Pseudoliodini (Coleoptera: Leiodidae: Leiodinae) of New Zealand

Richard A. B. Leschen
New Zealand Arthropod Collection, Landcare Research, Private Bag 92170, 120 Mt Albert Road, Auckland, New Zealand,
email: LeschenR@landcare.cri.nz

Abstract

The New Zealand Pseudoliodini include two genera and three species that are described as new: *Zelodes* n. gen. (Type species: *Z. kuscheli* n. sp.; and *Z. minutus* n. sp.) and *Colenisia zelandica* n. sp. The species of *Zelodes* are recognized by several distinctive characters that are unique for the tribe: eyes absent; patch of peglike setae present on labrum; mesosternum with a triangular ligulate process; ventrites I and II connate; tarsomeres not sexually dimorphic and 4-4-4; tenent setae present on pro- and mesotarsomeres 1 - 3. Notes on the identification of New Zealand leiodids and a discussion on characters associated with hind wing reduction in Leiodidae are included.

Key words: *Zelodes*, *Colenisia*, mycophagy, wingloss, new species.

Introduction

A significant portion of beetles occurring in leaf litter are species in the superfamily Staphylinoidea which includes the family Leiodidae. Species of Leiodidae are biologically diverse and feed on fungi, are saprophagous, or feed on the decay fluids or microorganisms in carrion. Because many species of Cholevinae and Leiodinae are associated with different microhabitats and are generally distributed throughout forests, Leiodidae are model candidates as bioindicators of forest health and of precise classes of forest communities (Topp & Engler 1980; Chandler & Peck 1992; Růžička 1994; Carlton & Robison 1999). For example, selective cutting in eastern North American old growth forests of different ages showed a difference in leiodid species abundance while species richness was maintained (Chandler & Peck 1992). Correlations between leiodid communities and types of ecosystems have not yet been determined in New Zealand. The leiodid fauna here is composed of winged and flightless species, and a rigorous biodiversity study using various trapping methods may show some interesting patterns of seasonal distribution and habitat selection between the two morphological classes. One hindrance to understanding underlying ecological patterns and phylogenetic relationships is the poor taxonomic knowledge of the family in New Zealand and the natural history of each species.

Studies on groups such as the Camiarinae would require a comprehensive study of numerous undescribed taxa to identify monophyletic higher taxa. The family-group classification reviewed by Newton (1998) provides an appropriate background for study of the family in New Zealand which consists of species in four subfamilies (Camiarinae, Cholevinae, Coloninae, and Leiodinae). They range in size from about 1.0 - 4.0 mm. Most are round or oval in outline while many members of the tribe Camiarini (Camiarinae) may be somewhat biconvex. The largest and most diverse taxon is the subfamily Camiarinae which has 12 genera and approximately thirty described species. These small Coleoptera can be identified using one or both of the family-level keys in Klimaszewski and Watt (1997) with caution because some of the couplets are vague and not all genera will key to Leiodidae.

In this paper the species of Pseudoliodini (Leiodinae) are reviewed and one genus (alluded to in Newton 1998), containing two species, is described as new. The genus *Colenisia* Fauvel was previously recorded in New Zealand by Kuschel (1990) and the single species is formally described herein.

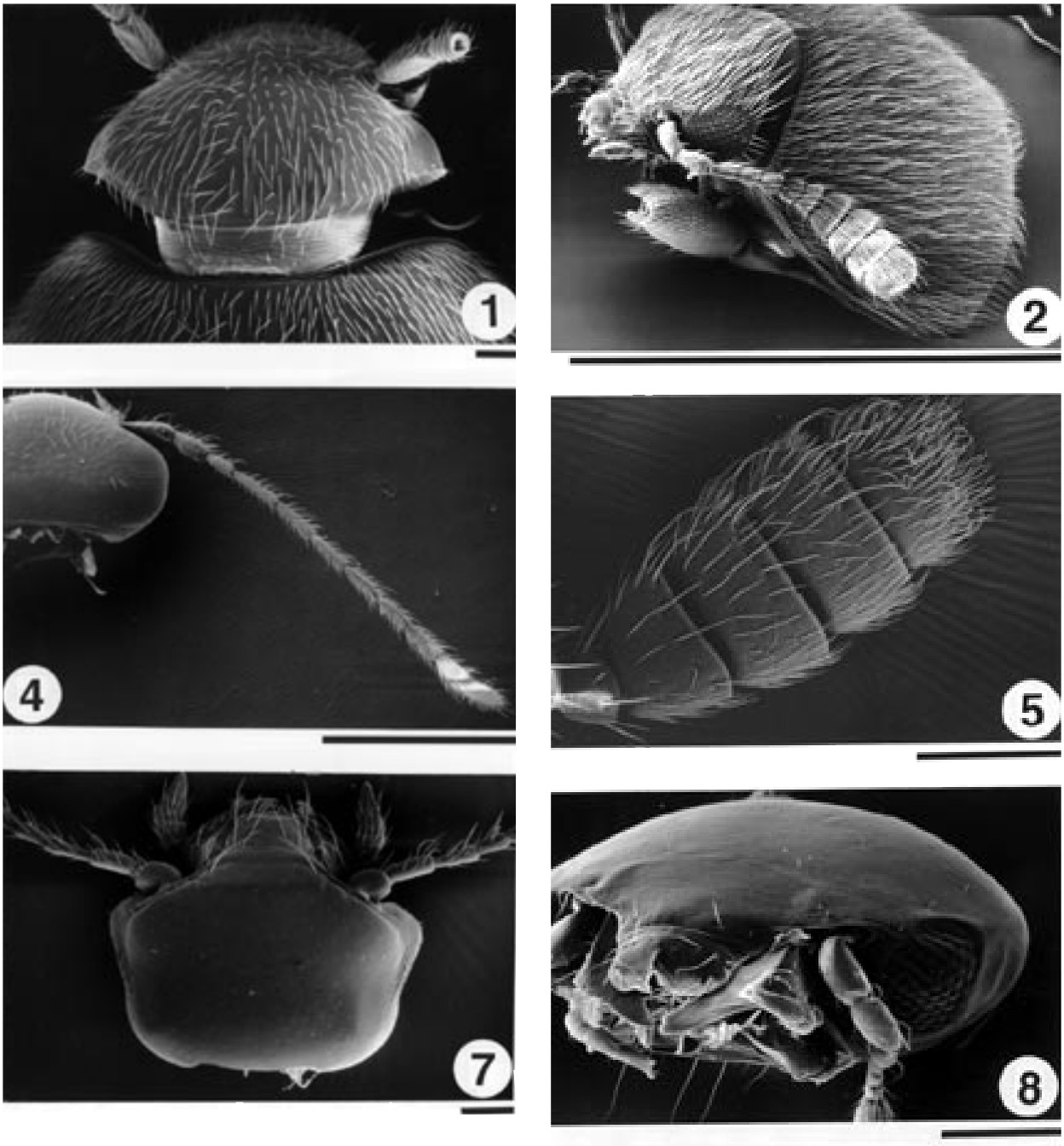
Specimens examined are deposited in the Entomology Research Museum (Lincoln University, Canterbury, LUNZ); Field Museum of Natural History (Chicago, FMNH); New Zealand Collection of Arthropods (Auckland, NZAC); Otago Museum (Dunedin, OMNZ); and Museum of New Zealand Te Papa Tongarewa (Wellington, MONZ).

