwarz 1907: 232, Pl. 6, fig. 2.

Psorochroa rotundicollis (Schwarz); Schwarz 1907: 232.

Adult material examined. *Amychus candezei*. **Lectotype:** here designated. “Syntype [Round, blue-bordered label] / type / Chatham I [Oval label, in Pascoe’s handwriting] / *Amychus candezei* Type, Pasc. [In Pascoe’s handwriting] / Pascoe Coll. 93-60 / Pascoe 93-60 refers to Accession to coll [BMNH collection] of Coleoptera 1870–1909. [Label added by C. von Hayek] / LECTOTYPE *Amychus candezei* Pascoe 1876 Marris & Johnson 2010” [Specimen length 17.5 mm] (BMNH). **Paralectotypes:** “Syntype? [Round, blue-bordered label] / ♀ / Chatham Is. [In Pascoe’s handwriting] / Janson coll. 1903-130 / *Amychus candezei*, Pasc. A.M.N.H. Ser. 4. XVII. p. 49 (No. 97. Jany. 1876). [The determination label is almost certainly that of Janson (C. von Hayek pers. comm. 2003)] / PARALECTOTYPE *Amychus candezei* Pascoe 1876 Marris & Johnson 2010” [Specimen length 17.5 mm] (BMNH); “*Amychus candezei*, Pascoe Type mihi D.S. [D. Sharp] Chatham Isld [Text written on specimen card mount] / New Zealand / Sharp Coll. 1905-313. / Syntype? [Round, blue-bordered label] / PARALECTOTYPE *Amychus candezei* Pascoe 1876 Marris & Johnson 2010” [Specimen length 15.0 mm] (BMNH).

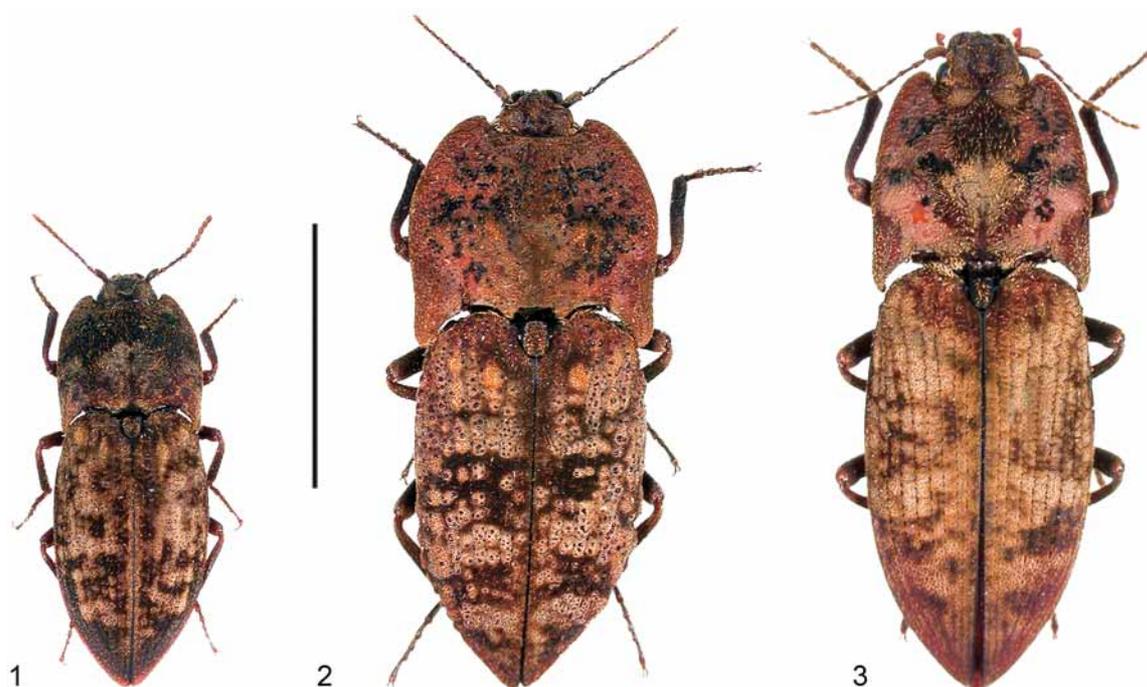
Amychus schauinslandi. **Syntype** ♂ “Chat-ham [Small label, written ‘Chat-‘ on first line ‘ham’ on second] / Typus [Printed red label] / *Amychus Schauinslandi* Schw.” [Specimen covered in fungal hyphae and is missing all except the first two segments of the left antenna, length 17 mm] (UMBB).

Additional material examined. Adults. New Zealand, Chatham Islands: Chatham Island: Hapupu (6 sex unknown; NZAC), Kaingaroa (1 ♂, CMNZ); Forty Fours (6 ♂, 4 ♀, 17 sex unknown; CMNZ, LUNZ); Little Mangere Island (1 ♀; LUNZ); Mangere Island (2 sex unknown; LUNZ); Pitt Island (1 ♀, 6 sex unknown; BMNH, CMNZ); South East Island (8 ♂, 8 ♀, 26 sex unknown; LUNZ, NZAC); Star Keys (2 ♂, 2 ♀, 11 sex unknown; LUNZ); The Sisters (4 ♂, 3 ♀, 4 sex unknown; CMNZ, NZAC). **Locality unrecorded:** (2 sex unknown; BMNH, NZAC). **Pupa. New Zealand, Chatham Islands:** New Zealand, CH, Star Keys, 23.i.1998, J.W.M. Marris, in soil under tussock base by rock face (1, LUNZ). **Larvae. New Zealand, Chatham Islands:** New Zealand, CH, Star Keys, 23.i.1998, J.W.M. Marris, in soil under tussock base by rock face (4, LUNZ); same data, died 20.iii.1998 (1, LUNZ); same data, died 28.x.1998 during lab rearing (1 + exuvium, LUNZ); New Zealand, CH, South East I., Woolshed Bush, 22.i.1998, J.W.M. Marris, ex rotten *Plagianthus* branch on ground, died during rearing (1 + exuvium, LUNZ); Mangere I., Chatham Is., 18.ix.1970, J.I. Townsend, litter 701178 (1, NZAC); Chatham Is., Mid Sisters I., 24.ix.1973, A. Whittaker, fern 73/152 (3, NZAC); New Zealand, CH, South East I., 17.i.1997, J.W.M. Marris, ex *Myrsine* log (1, LUNZ); New Zealand, CH, Chatham Islands, Little Mangere I., 23-6.i.1998, M & D. Bell, I Atkinson (1, LUNZ).

Adult Diagnosis. Known only from the Chatham Islands. Distinguished from other *Amychus* species by the following combination of characters: integument of dorsum with numerous weakly raised glossy pustules; prothorax with sides moderately curved to near apex of hind angles; elytra with disc convex at midlength, lacking strongly developed tubercles; hind wings micropterous.

Adult Redescription. As for the genus description and as follows. *Form.* Body (Fig. 1) length (excluding head) 12.7–18.5 (\bar{x} = 15.7) mm, width 4.6–7.4 (\bar{x} = 6.0) mm (n = 25 for all measurements given for this

species unless stated otherwise), moderately convex. Integument of dorsum with numerous weakly raised glossy pustules. Vestiture of dorsum moderately stout, golden.



FIGURES 1–3. *Amychus* species adult dorsal habitus. 1, *A. candezei* Pascoe; 2, *A. granulatus* (Broun); 3, *A. manawatawhi* Marris and Johnson, new species. Scale bar = 10 mm.

Head. Head (Fig. 1) with pustules on frontal region; EI 0.19–0.24 (0.22).

Thorax. Prothorax (Fig. 1) broad, PI 71–80 (75), not explanate, sides moderately curved to near apex of hind angles, widest at about posterior 2/3rd, hind angles parallel-sided to weakly convergent; disc moderately convex with faint median longitudinal depression. Hypomeron punctate throughout. Prosternum with anterior chin piece separated from basal section by a more or less distinct transverse sulcus; chin piece weakly to moderately deflexed ventrally. Prosternal spine length 1.0–1.4 (\bar{x} = 1.2) (n = 19) × procoxal cavity width. Scutellum with sides straight anteriorly. Elytra length 9.2–13.4 (\bar{x} = 11.3) mm; sides curved to apex, apex narrowly rounded; disc convex; surface with faint humeral and lateral tubercles; punctate, punctures widely separated; intervals convex, intervals 1, 3, 5, 7, and 9 raised; integument with numerous weakly raised glossy pustules. Hind wings micropterous; length 4.7–5.9 (\bar{x} = 5.1) mm (n = 6), width 0.9–1.5 (\bar{x} = 1.2) mm (n = 6); venation as in Fig. 5.