Specimens of the taxa described in this paper were compared to specimens of *Allocolenisia* Daffner (1 sp., Thailand), *Colenis* Erichson (4 spp., North and Central America), *Colenisia* (3 spp., Africa, New Caledonia), *Dermatohomoeus* Hlisnikovsky (2 spp., India), *Neohydnobius* Jeannel

(1 sp., Chile), Pseudcolenis Reitter (3 spp., Borneo, Japan, Sumatra), and two undetermined genera (2 spp., Africa, Ecuador). Otherwise comparisons were made to illustrations and descriptions in published work by Daffner (1983, 1986, 1988, 1989, 1990, 1991), Peck (1998), and Wheeler (1986).

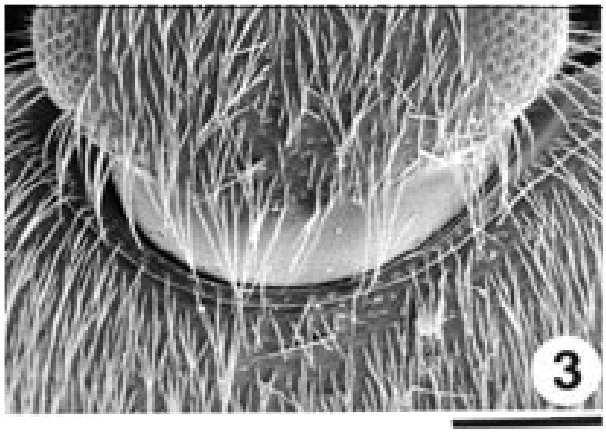
Key to the subfamilies of Leiodidae, the tribes of Leiodinae and species of Pseudoliodini

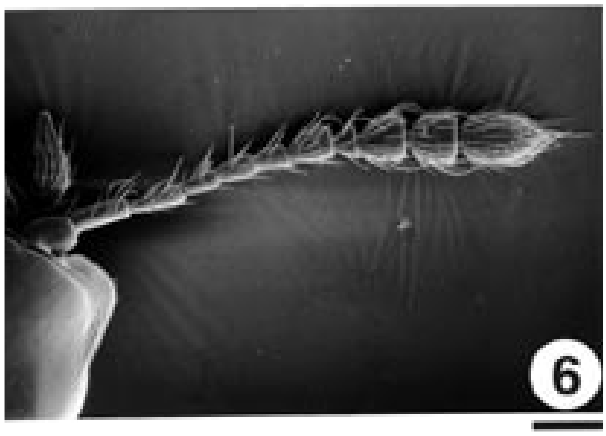
The identification of microcoleoptera can be difficult because character systems are not easily visible unless high magnification is used. For beginning students of Coleoptera, especially those who do not have access to a reference

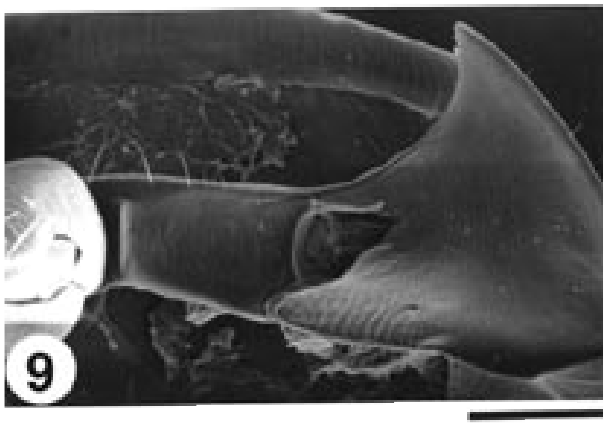


Figs 1 - 9. (1) Head of Paracatops sp., dorsal view (scale bar = 0.10 mm); (2) head of Colon sp., lateral view (scale bar = 1.0 mm); (3) same, dorsal view of head (scale bar = 0.10 mm); (4) Zearagytodes maculifer (Broun), dorsal view (scale bar = 0.50 mm); (5) antennal club of Zeadolopus sp., dorsal view (scale bar = 0.10 mm); (6) antenna of Zelodes kuscheli, n. sp., dorsal view (scale bar = 0.10 mm); (7) same, dorsal view of head (scale bar = 0.10 mm); (8) head of Colenisia

collection, the keys in Klimaszewski and Watt (1997) may prove challenging. Some micro-coleoptera may be misidentified as Leiodidae; however, most New Zealand leiodids have antennomere VIII smaller than VII and IX (Fig. 6; except Colon Herbst, Fig. 2; Zearagytodes Jeannel, Fig. 4, and an undescribed genus of







caledonica Fauvel, anterolateral view (scale bar = 0.10 mm); (9) same, prosternum, ventral view (scale bar = 0.10 mm).

Neopelatopini), and VIII may be concealed from view as in Zeadolopus Broun (Fig. 5). Other key characters for Leiodidae are the relatively strongly projecting procoxae and an excavate hind coxa (like that shown in Fig. 22) which may differentiate the family from similar looking Cucujoidea.

A key to the subfamilies by A. Newton is included in Klimaszewski and Watt (1997) and is modified below (based also on Newton 1998) to include the Leiodinae tribes and species of Pseudoliodini occurring in New Zealand. Numbers of described genera are listed after each family group, while an asterisk (*) indicates subfamilies containing undescribed genera.

1 Antennal insertions hidden in dorsal view (Fig. 8) ……Leiodinae; 4
- Antennal insertions visible in dorsal view (Figs 1, 2) ……2

2 Head with a distinct occipital crest (Fig. 1) ……Cholevinae (Mesocolon Broun, Pseudonemadus Portevin, Paracatops Portevin)
- Head without a distinct occipital crest (Figs 2, 3) ……3

3 Antennomere 8 equal to 9 and 10 (Fig. 2), epistomal suture absent……Coloninae (Colon)
- Antennomere 8 smaller than 9 and 10 (Fig. 6), or antennomere 8 equal to 9 and 10 (Fig. 4) and epistomal suture present ……Camiarinae* (Agyrtodini: Agyrtodes Portevin, Chelagyrtodes Scymczakowski, Zeagyrtodes Broun, Zeagyrtoma Scymczakowski, Zearagytodes; Camiarini: Baeosilpha Broun, Camiarites Jeannel, Camiarus Sharp, Inocatops Broun, Zenocolon Broun; Neopelatopini: Catopsolius Sharp)

4. Antennal club compact; antennomere VIII hidden between VII and IX (Fig. 5) ……Leiodini (Zeadolopus)
- Antennal club not compact; antennomere 8 visible between 7 and 9 (Fig. 6) ……5

5. Epipleuron visible in lateral view; tarsal formula 5-5-5 ……Sogdini* (Isocolon Broun)
- Epipleuron not visible in lateral view; tarsal formula 5-4-4 or 4-4-4 …… Pseudoliodini 6

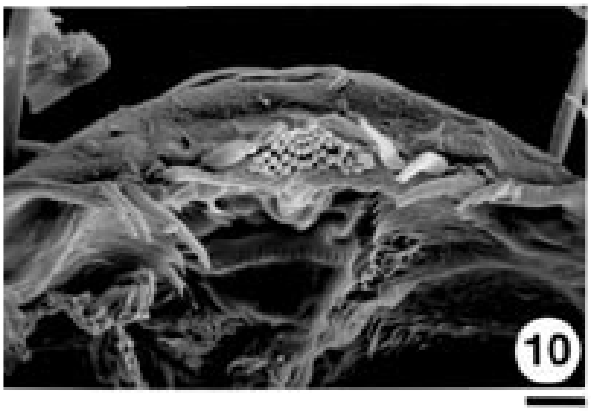
6. Eyes present (Fig. 8); dorsal surfaces with a sparse vestiture of setae ……Colenisia zelandica, new species
- Eyes absent (Fig. 7); dorsal surfaces without a vestiture of setae ……Zelodes, new genus; 7

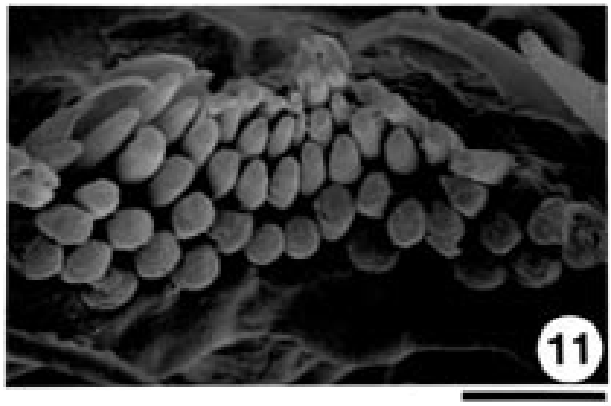
36 7. Width of prothorax equal to length of elytra (Fig. 27) .....Z. kuscheli, new species
- Width of prothorax shorter than length of elytra (Fig. 28) ……Z. minutus, new species

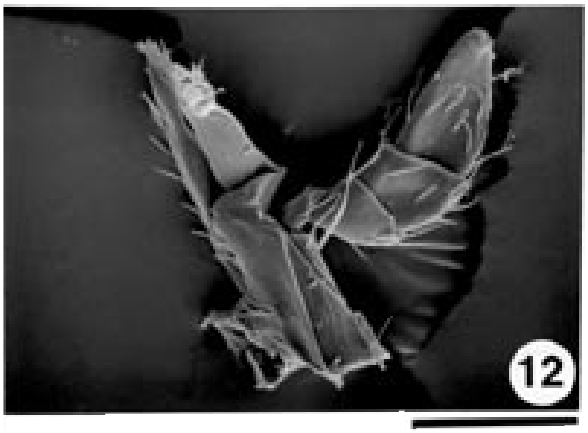
Tribe Pseudoliodini Portevin, 1926

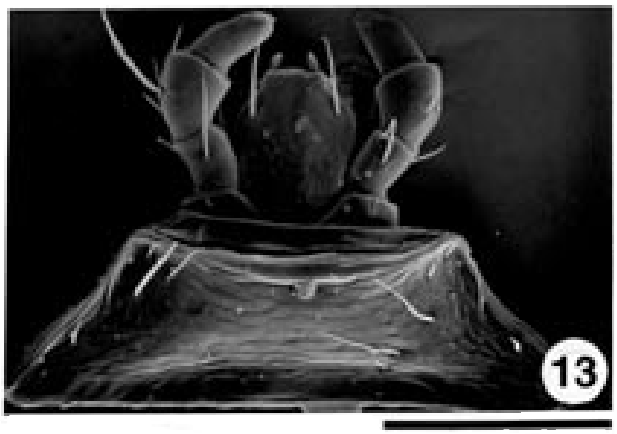
This is a relatively small group of Leiodinae with 11 genera and about 120 species described world wide, though most faunas of the world require study. Newton (1998) characterised this group based on several characters in his key to the Leiodinae tribes and in the diagnosis for the tribe. He provided evidence that Pseudoliodini is related to the tribes Agathidiini and Scotocryptini, although the exact relationships of these to one another are unknown as they are grouped into an unresolved trichotomy in his proposed phylogeny.