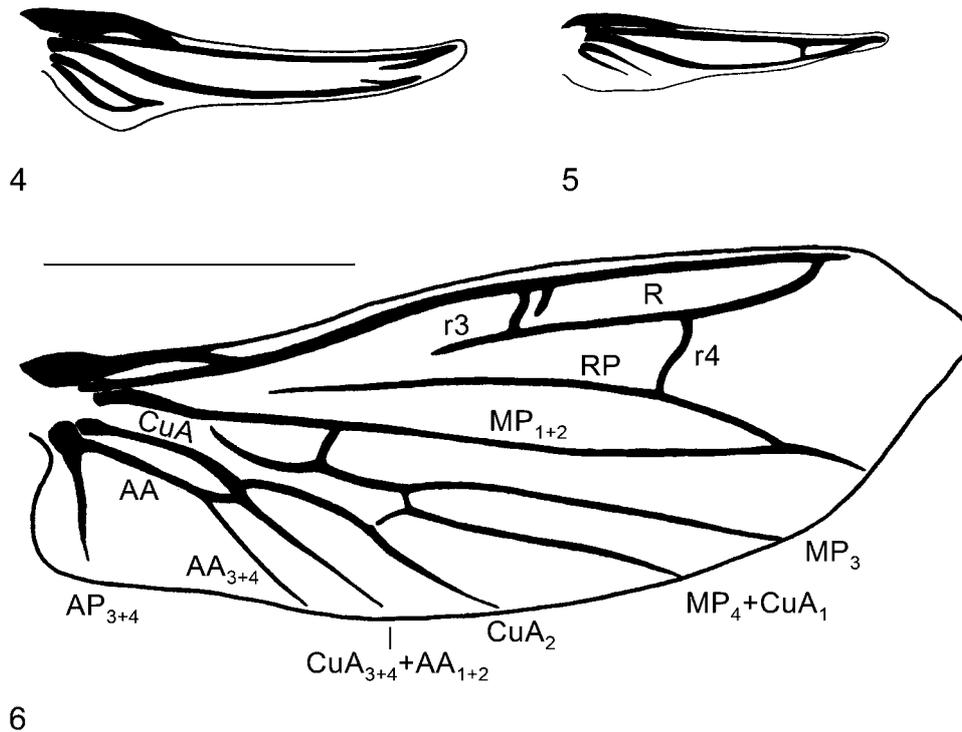
Abdomen. Abdominal ventrites evenly punctate throughout.

Male genitalia. Aedeagus (Fig. 7) length 2.0–2.3 (\bar{x} = 2.2) mm (n = 16), width 0.6–0.7 (\bar{x} = 0.6) mm (n = 16), 3.2–3.7 × as long as wide.

Female genitalia. Ovipositor length 4.6–5.2 (\bar{x} = 4.7) mm (n = 5); coxite length 1.1–1.2 (\bar{x} = 1.1) mm (n = 5); styli length 1.1 mm (n = 6). Genital tract as given for generic description.

Pupa Description. (Figs. 12–15) Pupa (Figs. 12,13) exarate; length 23.5 mm, width 7.0 mm; pale yellow throughout, except brown to black mandible apices, compound eyes, and pretarsal claws. Head hypognathous, partially retracted into prothorax; antenna (Fig. 14) lying straight and across hypomeron toward hind angle of pronotum. Pronotum shallowly convex; anterior angles each with single attenuate tubercle, hind angles each with single attenuate tubercle coincident with position of large hind angle seta of imago, and a pair of attenuate tubercles anterad of the scutellar emargination. Elytron (Fig. 14) and wing narrow, arcuate to ventrolateral area of thorax. Tarsus with extended ventral lobes coincident with setal pads of imago on

tarsomeres 1–4; claws with 2 digitiform ventral lobes coincident in position with large ventral setal group in imago. Abdomen with hind angles of tergites slightly elevated, but lacking gin-traps; anal region (Fig. 15) with a pair of arcuate and attenuate tubercles each side.

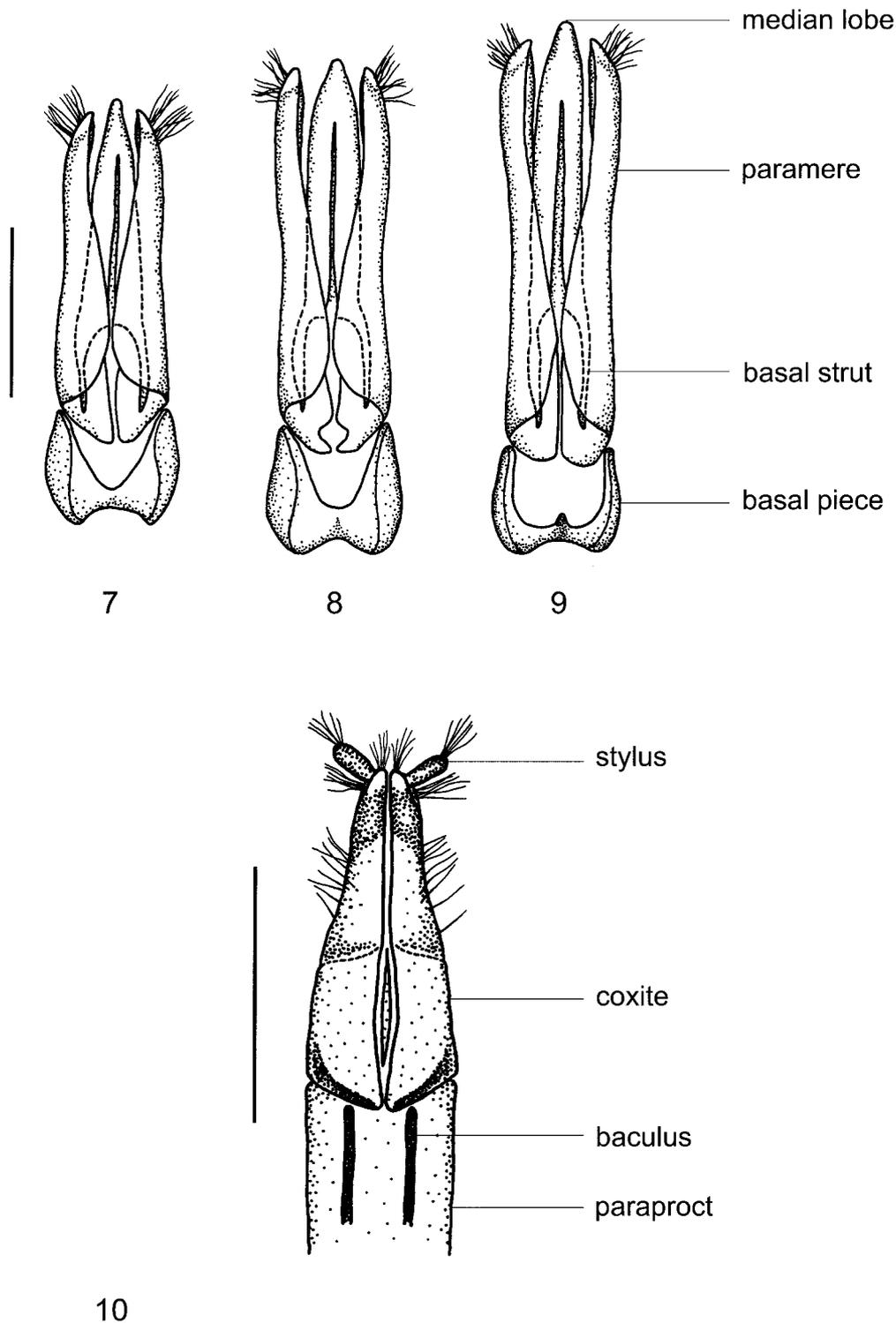


FIGURES 4–6. *Amychus* species hind wings. 4, *A. granulatus* (Broun); 5, *A. candezei* Pascoe; 6, *A. manawatawhi* Marris and Johnson, new species. Scale bar = 5 mm.

Larva Description. See Figs. 16–19, and as for the genus description and as follows: Length ca. 27.0 mm (probably 3rd instar); head with frons narrowly pedunculate posteriorly, posterior frontal arms of sutures shallowly and evenly arcuate; abdomen with terga 1–8 with fine punctures, on terga 1–7 each puncture adjacent to a short, transverse, moderately sclerotized carinula that partially forms the puncture margin; punctures extending to posterior margin of tergite, but carinulae becoming obsolescent at posterior third on terga 7–8; tergite 9 with dorsolateral tubercles with anterior pair elevated, distinct, apex arcuate posteromedially.

Notes. Elaterid larvae typically develop through 3–5 instars (Johnson 2002), with the lower number being the most commonly observed value. We have inadequate material of *Amychus* larvae to accurately assess instar numbers, but presume the standard three-instar pattern and estimate the instar for specimens by using body proportions relative to pupal and adult size. The two larvae and one pupa reported here from Star Keys were collected together. As such, the larger larva is judged a mature and probable 3rd instar specimen. The second larva measured ca. 16.5 mm in length and may represent a mature 2nd instar larva. A third specimen measured 16.7 mm in length, is unnaturally contracted, but is probably also a 2nd instar. One specimen measured ca. 33.5 mm and another ca. 40.3 mm, but these are highly distended specimens yet are probably 3rd instar larvae.

Distribution. Restricted to the Chatham Islands group (CH) from: Chatham Island (43°55'S, 176°30'W), Little Mangere Island (Tapuaenuku) (44°17'S, 176°19'W), Mangere Island (44°16'S, 176°18'W), Pitt Island (44°17'S, 176°13'W), South East Island (Rangatira) (44°21'S, 176°10'W), Star Keys (Motuhope) (44° 14' S, 176° 49' W), The Forty Fours (Motuhara) (43°58'S, 175°50'W), and The Sisters (Rangitatahi) (43°34'S, 176°49'W).