Pseudoliodini are collected most frequently by sifting leaf litter, although it is not surpising that Colenisia zelandica may be associated with Basidiomycetes because many leiodids are mycophagous. Three genera and several species of Pseudoliodini (including Australian species of Colenisia) have been collected from various Basidiomycetes (Newton 1984). I have seen no records for larval Pseudoliodini from fungi, despite the relatively common occurrence of some species in mushrooms in North America (Leschen 1988, Peck 1998) (Note that Newton (1984) has reared larvae of North American Colenis from sap flows). Similar habits may be shared for the species of Colenisia described below because it was collected three times from Basidiomycetes: Boletus sp. (Boletaceae), Coltricia cinnamomea









Figs 10 - 16. Zelodes kuscheli, n. sp. (10 - 15): (10) labrum, anterior view same, (scale bar = 10.00 um); (11) same, detail of sensory setae (scale bar = 5.00 um); (12) left maxilla, ventral view (scale bar = 0.10 mm); (13) mentum and labium, ventral view (scale bar = 0.10 mm); (14) right maxilla showing detail of lacinea and galea, ventral view (scale bar = 0.05 mm); (15) right mandible, ventral view (scale bar = 0.10 mm); (16) meso-, meta-, and abdominal sterna of Colenisia caledonica, ventral view (scale bar = 0.10 mm).

(Polyporaceae), and Amanita muscaria (Amanitaceae) that was infected with Hyphomyces (Ascomycetes). It is curious that specimens of our Colenisia were collected from Hyphomyces-infected Amanita because many of the records of Colenis spp. recorded in Leschen (1988) were also from parasitised mushrooms. The gut of one paratype of Colenisia zelandica was packed with spores of Coltricia cinnamomea.

Genus Colenisia Fauvel

(Figs 8, 9, 16, 26, 29, 34-37)

***Colenisia zelandica,* n. sp.**

(Figs 26, 29, 34-37)

Description: Length 1.37 mm (1.30 1.45; n = 6), width 1.00 (0.87 1.12), depth 0.44 (0.37 0.50). Colour of body dark and light yellow brown; head in most specimens, elytra, antennal club and disk of mesosternum darker. Relative lengths of antennomeres 3:5:3:1.2:1:1.1:3:1:3:2.1:5. Head, pronotum and elytron with well developed transverse strigulae. Epistomal suture straight and weakly impressed. Male tenent setae present on protarsomeres 1-3. Aedeagus 2 times longer than wide, aedeagal apex evenly rounded or slightly acute; parameres reaching to apical 1/5 of aedeagus, apex bisetose and arising from bifurcate apex, setae of subequal sizes; internal sac complex. Spermatheca with distal chamber slightly longer than globular proximal chamber. Gonocoxite with three elongate setae; stylus with three subequal setae.

Etymology: Based on the distribution of the species in New Zealand.

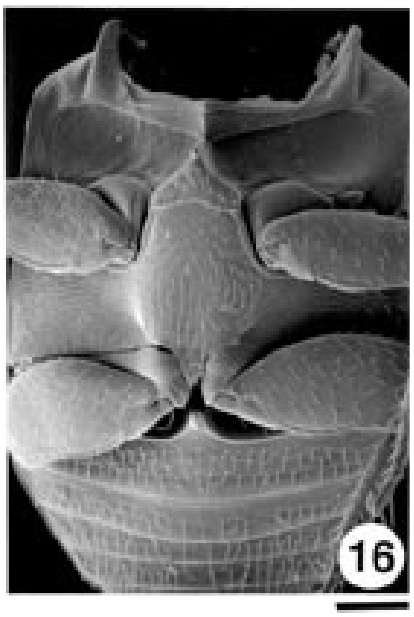
Remarks: Colenisia zelandica is known from the northern portion of the North Island. Based on aedeagal characters described by Daffner (1986, 1989), C. zelandica may be related to some of the Colenisia species of New Caledonia and New Guinea. In some of these species and C. zelandica, the apical setae of the parameres are subequal in length. C. zelandica differs from all the species by having two anterior lobes arising from the base of the internal sac. The described Colenisia species from Australia have a very short inside (or dorsal) apical seta, half or less the length of the outer seta. Colenisia zelandica and C. serica Daffner share a pair of well developed symmetrical sclerites in the middle of the internal sac, but differ in the shape of the apex of the aedeagus.

A single teneral male specimen of the genus Colenisia was collected from the Three Kings Islands and appears to be similar to C. zelandica, but was not dissected and included in the type series. It differs externally from the specimens C. zelandica by its poorly developed transverse strigulations of the body.

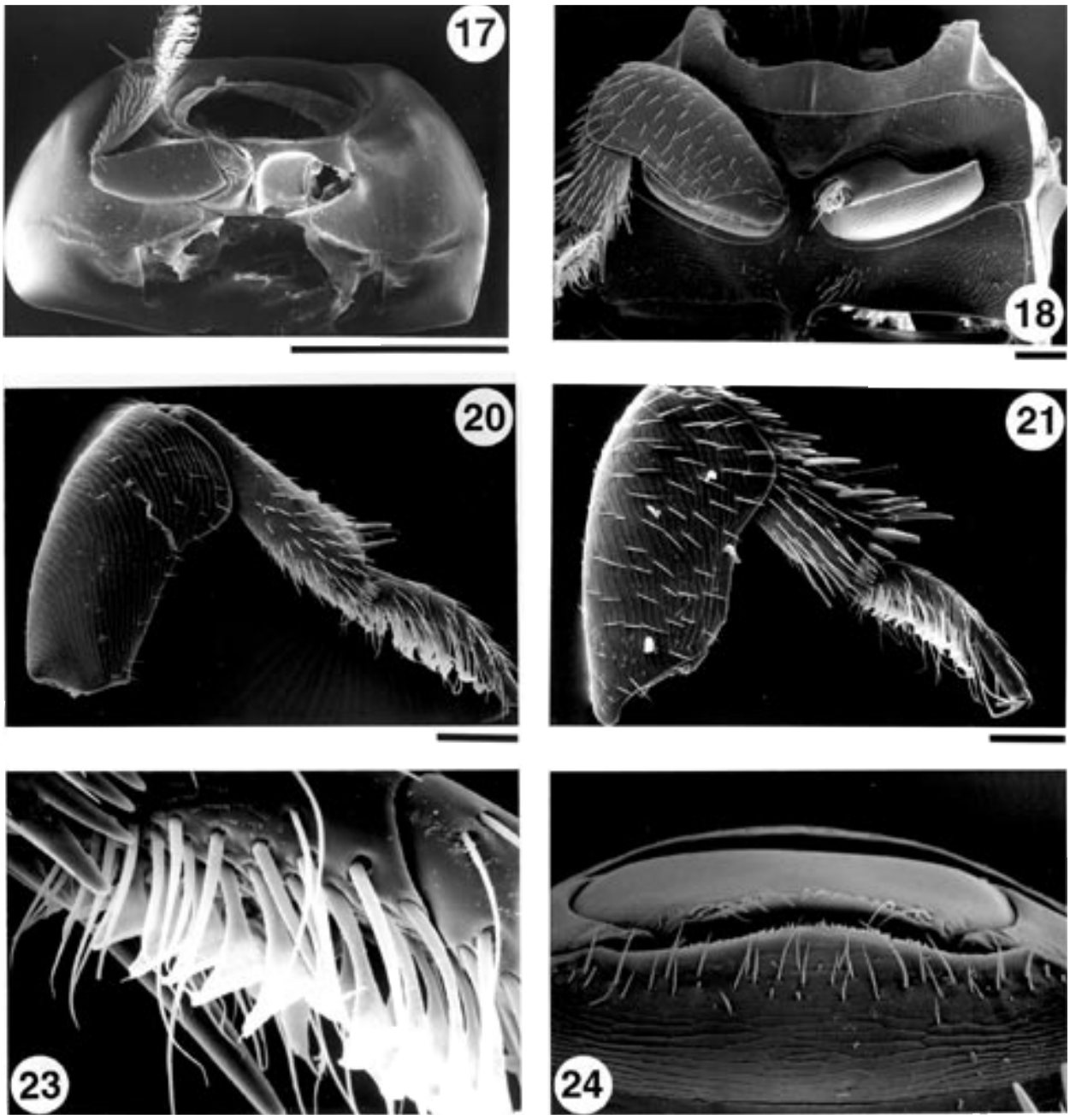
While larval habits are unknown, adults are associated with fresh and decaying Basidiomycetes.

Type Material:

Holotype: New Zealand, AK, Lynfield, Tropicana Drive, 10 July 1976, G. Kuschel, bush margin (NZAC). Paratypes: New Zealand: 1, AK, Hunua, Waharau Reserve, 23 May 1999, R.



Leschen, R. Hoare leaf litter and fungi berlesate, RL412, 37˚03´S, 175˚17´E;1, same, but, *Boletus* sp., RL413; 1, AK, Lynfield WB, 30 Sep 1980, G. Kuschel, litter (NZAC); 1, AK, Kaipara Harbour, Kaukapakapa, 23 Sep 1977, G. Kuschel, litter (NZAC); 6, ND, Ranfurly Scenic Reserve, 29
38 July 1998, R. Leschen, R. Hoare, ex *Coltricia cinnamomea*, RL200, 35˚02´S, 173˚45´E (LUNZ, MONZ, NZAC, OMNZ); 1, ND, Tapotupotu Bay, 30 July 1998, R. Leschen, R. Hoare leaf litter fungi, RL222, 34˚26´S, 172˚42´E (NZAC); 1, ND, Waipoua SF, 25 Nov 1980, G. Kuschel, sifted litter 80/121(NZAC); 2, ND, Puketi National Forest, Nature Track, RL374, 35˚13´S 173˚47´E, ex *Amanita muscaria* infected by *Hyphomyces*, 31 March 1999, R. Leschen (NZAC).



Figs 17 - 25. *Zelodes kuscheli*, n. sp.: (17) prosternum, ventral view (scale bar = 0.50 mm); (18) Meso- and metasternum, ventral view (scale bar = 0.10 mm); (19) same, showing detail (scale bar = 0.10 mm); (20) fore leg of male, anterior view (scale bar = 0.10 mm); (21) middle leg of male, anterior view (scale bar = 0.10 mm); (22) hind leg, anterior view (scale bar = 0.50 mm); (23) detail of mesotarsus showing tenent setae of male (scale bar = 0.05 mm); (24) apex of

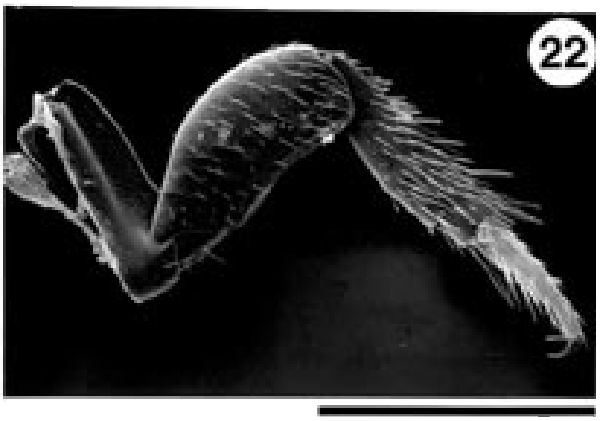
Other material examined: New Zealand, TH, Great I, Tasman Valley, NZMS 260 L01 316823, 7-10.xii.1996, J.W. M. Marris, yellow pan traps in Kunzea broadleaved forest (LUNZ).

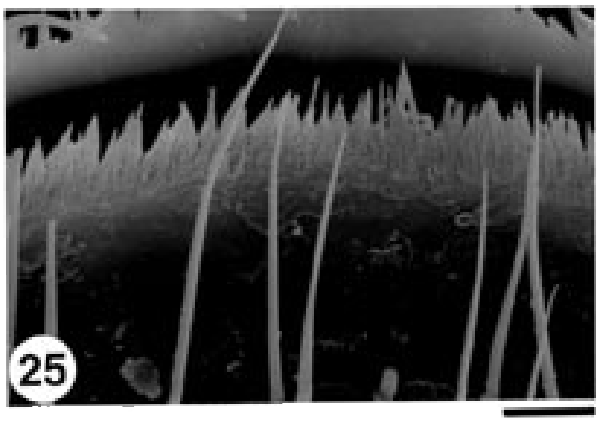
Genus *Zelodes,* n. gen.