FIGURES 7–10. *Amychus* species genitalia. 7, *A. candezei* Pascoe aedeagus, dorsal view; 8, *A. granulatus* (Broun) aedeagus, dorsal view; 9, *A. manawatawhi* Marris and Johnson, new species, aedeagus, dorsal view; 10, *A. manawatawhi* Marris and Johnson, new species, ovipositor, ventral view. Scale bars = 1 mm.

Amychus candezei is largely confined to islands free of introduced mammalian predators within the Chatham Islands group except for Chatham Island, where mice (*Mus musculus* Linnaeus), Norway rats (*Rattus norvegicus* Berkenhout) and ship rats (*R. rattus* Linnaeus) are present. Emberson (1998) noted that this species was last found on Chatham Island at Hapupu in 1967 but could not be found there in 1992.

Subsequently, however, one beetle was found under a log at this locality in 2001 (J.I. Townsend pers. comm. 2003) and another was collected from under loose bark in 2005 (J. Goldberg pers. comm. 2009). Specimens have also been collected recently in the north-western part of Chatham Island from the Harold Peirce Scenic Reserve (43°46'S, 176°48'W) (D. Clarke pers. comm. 2006) and nearby at Waitangi West (43°47'S, 176°49'W) (N. Curtis pers. comm. 2008).

Biology. Adults have been collected on tree trunks (including *Melicytus chathamicus* (F. Meull.) Garnock-Jones and *Olearia traversii* (F. Meull.) Hook. f.) at night, under logs, and from under rocks and low vegetation in coastal scrub and sward. Larvae have been collected from rotten *Plagianthus* and *Myrsine* wood, in soil at the bases of tussock grasses and from fern litter.

Remarks. A lectotype for *Amychus candezei* Pascoe is hereby designated to ensure nomenclatural stability by clarifying the nominal taxon. The lectotype is considered to be the most likely specimen to have been examined by the author at the time of description based on the locality and type labels being written in Pascoe's handwriting and the specimen having been held in his personal collection. The lectotype specimen is labelled "Chatham I", yet Pascoe's (1876) description noted the habitat as "Pitt's [sic] Island". Earlier in the same paper, however, in the description of *Inophloeus transversii* the "Hab." is given as "Chatham Islands" but, in the comment which follows, Pascoe remarks "It is from Pitt's Island one of the Chatham Group where it was found by Mr Travers". The size range given by Pascoe (1876) indicates a series of specimens were examined for his description. The Janson and Sharp collection specimens are included as paralectotypes based on the knowledge that specimens were frequently given to friends (C. Von Hayek pers. comm. 2003) and, in the case of the Janson specimen, due to the locality label being written in Pascoe's handwriting.

Hudson's (1934) synonymy of *Amychus candezei* and *Psorochroa granulata* is incorrect as he refers to the species as being "Apparently confined to the islands in Cook Strait (Stephen's [sic] Island and The Brothers) ...", thus indicating he was unaware of specimens from the Chatham Islands. In addition, comparison of type material clearly shows them to be separate species. Brookes (1932) was aware of a Chatham Islands species, noting that *Psorochroa granulata* is found on "... Stephen [sic] Island ... but is to be met with again at the Chatham Islands", but despite this, wrongly followed Hudson's (1934) synonymy.

Examination of the type specimen of *A. schauinslandi* showed no clear morphological differences from *A. candezei*. The type of *A. rotundicollis* could not be located in the Übersee Museum collection and is presumed to have been lost during World War II (P.-R. Becker pers. comm. February 1998). Emberson's (1998) synonymy of *A. rotundicollis* and *A. candezei* is supported here based on Schwarz's (1901) description. Moreover, the Chatham Islands' beetle fauna has been extensively studied in recent times and is well documented (Emberson 1998, 2002) and no specimens resembling *A. rotundicollis* and differing from *A. candezei* have been found.

Amychus candezei is listed by Molloy and Davis (1994) in Category C (the third highest priority category for conservation) and is protected under the Seventh Schedule of the Wildlife Act 1953 (Anonymous, 1980). Hitchmough *et al.* (2007) placed *A. candezei* in the Range Restricted category of the New Zealand Threat Classification System.

***Amychus granulatus* (Broun)**

(Figs. 2, 5, 9)

Psorochroa granulata Broun 1883: 302 – Broun 1886: 773; Hudson 1934: 81.

Amychus stephensiensis Schwarz 1901: 193 – Schwarz 1907: 232; Tarnawski 2001: 305.

Amychus granulatus (Broun) – Ramsay and Gardner 1977: 3.

Type material. Lectotype, here designated: "Syntype [Round, blue-bordered label, added in March 2003 (C. von Hayek pers. comm. 2003)] / New Zealand Broun Coll. Brit. Mus. 1922-482 / Brothers Isles / *Psorochroa graniger* [sic] [In Broun's handwriting] / 1370 [In Broun's handwriting] / LECTOTYPE *Amychus granulatus*

(Broun 1883) Marris & Johnson 2010" [Specimen length 19.5 mm] (Broun Collection, BMNH). *Paralectotypes*: "Syntype? [Round, blue-bordered label] / Brothers Is. Cook Strait Sandager / G.C. Champion Coll. B.M. 1927-409. / Possible syntype C.M.F. von Hayek 03.2003 / PARALECTOTYPE *Amychus granulatus* (Broun 1883) Marris & Johnson 2010" [σ , aedeagus on card, length c. 18 mm] (BMNH); "Syntype? [Round, blue-bordered label] / φ / New Zealand [Oval label] / 1370 [In Broun's handwriting] / Pascoe Coll. 93-60. / Syntype? *Psorochroa granulatus* Pascoe, C.M.F. von Hayek 2004. / PARALECTOTYPE *Amychus granulatus* (Broun 1883) Marris & Johnson 2010" [Specimen length 18.0 mm] (BMNH); "The "Brothers" Cook Straits [sic] [In Broun's handwriting] / *Psorochroa granulata* [In Broun's handwriting] / PARALECTOTYPE *Amychus granulatus* (Broun 1883) Marris & Johnson 2010" [Specimen length 19.0 mm] (NZAC).

Additional adult material. New Zealand, Marlborough Sounds/Cook Strait: Maud Island (1 σ , 4 φ , 6 sex unknown; CMNZ, LUNZ, NZAC); Sentinel Rock (1 σ , 2 sex unknown; LUNZ, CMNZ); Stephens Island (16 σ , 11 φ , 53 sex unknown; BMNH, CMNZ, CNCI, LUNZ, USNM, NZAC); The Brothers (4 σ , 1 φ , 6 sex unknown; BMNH, LUNZ, MONZ, NZAC); Trio Islands: middle Trio Island (1 φ , 5 sex unknown; CMNZ, LUNZ, NZAC), south Trio Island (1 sex unknown; LUNZ); **North Canterbury;** near Waikari (1 sex unknown, CMNZ). One specimen, collected by Helms and from the Sharp collection (BMNH), is labelled as from Greymouth. This was possibly mislabeled since no other records of *A. granulatus* are known from the Greymouth area. Helms sent beetles to Sharp from the vicinity of Greymouth and Picton (Watt 1977). One specimen ostensibly from Ovalau, Fiji (USNM), is assumed to be incorrectly labelled as no *Amychus* species are known from beyond New Zealand.

Larval material examined. New Zealand, Marlborough Sounds/Cook Strait: New Zealand, SD, Middle Trio Island, 15.ii.1995, J.W.M. Marris, ex partially rotten base of *Olearia paniculata* tree (1, LUNZ)

Adult diagnosis. Extant populations known only from the Marlborough Sounds/Cook Strait region. Distinguished from other *Amychus* species by the following combination of characters: integument of dorsum with numerous strongly raised glossy pustules; prothorax strongly explanate; elytra strongly tuberculate, flattened mesally to steeply declivous laterally at midlength; hind wings micropterous.

Adult redescription. Form. Body (Fig 2) length (excluding head) 16.0–22.5 (\bar{x} =20.0) mm, width 6.1–9.0 (\bar{x} =7.5) mm ($n=20$ for all measurements given for this species unless stated otherwise), strongly flattened. Integument of dorsum with numerous strongly raised, dome-like glossy pustules. Vestiture of dorsum stout, strongly decumbent, orange.

Head. Head (Fig. 2) with distinct pustules on frontal region; vestiture stout; EI 0.20–0.29 (\bar{x} =0.24).

Thorax. Prothorax (Fig. 2) very broad, PI 67–73 (\bar{x} =70), strongly explanate; sides strongly curved to base of hind angles, widest at about midpoint, hind angles parallel-sided to weakly divergent; disc flattened. Hypomeron evenly punctate throughout. Prosternum with anterior chin piece separated from basal section by a faint transverse sulcus or sulcus obsolete; chin piece weakly deflexed ventrally. Prosternal spine length 1.3–1.6 (\bar{x} =1.4) ($n=18$) x procoxal cavity width. Scutellum with sides parallel-sided to weakly concave anteriorly. Elytra length 11.6–18.2 (\bar{x} =14.5) mm; sides parallel-sided to basal 3/5th, apex narrowly rounded; disc strongly flattened mesally, lateral 1/5th steeply declivous to sides from behind humerus to basal 3/5th; surface strongly tuberculate, tubercles prominent humerally and laterally; striae weakly impressed to obscured laterally; intervals flattened; weakly punctate, punctures widely separated; integument with numerous strongly raised glossy dome-like pustules. Hind wings micropterous; length 4.8–7.5 (\bar{x} =6.0) mm ($n=6$), depth 1.3–1.8 (\bar{x} =1.6) mm ($n=6$); venation as in Fig. 4.

Abdomen. Abdominal ventrites evenly punctate throughout.

Male genitalia. Aedeagus (Fig. 9) length 2.5–3.0 (\bar{x} =2.8) mm ($n=10$), width 0.6–0.7 (\bar{x} =0.7) mm ($n=10$), 3.9–4.6 x as long as wide.

Female genitalia. Ovipositor length 4.3–4.7 (\bar{x} =4.6) mm ($n=4$); coxite length 1.1–1.2 (\bar{x} =1.2) mm ($n=4$); styli length 1.8 mm ($n=4$). Genital tract as given for generic description.

Larval description. As for the genus description and as follows. Length ca. 27.5 mm (early last instar); head with frons moderately pedunculate posteriorly, posterior frontal arms of sutures moderately arcuate then subparallel on vertex; abdomen with terga 1–8 with deep and moderately coarse punctures, on terga 1–7 each puncture adjacent to a transversely undulating, moderately sclerotized carinula that partially forms the puncture margin; punctures extending to before posterior margin of tergite, but carinulae becoming obsolescent at posterior third on terga 7–8; tergite 9 with dorsolateral tubercles with anterior pair low, indistinct.

Distribution. Presently restricted to islands of the Marlborough Sounds and Cook Strait (SD) from: Maud Island (Te Hoiere) (41°02'S, 173°53'E), Sentinel Rock (40°53'S, 174°08'E), Stephens Island (Takapourewa) (40°40'S, 173°58'E), The Brothers (41°06'S, 174°26'E), and the Trio Islands (Kuru Pongi) (middle and south Trio Islands) (40°50'S, 174°00'E). Also recorded from subfossil remains from Arden near Waikari (NC) (42°57'S, 172°46'E), South Island (Worthy and Holdaway 1996).

Records of specimens collected from "The Brothers", were almost certainly taken from the northern island of The Brothers group (usually referred to as North Brother or Little Brother Island), which is the site of a previously manned lighthouse station. *Amychus granulatus* was described from specimens collected by Mr P. Stewart-Sandager (Broun 1883) who was a lighthouse keeper on North Brother Island (Watt 1977). There are no records of *A. granulatus* from South (or Big) Brother Island. Recent attempts to locate *A. granulatus* specimens on North Brother Island were unsuccessful and it is possible that the species is now extinct on its type locality island (Marris unpublished data).

Meads (1976) reported *A. granulatus* as present on Outer Chetwode Island (Te Kakaho). This record was based on the sighting of beetle remains that were not collected (M.J. Meads pers. comm. 1994). No other record of *Amychus granulatus* exists from Outer Chetwode Island despite recent efforts to search for this species (Marris unpublished data).

Biology. Adults have been collected from on tree trunks (including *Beilschmiedia tawa* (Cunn.) Benth. and Hook. f. ex Kirk, *Coprosma repens* Hook. f., *Fuchsia excorticata* (J.R. Forster and G. Forster) L. f., and *Myoporum laetum* G. Forster) at night, from under logs, rocks, low vegetation (*Tetragonia tetragonioides* (Pall.) Kuntze and *C. repens*) and dead rank grass, and from pitfall traps. Only one larva is known for the species. This was collected from the partially rotten base of the tree *Olearia paniculata* (J.R. Forster and G. Forster) Druce.

Remarks. A lectotype for *Amychus granulatus* (Broun 1883) is hereby designated to ensure nomenclatural stability by clarifying the nominal taxon. The lectotype is considered to be the most likely specimen to have been examined by the author at the time of description based on its identification and species number labels being written in Broun's handwriting and its locality designation.

Schwarz (1907) transferred *A. stephensiensis* to *Psorochroa* and included it as a "var." (= variety) of *P. granulata*. This ranking was repeated by Schenkling (1927). Article 45.6.4 of the Code of Zoological Nomenclature (International Commission on Zoological Nomenclature 1999) states that the use of variety in this instance places *A. stephensiensis* at subspecies rank. Schwarz (1907) thereby effectively synonymised these species. Van Zwaluwenburg (1932) listed *P. granulata*, but did not include the synonymy while incorrectly recording the distribution as Chatham [Islands]. Tarnawski (2001) apparently overlooked both the Schwarz (1907) action and Hudson's (1934) synonymy of the two genera. The type of *A. stephensiensis* could not be located in the Übersee Museum collection and it is presumed to have been lost during World War II (P.-R. Becker pers. comm. February 1998). Schwarz's (1907) synonymy is justified based on comparison of the descriptions of the two species and because only *A. granulatus* has subsequently been found on Stephens Island, the type locality of *A. stephensiensis*.

The combination "*Amychus granulatus*" was apparently first used by Ramsay and Gardner (1977). This combination was subsequently adopted by various authors (e.g., Anonymous 1980, Meads 1990, Ramsay *et al.* 1988).

Worthy and Holdaway's (1996) subfossil record of *A. granulatus* (see *Distribution*) is the only record of this species, or any *Amychus* species, from mainland New Zealand. They collected a partly damaged

pronotum (not a single elytron as noted) from a nest site of the extinct laughing owl (*Sceloglaux albifacies* Gray). The specimen was identified as “*Amychus* cf. *granulatus*”, however, the shape and dimensions of the pronotum are consistent with *A. granulatus*. Kuschel and Worthy (1996) identified several large flightless weevil (Coleoptera: Curculionidae) species, which are presently restricted to rodent-free offshore islands, from subfossil nest and cave deposits from mainland New Zealand. They attributed the reduction in range of these species as primarily due to predation by introduced rodents. The mainland subfossil record of *A. granulatus* and the species’ present distribution on rodent-free islands supports this hypothesis.

Amychus granulatus is listed in Molloy and Davis (1994) in Category B (the second highest priority category for conservation) and is protected under the Seventh Schedule of the Wildlife Act 1953 (Anonymous 1980). Hitchmough *et al.* (2007) placed *A. granulatus* in the Nationally Endangered category of the New Zealand Threat Classification System.

***Amychus manawatawhi*, sp. nov.**

(Figs. 3, 6, 9–11, 20–26)

Adult material examined. *Holotype*. ♂. “New Zealand, TH [Three Kings Islands], Great Island, Lighthouse Bush, NZMS 260 LO1 316827, 5.xii.1996, J.W.M. Marris, on *Kunzea* trunk at night / HOLOTYPE ♂ *Amychus manawatawhi* Marris & Johnson 2010 [Red label]” [Dissected, genitalia vial attached to pin] [specimen length 22.5 mm] (LUNZ). *Paratypes*. **New Zealand, Three Kings Islands: Great Island**, New Zealand, TH, Great Island, Tasman Valley, NZMS 260 LO1 316823, 9 December 1996, J.W.M. Marris, on trees and logs at night (8 sex unknown, AMNZ, BMNH, CMNZ, MONZ); New Zealand, TH, Great Island, Tasman Valley, NZMS 260 LO1 316823, 9 December 1996, J.W.M. Marris, on tree at night (1 ♂, 2 sex unknown, LUNZ); New Zealand, TH, Great Island, Tasman Valley, NZMS 260 LO1 316823, 9 December 1996, J.W.M. Marris, on *Kunzea* trunk at night (3 ♀, 1 sex unknown, LUNZ); New Zealand, TH, Great Island, Lighthouse Bush, NZMS 260 LO1 316827, 7 December 1996, J.W.M. Marris, on *Kunzea* trunk at night (1 ♂, 2 ♀, LUNZ); New Zealand, TH Great Island, Tasman Valley NZMS 260 LO1 316823 7 December 1996 J.W.M. Marris, in dead, standing *Kunzea* tree (1 sex unknown, LUNZ); New Zealand, TH, Great Island, Lighthouse Bush, NZMS 260 LO1 316827, 7 December 1996, G.L.F. Carlin, on *Kunzea* trunk at night (1 sex unknown, LUNZ); New Zealand, TH, Great Island, Tasman Valley NZMS 260 LO1 316823, 7 December 1996, G.L.F. Carlin, under loose bark of *Kunzea* tree (1 sex unknown, LUNZ); New Zealand, TH, Great Island, Lighthouse Bush, NZMS 260 LO1 316827, 5 December 1996, J.W.M. Marris, on *Kunzea* trunk at night (1 ♂, 3 sex unknown, LUNZ); New Zealand, TH, Great Island, Lighthouse Bush, NZMS 260 LO1 316827, 6 December 1996, J.W.M. Marris, on *Kunzea* trunk at night (1 sex unknown, LUNZ); New Zealand, TH, Great Island, Tasman Valley, NZMS 260 LO1 316823, 10 December 1996, J.W.M. Marris, under stones and loose bark *Kunzea*/broadleaved forest (1 ♂, 1 sex unknown, LUNZ); New Zealand, TH, Great Island, South East Bay Bush, NZMS 260 LO1 324833, 9 December 1996, F.J. Brook, under *Cordyline* log (1 sex unknown, LUNZ); New Zealand TH, Great I, Tasman Stream, 7 November 1999, F.J. Brook, on kanuka [*Kunzea sinclairii*] at night (1 ♂, 1 ♀, AMNZ); New Zealand, TH, Great Island, Baylis Stream, 11 April, M.J. Thorsen, on kanuka [*Kunzea sinclairii*] at night (1 ♂, 1 sex unknown, LUNZ); New Zealand, TH, Great Island, Baylis Stream, 11 April, F.J. Brook, on kanuka [*Kunzea sinclairii*] at night (1 sex unknown, LUNZ); Three Kings Islands, N[ew] Z[ealand], Great Island, 45 m, South East Bay, 27 November–1 December 1983, J.C. Watt, Pit trap 83/136 (3 sex unknown, NZAC); Castaway Camp, Three Kings Islands, Great Is[land], November [19]70, N[ew] Z[ealand] Ent[omology] Div[ision] Exp[edition], J.C. Watt (4 sex unknown, NZAC); Tasman Valley, Three Kings Islands, Great Is[land], November [19]70, N[ew] Z[ealand] Ent[omology] Div[ision] Exp[edition], J.C. Watt, under bark *Leptospermum ericoides* [= *Kunzea sinclairii*] (4 sex unknown, NZAC); Tasman Valley, Three Kings Islands, Great Is[land], November [19]70, N[ew] Z[ealand] Ent[omology] Div[ision] Exp[edition], J.C. Watt, under bark *Leptospermum ericoides* [= *Kunzea sinclairii*], Illustrated J. Liddiard 14 February [19]92 (1 sex unknown, NZAC); Tasman Valley, Three Kings