(Figs 6, 7, 10-15, 17-25, 27, 28, 30-33, 38, 39)

Type species: Zelodes kuscheli new species

Diagnosis: Eyes absent; patch of peglike setae present on labrum; mesosternum with a triangular ligulate process; length of metasternum subequal to width of mesocoxa; metasternum of male without setiferous sex patch; elytra with transverse striations; epipleuron completely hidden in lateral view; wings absent; ventrites I and II connate; tarsomeres not sexually dimorphic and 4-4-4; tenent setae present on pro- and mesotarsomeres 1-3; basal lobes of parameres meeting dorsally and fused to aedeagal body; spermatheca elongate, consisting of a single body with well developed cuticular rings.





male abdomen, posterior view (scale bar = 0.10 mm); (25) detail of frayed edge of ventrite VI of male, ventral view (scale bar = 10.00 um).

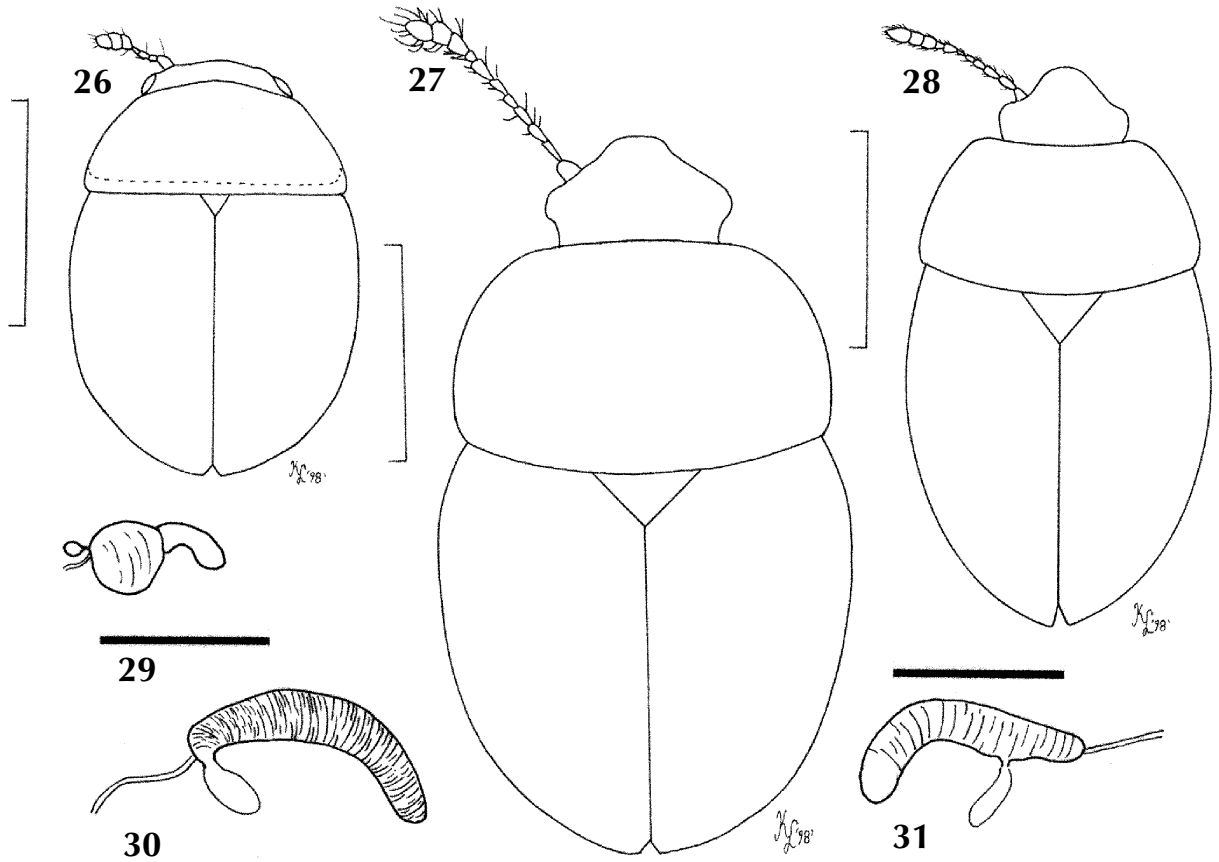
Description: Length about 1.4-1.7 mm. Colour dark red or yellow brown. Body completely glabrous dorsally. Head transverse with 2 pairs of widely spaced pores on the vertex. Antenna about 1.7 x as long as head width, with a weak 5-segmented club; segments 7, 9, and 10 with periarticular gutter, internal vesicles absent. Epistomal suture straight and very weakly impressed. Labrum subtransverse, apical margin without a shallow emargination, bearing a short and dense patch of peglike setae. Epipharynx without a short apical furrow. Mandibles asymmetrical along inside edge, with preapical teeth, well developed prostheca, and a strong molar lobe at base. Labium transverse; pair of stout setae present. Lacinia and galea of equal widths; lacinia with midlateral spines present amongst marginal setae; galea without field of micropores. Tentorium with or without median spine; not tuberculate. Eyes absent; field of setae present in ocular area. Occipital bead narrow. Antennal grooves absent, genal shelf rounded and not visible in dorsal view. Prothorax without a well-developed anterior angle; prosternum relatively well developed with a narrow prosternal process; ventral surfaces of prosternal process and anterior portion of prosternum contiguous and on the same plane. Mesosternum with broad prepectus and a narrow median carina; a triangular ligulate process present. Metasternal process between mesocoxae depressed anteriorly, its surface separated from and not at same level as mesosternum. Metasternal width subequal to width of mesocoxae; disc not vaulted; subcoxal bead of metasternum present; pronged posterior process more or less parallel sided; male without setiferous sex patch. Length of median stalk of metendosternite shorter than length of arm. Elytra with transverse striations; humeral region with distinct microsculpture;

epipleuron completely hidden in lateral view. Hind wings absent. Abdominal ventrite VI apically frayed in male; ventrites I and II connate. Tarsal formula not sexually dimorphic and 4-4-4; tenent setae of male present on pro- and mesotarsomeres 1-3. Aedeagus 3 times longer than wide and in body cavity extending to a level of middle of metasternum, apiculate with a squarish apex; parameres lacking apical setae, basal lobes of parameres meeting dorsally and fused to aedeagal body. Spermatheca elongate, consisting of a single body with well developed cuticular rings, accessory sac present.

Etymology: A combination of parts of the words New Zealand and Leiodes Latreille.

Remarks: The Leiodinae tribe Pseudoliodini currently contains 11 genera (Newton 1998) including Zelodes. This genus is placed into this tribe based on the following characters (Newton 1998): head without antennal grooves, procoxal cavities closed laterally by a triangular notal process (Fig. 17), mesocoxae rather widely separated by a metasternal process (Figs 18, 19), tarsal formula usually not sexually dimorphic, and free parameres of aedeagus with basodorsal lobes that may meet dorsally (although the parameres are fused rather broadly with the base of the median lobe as shown in Figs 32, 33). Zelodes is unlike other pseudoliodines and can be easily distinguished from the remaining species by its lack of eyes, presence of a broad ligulate process on the mesosternum, and tenent setae present on pro- and mesotarsi of the male.

Phylogenetic relationships among the genera of Pseudoliodini are basically unknown, and determining the sister taxon of Zelodes is problematic. Many characters present in Zelodes are unique and do not provide ample information for determining its placement in the tribe. For example, the prosternum is reduced (Fig. 9) and the



Figs 26 31. Dorsal habitus and spermathecae of Pseudoliodini: (26) Colenisia zelandica, n. sp., habitus; (27) Zelodes kuscheli, n. sp, habitus; (28) Zelodes minutus, n. sp, habitus; (29) Colenisia zelandica, n. sp., spermatheca; (30) Zelodes kuscheli, n. sp, spermatheca; (31) Zelodes minutus, n. sp, spermatheca. (Scale bars for Figs 26 - 28 = 1.00 mm; scale bars for 29 - 31 = 0.01 mm).

mesosternum is carinate in most species of Pseudoliodini (Fig. 16); but the prosternum is relatively well developed (Fig. 17) and the mesosternum is modified in Zelodes (Figs 18, 19).

The guts of three dissected specimens of Zelodes were filled mostly with unidentified matter, and possibly spores and hyphae in one specimen of Z. kuscheli.

***Zelodes kuscheli,* n. sp.**

(Figs 6, 7, 10-15, 17-25, 26, 30, 32, 33, 38)

Diagnosis: Colour of body dark red brown; pronotum about as wide as length of elytra; spermatheca with accessory sac attached proximal to spermathecal duct attachment.

Description: Length 1.72 mm (1.55 - 1.85; n = 9), width 1.28 (1.12 - 1.45), depth 0.63 (0.70 - 0.75). Colour of body dark red brown. Head strongly punctate, punctures separated by 1-2 diameters; punctation may consist of punctures of two sizes in some specimens. Epistomal bead well developed. Relative lengths of antennomeres 5:5:4:3:3:3:4:2:5:5:7. Tentorial spine present. Pronotum with punctures lightly impressed in most specimens, more defined at lateral margins; punctures separated by 3 diameters. Anterior edge of furcal arms of metendosternite irregular; width greatest at middle. Elytron with dense punctation in anterior half; punctures separated by 1 diameter. Aedeagus complex with internal sac consisting of a broad anterior plate, a middle portion with a series of smaller overlapping plates and the posterior portion membranous. Spermatheca with accessory sac attached proximal to spermathecal duct attachment, cuticular striations dense. Gonocoxite with the two lateral setae equal in length to single inside one.

Etymology: Patronymic for Willy Kuschel, one of the collectors of this species and in honour of his many contributions to the knowledge of New Zealand Coleoptera.

Remarks: This species, known only from the northern portion of the South Island, can be distinguished from Z. minutus by its relative size and body shape.

Type material:

Holotype: New Zealand, SD, Picton, Shakespeare Bay, 11 Aug 1969, J. McBurney, Litter 69/144 (NZAC). Paratypes: 1, same data as holotype (NZAC); 1, SD, Port Ligar, 1000', 26 Oct 1969, F. A. Alack, Litter 69/175 (NZAC); 6, SD, Port Underwood Sdle, 1 Sep 1969, G. Kuschel, Litter 69/152 (LUNZ, OMNZ, NZAC); 1, SD, Port Underwood Saddle, 3 km SSE Curious Cove, 15 Nov 1999, R. Leschen, sifting leaf litter, RL480 41˚17´S, 174˚05´E (NZAC); 1, MB, Richmond Ra, Onamalutu Valley, 5 Jul 1947, Leaf mould (MONZ); 1, MB, Pelorus Bridge, 20 Oct 1963, J. I. Townsend (FMNH); 1, MB, Pelorus Bridge, 25 Sep 1967, G. Kuschel, Litter 67/220 (NZAC); 1 (slide mounted), MB, Mt Robison Ridge, Kenepuru Sd., 500 m, 13 Mar 1970, J. I. Townsend, litter (NZAC).

***Zelodes minutus,* n. sp.**

(Figs 28, 31, 39)

Diagnosis: Colour of body yellow brown; width of pronotum less than length of elytra; spermatheca with accessory sac attached distal to spermathecal duct attachment.

Description: Length 1.40 mm (1.40 - 1.62; n= 3), width 1.04 (0.95 - 1.12), depth 0.30 (0.27 - 0.35). Head with punctures separated by 1-2 diameters. Epistomal bead poorly developed. Relative lengths of antennomeres 5:5:4:3:3:2:3:2:4:4:6. Pronotum lacking well defined punctures. Tentorial spine absent. Anterior edge of furcal arms of metendosternite smooth; width greatest at base. Elytron with punctation present in anterior half; punctures separated by 1 diameter. Spermatheca with accessory sac attached distal to spermathecal duct attachment, cuticular striations sparse. Gonocoxite with the two lateral setae much shorter in length than the single inside one.

Etymology: Based on the Latin word minutus, meaning small.