Islands, Great Is[land], November [19]70, N[ew] Z[ealand] Ent[omology] Div[ision] Exp[edition], G. Kuschel (3 ♂, 6 ♀, 7 sex unknown, NZAC); Tasman Valley, Three Kings Islands, Great Is[land], November [19]70, N[ew] Z[ealand] Ent[omology] Div[ision] Exp[edition], G. Kuschel, litter (1 ♀, NZAC); Tasman V, Great Is, Three Kings Is, P. Johns, 14.12.[19]63, at night (1♂, 1♀, CMNZ); **South West Island:** New Zealand, TH, South West Island, 29 November 1997, F.J. Brook, P. Aderson, on *Meryta* and *Cordyline* trunks at night (2 ♂, 2 sex unknown, LUNZ).

Larval Material Examined. New Zealand, Three Kings Islands: South West I., Three Kings Is., 1.iii.1949, G.A. Buddle (1, AMNZ).

Adult diagnosis. Known only from the Three Kings Islands. Distinguished from other *Amychus* species by the following combination of characters: dorsum lacking glossy pustules (occasionally with a few faintly raised glossy pustules restricted to prothorax); prothorax strongly explanate; elytra flattened mesally, lateral ½ sloping obliquely to sides at midlength; hind wings brachypterous, reaching apex of elytra.

Adult description. As for the generic description and as follows. *Form.* Body (Fig. 3) length (excluding head) 16.1–24.2 (\bar{x} = 20.5) mm, width 5.7–8.9 (\bar{x} = 7.4) mm (n = 20 for all measurements given for this species unless stated otherwise), moderately flattened. Integument of dorsum with, at most, a few faintly visible, glossy pustules on pronotum, absent on head and elytra. Vestiture of dorsum stout, golden.

Head. Head (Fig. 20) without pustules; vestiture stout; EI 0.23–0.31 (\bar{x} = 0.26). Mandibles, antennae, maxillae and labium as in Figs. 21, 24–26.

Thorax. Prothorax broad, PI 73–83 (\bar{x} = 77), strongly explanate; sides weakly curved to base of hind angles, widest at about posterior 2/3rd and near apex of hind angles, hind angles parallel-sided to weakly divergent; disc flattened. Hypomeron with faint punctation. Prosternum with anterior chin piece separated from basal section by a faint transverse sulcus or sulcus obsolete; chin piece weakly deflexed ventrally. Prosternal spine (Fig. 22) length 1.5–1.7 (\bar{x} = 1.6) (n = 12) x procoxal cavity width. Scutellum with sides parallel-sided to weakly concave anteriorly. Elytra length 11.7–17.9 (\bar{x} = 15.0) mm; sides curved to apex, apex narrowly rounded; flattened mesally, lateral ½ sloping obliquely to sides from behind humerus to about midpoint; surface lacking sculpturation except for postbasal tubercle present on 4th interval; striae impressed; intervals flattened to weakly convex; integument without glossy pustules. Hind wing brachypterous; length 13.8–15.6 (\bar{x} = 14.7) mm (n = 5), depth 4.6–5.3 (\bar{x} = 4.9) mm (n = 5); wedge cell absent; apex of wing without sclerotisations; without transverse apical fold in repose; venation as in Fig. 6; venation varies as described for the genus.

Abdomen. Abdominal ventrites punctate throughout.

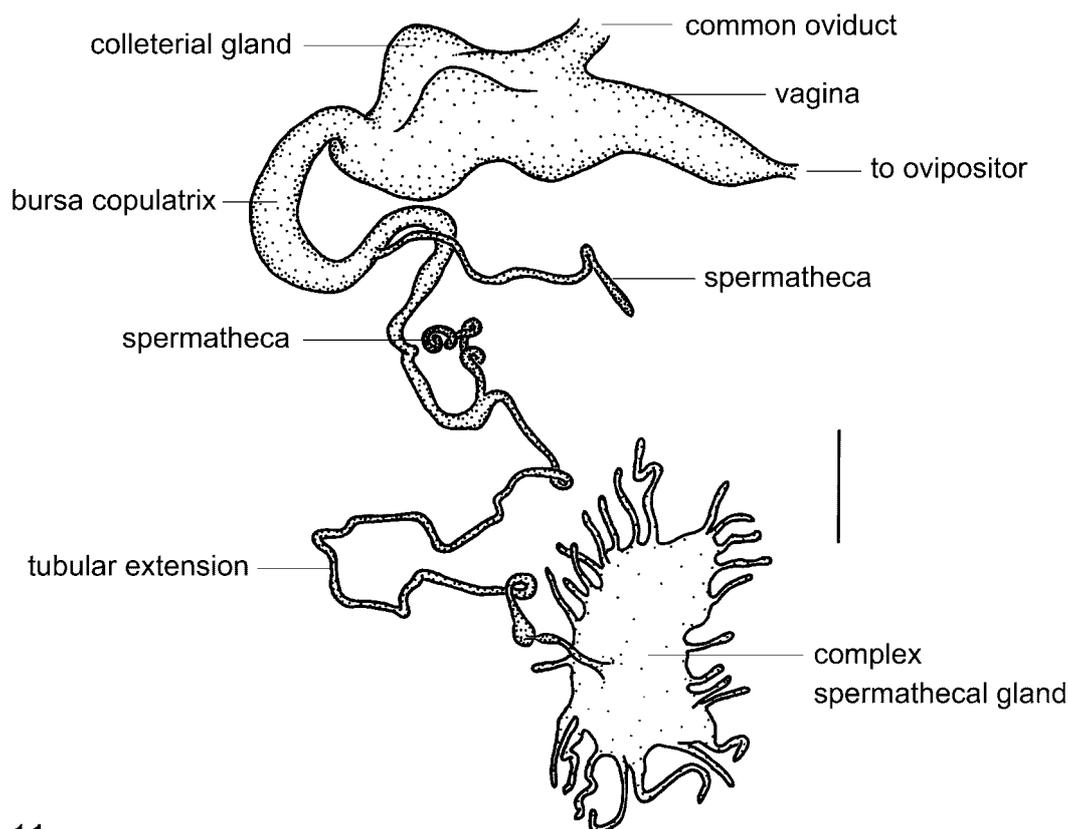
Male genitalia. Aedeagus (Fig. 9) length 2.9–3.2 (\bar{x} = 3.0) mm (n = 10), width 0.6–0.7 (\bar{x} = 0.6) mm (n = 10), 4.3–5.3 x as long as wide.

Female genitalia. Ovipositor (Fig. 10) length 5.5–6.0 (\bar{x} = 5.7) mm (n = 5); coxite length 1.2 mm (n = 5); styli length 0.18–0.20 (\bar{x} = 0.18) mm (n = 5). Genital tract (Fig. 11) as given for generic description.

Larval description. As for the genus description and as follows. Length ca. 30.8 mm (late last instar); head with frons narrowly pedunculate posteriorly, posterior frontal arms of sutures shallowly and evenly arcuate; abdomen with terga 1–8 with deep and moderately coarse punctures, on terga 1–7 each puncture adjacent to a transversely undulating, moderately sclerotized carinula that partially forms the puncture margin; punctures extending to near posterior margin of tergite, but carinulae becoming obsolescent at posterior third on terga 7–8; tergite 9 with dorsolateral tubercles with anterior pair elevated, distinct.

Distribution. Restricted to the Three Kings Islands group (TH): Great Island (34°10'S, 172°08'E) and South West Island (34°11'S, 172°04'E).

Biology. Adults have been collected from on tree trunks (including *Cordyline kaspar* W.R.B. Oliver, *Kunzea sinclairii* (Kirk) W. Harris and *Meryta sinclairii* (Hook. f) Seem.) and logs at night and, by day, from under bark, stones and logs, and from pitfall traps and litter samples. The larva of *A. manawatawhi* is known from a single specimen from South West Island. No habitat information was given in the label data.



11

FIGURE 11. *Amychus manawatawhi* Marris and Johnson, new species, female genital tract. Scale bar = 1 mm.

Remarks. The Three Kings Islands support a large number of endemic taxa including several genera and species of beetles (e.g., Britton 1964; Given 1954; Holloway 1963, 1982; Watt *et al.* 2001). The high number of endemics reflects the islands' long period of isolation, since at least the late Miocene (Brook and Thrasher 1991). *Amychus manawatawhi* is presumed to be a primary endemic species, that is, naturally restricted to the Three Kings Islands. If this species was a secondary endemic, that is, restricted to relict populations due to predator-induced extinction, populations would be expected to exist on other predator-free northern offshore islands. A probable example of a secondary endemic is the large entimine weevil *Anagotus turbotti* (Spiller), known from the Three Kings, Hen and Chicken and Poor Knights Islands.

Molloy and Davis (1994) listed this species in category I, that is, species about which little is known, but based on existing knowledge are considered to be under threat. Hitchmough *et al.* (2007) placed *A. manawatawhi* (listed as *Amychus* sp.) in the Range Restricted category of the New Zealand Threat Classification System.

Etymology. The specific epithet is named for Manawa Tawhi, the Maori name for Great Island, the main island of the Three Kings group. Manawa Tawhi translates as "panting breath". According to Aopuri Maori, the chief Rauru swam from the mainland to the Three Kings Islands and arrived exhausted and much out of breath (Cheeseman 1888).

Family-Group Assignment

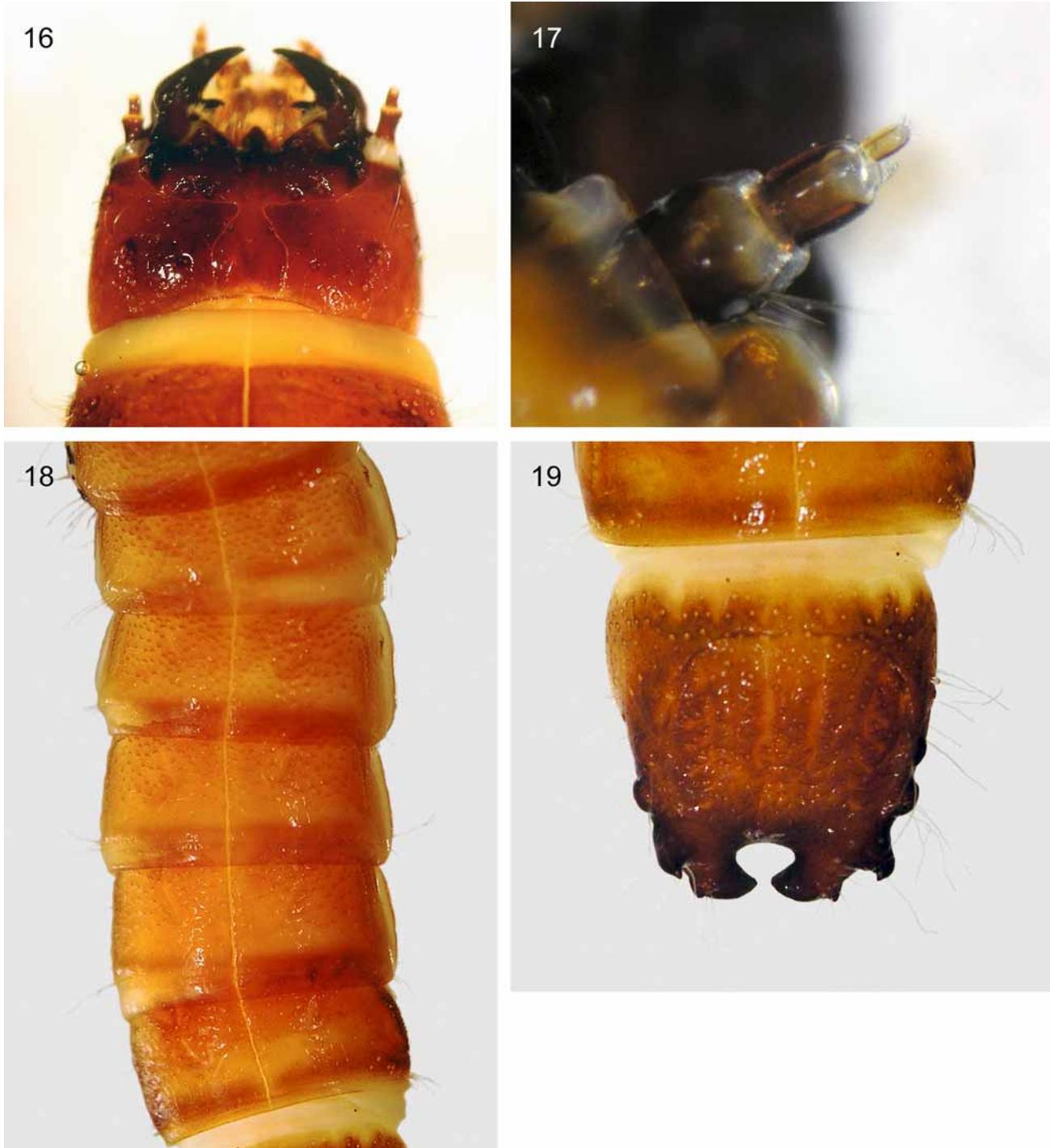
Historically since Candèze (1891), *Amychus* and *Psorochroa* were classified within taxa now regarded as comprising the Denticollinae, Ctenicerini (*sensu* Stibick 1979), based on their adult facies. It should be noted that Sánchez Ruiz (1996) changed the subfamily name to Dendrometrinae Gistel, which has strict priority but



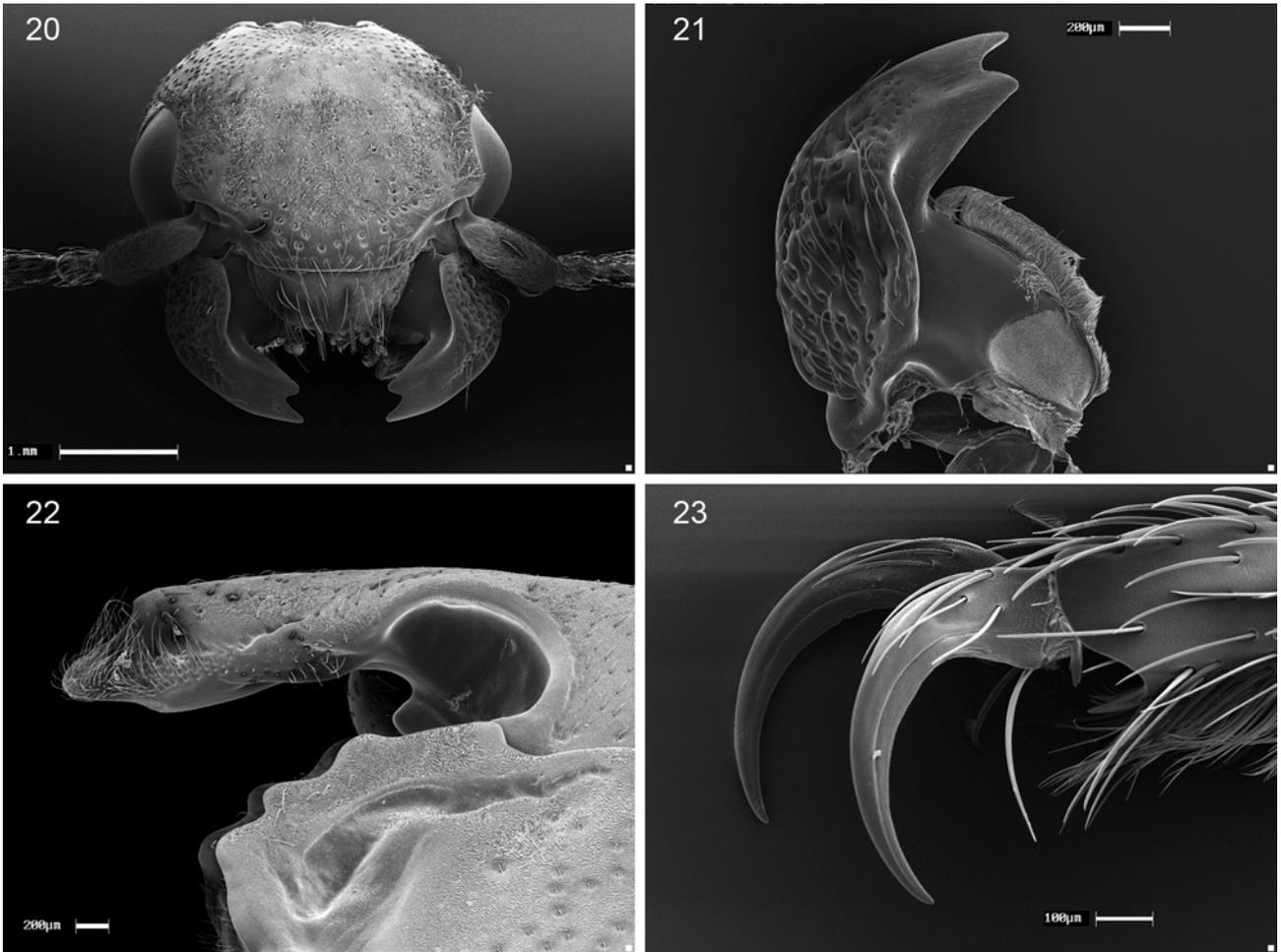
FIGURES 12–15. *A. candezei* Pascoe pupa. 12, Ventral habitus; 13, Dorsal habitus; 14, Head and thorax, lateral; 15, Apex of abdomen, dorsal.

this requires an assessment of whether the name is a *nomen dubium*. Therefore we are using the most familiar family-group names, Denticollinae and Ctenicerini, in recent taxonomic literature. Taxonomically, several New Zealand elaterid genera (Calder 1984, Johnson 1995) placed in Ctenicerini, including *Amychus*, present taxonomic difficulties for the separation of the presumed sister-taxa Agrypninae and Denticollinae (Stibick

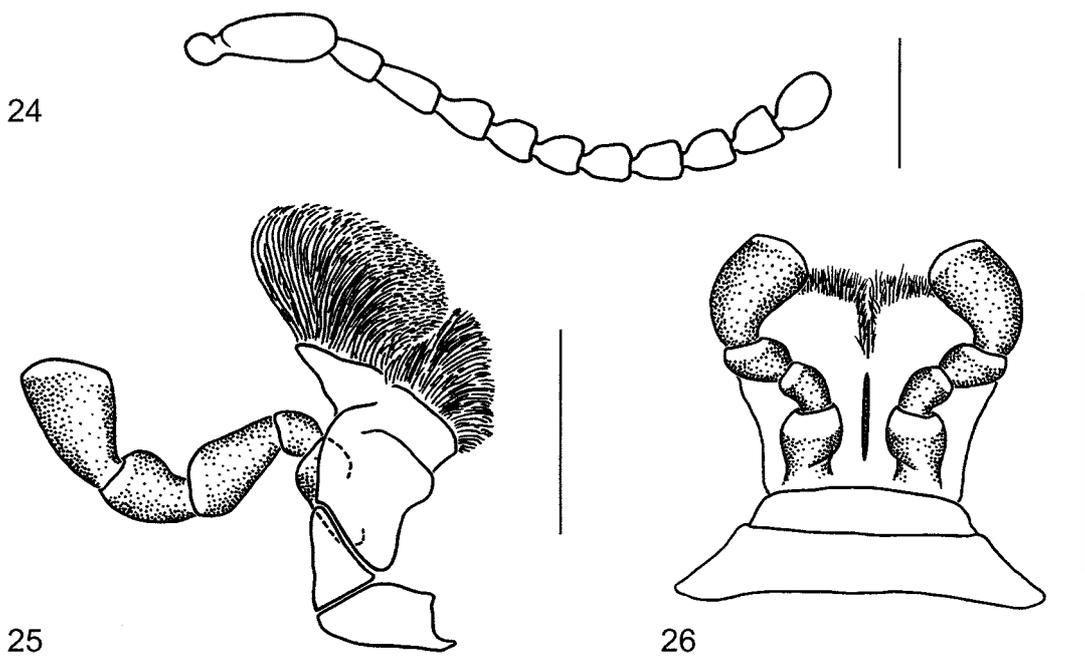
1979). *Amychus* is an exemplary taxon illustrating the dilemma of defining monophyly of these subfamilies, and we await results from ongoing studies by others (J. Lawrence *in litt.*, C. Costa *in litt.*) incorporating elaborate phylogenetic analyses of multiple characters, including molecular markers and sequences, for production of a new phylogenetic hypothesis for Elateriformia. Morphologically, the adult stage of *Amychus* beetles is replete with unique derived traits, particularly traits associated with the development of a cryptic, slow moving, flightless life history.



FIGURES 16–19. *Amychus candezei* Pascoe larva. 16, Head, dorsal.; 17, Right antenna, dorsolateral view; 18, Abdominal tergites 3–9 dorsal; 19, Abdominal tergite 9, dorsal.



FIGURES 20–23. Scanning electron micrographs of *Amychus manawatawhi* Marris and Johnson, new species. 20, Head, anterodorsal view; 21, Left mandible, dorsal view; 22, Prosternal process and procoxal cavity, left lateral view; 23, tarsal claw, right hind tarsus.



FIGURES 24–26. Antenna and ventral mouthparts of *Amychus manawatawhi* Marris and Johnson, new species. 24, Right antenna; 25, Right maxilla, ventral view; 26, labium, ventral view. Scale bars = 1 mm.

The presence of large setae emergent from the ventrolateral areas of the base of each tarsal claw and smaller setae along the dorsolateral areas has long been used with the presence of a wedge or anal cell in the metathoracic wing for defining Agrypninae as a monophyletic taxon (e.g., Crowson 1960, Stibick 1979, Calder *et al.* 1993, Johnson 1995, Calder 1996). The adults of Denticollinae stereotypically lack both the tarsal claw setae and the wedge cell of the wing, which have been shown to have phylogenetic value by the previous authors. With regard to larval traits, the absence of a mandibular retinaculum and presence of a triangular prementum in Agrypninae contrasted with the presence of a retinaculum and a quadrangular prementum in Denticollinae are supposedly comparable monophyletic traits. Table 1 compares the presence of salient morphological traits between Agrypninae and Denticollinae as they occur in *Amychus* spp.

TABLE 1. Comparison of morphological traits among Agrypninae, Denticollinae and *Amychus* species (Stibick 1979; Calder *et al.* 1993; Johnson, unpubl.).

Character	Agrypninae	Denticollinae	<i>Amychus</i> spp.
Adult tarsal claw setae	Present	Absent	Present
Adult wedge cell	Absent	Present	Absent
Larval cranium	Sulcate with adjacent carina	Smooth, rarely with shallow linear impression	Smooth
Larval postmentum	Triangular, with adjacent stipites	Quadrangular, with widely separated stipites	Quadrangular, with widely separated stipites
Larval tergite carinulae	Absent	Usually present	Present
Larval mandibular retinaculum	Absent	Present	Present
Larval cranial sutures	Indistinct, not cleaving at ecdysis	Distinct, cleaving at ecdysis	Distinct, presumably cleaving at ecdysis
Larval antenna	Antennomeres 1 & 2 with numerous midlength setae	Antennomeres 1& 2 with 0–3 midlength setae	Antennomeres 1&2 with 1–3 midlength setae
Larval pygopodium	With hinged and flap-like ventral sclerite, often with lateral teeth or hooks	With ring sclerite, no lateral teeth or hooks	With ring sclerite, no lateral teeth or hooks

The metathoracic wing venation of *Amychus* species is typical of the agrypnine pattern and expressed by *A. manawatawhi*. The wedge cell is absent and the apical RP sclerotizations are strongly reduced, though the apical sclerotizations can be variable within other elaterids and its expression in *Amychus* species could be affected by the absence of an apical fold in *A. manawatawhi* and by microptery as shown by *A. candezei* and *A. granulatus* (Figs. 4, 5). Following Johnson (1995), the medial-cubital venation pattern is typical of Agrypninae, where the CuA₁ crossvein is distal of the MP₃–MP₄ juncture, and each of these veins are straight through most of their length.

In contrast, the *Amychus* larvae studied here possess characters and states typical of other taxa in Denticollinae, and even Ctenicerini. A brief summary of some of the more distinctive discriminating characteristics thought to have phylogenetically interpretive value by other authors is given in Table 1.

The characteristics given in Table 1 show a clear indication of *Amychus* adults having characters defining them in the Agrypninae. In contrast, the larval characters show that *Amychus* must be placed in Denticollinae. It is our assessment of available characteristics and their interpretation that under the current infra-familial classification of the Elateridae (Lawrence and Newton 1995, Lawrence *et al.* 1999) the appropriate position of *Amychus* is equivocal.

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References

- Anonymous (1980) Wildlife Act 1953: 7th Schedule, Sections 2, 7B. Government Printer, Wellington.
- Britton, E.B. (1964) New Carabidae (Coleoptera) from the Three Kings Islands, New Zealand. *New Zealand Journal of Science*, 7, 521–527.
- Brook, F.J. & Thrasher, G.P. (1991) Cretaceous and Cenozoic geology of northernmost New Zealand. *New Zealand Geological Survey Record*, 41, 1–42.
- Brookes, A.E. (1932) A new genus and six new species of Coleoptera. *Transactions and Proceedings of the New Zealand Institute*, 63, 25–33.
- Broun, T. (1883) The New Zealand Carabidae. *New Zealand Journal of Science, Dunedin*, 1, 287–304.
- Broun, T. (1886) *Manual of New Zealand Coleoptera, Part 3*. Government Printer, Wellington, pp. 745–815.
- Calder, A.A. (1984) *Acritelater* (Coleoptera: Elateridae), a new genus of click beetle from New Zealand. *New Zealand Journal of Zoology*, 11, 35–42.
- Calder, A.A. (1996) *Click Beetles: Genera of Australian Elateridae (Coleoptera)*. Monographs on Invertebrate Taxonomy Vol. 2. CSIRO Publishing, Collingwood, Victoria, x + 401 pp.
- Calder, A.A., Lawrence, J.F. & Trueman, J.W.H. (1993) *Austrelater*, gen. nov. (Coleoptera: Elateridae), with a description of the larva and comments on elaterid relationships. *Invertebrate Taxonomy*, 7, 1349–1394.
- Candèze, E. (1891) Catalogue Méthodique des Élatérides connus en 1890. H. Vaillant-Carmanne, Liège, pp. xii+246.
- Cheeseman, T.F. (1888) Notes on the Three Kings Islands. *Transactions and Proceedings of the New Zealand Institute*, 20, 141–150.
- Crosby, T.K., Dugdale, J.S. & Watt, J.C. (1998) Area codes for recording specimen localities in the New Zealand subregion. *New Zealand Journal of Zoology*, 25, 175–183.
- Crowson, R.A. (1960) On some new characters of classificatory importance in adults of Elateridae (Coleoptera). *Entomologist's Monthly Magazine*, 96, 158–161.
- Emberson, R.M. (1998) The beetle (Coleoptera) fauna of the Chatham Islands. *New Zealand Entomologist*, 21, 25–64.
- Emberson, R.M. (2002) The beetle (Coleoptera) fauna of the Chatham Islands: additions and corrections. *New Zealand Entomologist*, 25, 69–77.
- Gistel, J.N.F.X. (1848) *Naturgeschichte des Thierreichs*. Zür höhere Schulen. Schieitlin and Kraiss, Stuttgart. xix+216+4 pp, 32 plates.
- Given, B.B. (1954) Melolonthinae (Coleoptera) from the Three Kings Islands. *Records of the Auckland Institute and*

- Museum*, 4, 267–270.
- Hitchmough, R., Bull, L. & Cromarty, P. (compilers) 2007 *New Zealand Threat Classification System lists 2005*. Department of Conservation, Wellington, 194 pp.
- Holloway, B.A. (1963) A new species of *Lissotes* Westwood from New Zealand, and a description of the female of *L. oconori* Holloway (Coleoptera: Lucanidae). *Transactions of the Royal Society of New Zealand*, 3, 77–80.
- Holloway, B.A. (1982) Anthribidae (Insecta: Coleoptera). *Fauna of New Zealand* 3, 265 pp.
- Hudson, G.V. (1934) *New Zealand beetles and their larvae: an elementary introduction to the study of our native Coleoptera*. Ferguson and Osborne, Wellington, 236 pp.
- International Commission on Zoological Nomenclature (1999) *International Code of Zoological Nomenclature*, 4th edition. The International Trust for Zoological Nomenclature, London, 306 pp.
- Johnson, P.J. (1995) A new genus of Conoderini, with new generic classifications for *Ctenicera sleeperi* Becker and *Ctenicera pilatei* (Champion), and a new species from Jamaica. *The Coleopterists Bulletin*, 49, 59–71.
- Johnson, P.J. (2002) Family 58. Elateridae. In: Arnett, R.H., Jr., Thomas, M., Skelley, P.E. and Frank, J.H. (Eds.), *American Beetles, vol. 2, Polyphaga: Scarabaeoidea through Curculionoidea*. CRC Press, Boca Raton. pp. 160–173.
- Klimaszewski, J. & Watt, J.C. (1997) Coleoptera: family group review and keys to identification. *Fauna of New Zealand* 37, 199 pp.
- Kukalová-Peck, J. & Lawrence, J.F. (1993) Evolution of the hind wing in Coleoptera. *The Canadian Entomologist*, 125, 181–258.
- Kuschel, G. & Worthy, T.H. (1996) Past distribution of large weevils (Coleoptera: Curculionidae) in the South Island, New Zealand, based on Holocene fossil remains. *New Zealand Entomologist*, 19, 15–22.
- Lawrence, J.F. (1991) Order Coleoptera. In: Stehr, F.W. (Ed.), *Immature Insects, vol. 2*, Kendall/Hunt, Dubuque, Iowa. pp. 144–658.
- Lawrence, J.F. & Britton, E.B. (1991) Coleoptera. In: CSIRO, *The Insects of Australia, 2nd edition, vol. II*. Melbourne University Press, Melbourne. pp. 543–683.
- Lawrence, J.F., Hastings, A.M., Dallwitz, M.J., Paine, T.A. & Zurcher, E.J. (1999) *Beetle Larvae of the World: Descriptions, Illustrations, Identification, and Information Retrieval for Families and Sub-families*. CD-ROM, Version 1.1 for MS-Windows. CSIRO Publishing, Melbourne.
- Lawrence, J.L. & Newton, A.F. Jr. (1995) Families and subfamilies of Coleoptera (with selected genera, notes, references and data on family-group names). In: Pakaluk, J. and Ślipiński, A. (Eds), *Biology, Phylogeny, and Classification of Coleoptera: Papers Celebrating the 80th Birthday of Roy A. Crowson*. Muzeum I Instytut Zoologii PAN, Warszawa, pp. 779–1006.
- Marris, J.W.M. (1996) *The conservation status of the Cook Strait click beetle, Amychus granulatus (Broun) (Coleoptera, Elateridae): with comments on other endangered insects of the Marlborough Sounds*. Report for the Department of Conservation, Nelson/Marlborough Conservancy, 33 pp.
- Meads, M.J. (1976) *Visits to Chetwode Islands, Middle Trio Island, Cook Strait; Maud Island, Marlborough Sounds, from 23 September to 7 October 1976: a report*. Unpublished report, Ecology Division, Department of Scientific and Industrial Research, Taita, 16 pp.
- Meads, M.J. (1990) *Forgotten fauna: the rare, endangered and protected invertebrates of New Zealand*. DSIR Information Series, no. 170. DSIR Publishing, Wellington, 95 pp.
- Molloy, J. & Davis, A. (1994) *Setting priorities for the conservation of New Zealand's threatened plants and animals*. 2nd edition, collated by C. Tisdall. Department of Conservation, Wellington, 64 pp.
- Ramsay, G.W., Meads, M.J., Sherley, G.H. & Gibbs, G.W. (1988) *Wildlife Research Liaison Group, research on terrestrial insects in New Zealand*. Wildlife Research Liaison Group Research Review No. 10. Department of Conservation, Wellington, 49 pp.
- Pascoe, F.P. (1876) Descriptions of new genera and species of New Zealand Coleoptera. Part 2. *Annals of the Magazine of Natural History (Series 4)*, 17, 48–60.
- Pascoe, F.P. (1877) [imprint date 1876] Descriptions of new genera and species of New Zealand Coleoptera. *Transactions and Proceedings of the New Zealand Institute*, 9, 402–427.
- Ramsay, G.W. & Gardner, N.W. (1977) Endangered and rare New Zealand invertebrate species. *The Weta*, 1, 3–6.
- Sánchez Ruiz, A. (1996) *Catálogo Bibliográfico de las Especies de la Familia Elateridae (Coleoptera) de la Península Ibérica e Islas Baleares*. Documentos Fauna Iberica 2. Museo Nacional de Ciencias Naturales, Madrid, 265 pp.
- Schenkling, S. (1927) Elateridae II. In: *Coleopterorum Catalogus auspiciis et auxilio W. Junk, Pars 88*, pp. 265–636. W. Junk, Berlin.
- Schwarz, O. (1901) Elateriden von der Stephens-insel und den Chatam-inseln gesammelt von hrn. direktor Schauinsland. *Deutsche Entomologische Zeitschrift*, 45, 193–196.
- Schwarz, O. (1906) Coleoptera, Fam. Elateridae. Fasc. 46B. In: Wytsman, P. (Ed.), *Genera Insectorum*. P. Wytsman, Bruxelles, pp 113–224.
- Schwarz, O. (1907) Coleoptera, Fam. Elateridae. Fasc. 46C. In: Wytsman, P. (Ed.), *Genera Insectorum*. P. Wytsman,

Bruxelles, pp 225–370.

- Stibick, J.N.L. (1979) Classification of the Elateridae (Coleoptera): Relationships and classification of the subfamilies and tribes. *Pacific Insects*, 20(2–3), 145–186.
- Tarnawski, D. (2001) A world catalogue of Ctenicerini Fleutiaux, 1936. Part II (Coleoptera: Elateridae: Athoinae). *Genus*, 12, 277–323.
- Van Zwaluwenburg, R.H. (1932) Check list of Elateridae of Oceania. *Occasional Papers of the Bernice P. Bishop Museum*, 9(23), 1–28.
- Watt, J.C. (1977) Conservation and type localities of New Zealand Coleoptera, and notes on collectors 1770–1920. *Journal of the Royal Society of New Zealand*, 7, 79–91.
- Watt, J.C., Marris, J.W.M. & Klimaszewski, J. (2001) A new species of *Platysus* Erichson (Coleoptera: Cucujidae) from New Zealand, described from the adult and larva. *Journal of the Royal Society of New Zealand*, 31, 327–339.
- Worthy, T.H. & Holdaway, R.N. (1996) Quaternary fossil faunas, overlapping taphonomies, and palaeofaunal reconstruction in North Canterbury, South Island, New Zealand. *Journal of the Royal Society of New Zealand*, 26, 275–361.