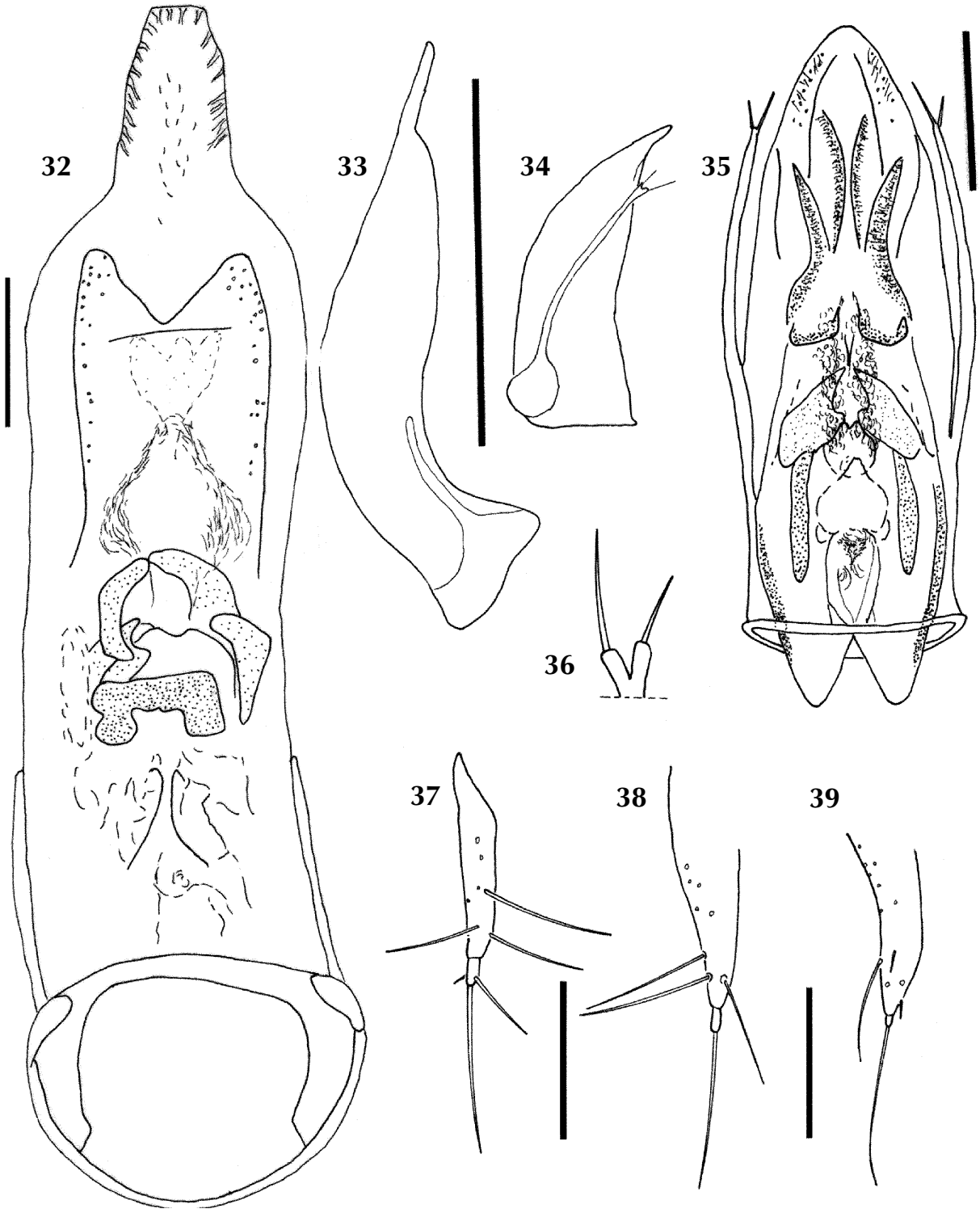
Remarks: All too little is known about this species, because specific locality data are lacking and it is known only from females.

Type material:

Holotype: New Zealand, taken from decaying potatoes, Coll. A. Philpott, A. E. Brookes Collection (NZAC). Paratypes: 4 (1 slide mounted and 1 with head missing), same data as holotype (NZAC).

Characters Associated with Hind Wing Reduction in *Zelodes*

Almost every group of Coleoptera includes species that have undergone some form of hind wing reduction and there are some excellent



Figs 32 - 39. Terminal segments of Pseudoliodini: (32) Zelodes kuscheli, n. sp, aedeagus, ventral view; (33) same, lateral view; (34) Colenisia zelandica n. sp., aedeagus, lateral view; (35) same, dorsal view; (36) same, close up of apex of left paramere; (37) same, dorsal view of left gonocoxite; (38) Zelodes kuscheli, n. sp, dorsal view of left gonocoxite; (39) Zelodes minutus, n. sp, dorsal view of left gonocoxite. (Scale bars for Figs 32, 35, and 37 - 39 = 0.01 mm; scale bar for 33 and 34 = 0.05 mm).

reviews (e.g., Roff 1990, Thayer 1992) and taxon-specific papers that document this phenomenon (e.g., see Holloway 1963 for New Zealand Lucanidae). The incidence of hind wing reduction is very high in New Zealand Coleoptera, as expected for insular faunas (Darlington 1936). Hind wing loss or reduction in Leiodidae is fairly common, and the phenomenon has been reviewed for cave and soil dwelling North American species in the genus Ptomaphagus Illiger by Peck (1973). The hind wing may be reduced to a narrow strip retaining some of its wing veins, reduced to a small flap that lacks veins, or completely absent as in Zelodes.

Leiodids that have undergone wing reduction may have several characteristic modifications in the rest of the body. The body shape of Zelodes is rather ordinary and not as streamlined as the body shape in many apterous cholevines - the round or oblong body form of Zelodes species is also present in winged pseudoliodines. In Camiarinae the body forms are variable, and hind wing reduction may be associated with biconvexity (e.g., some Camiarini) which is present in other beetle families that primitively have the body outline more or less continuous (e.g., Languriidae; Zablotny and Leschen 1996).

Eye reduction and other characters may correlate with leiodid wing loss (Thayer 1992), in soil and cave dwelling Cholevinae and Catopocerinae, inquiline Scotocryptini, and mammal associated Platypsyllinae. Complete absence of eyes and red coloration of Zelodes is unique in Pseudoliodini. There is a corresponding change of the metendosternite and a shortening of the metasternum with the loss of flight musculature in Coleoptera, and Zelodes has a relatively short median stalk of the metendosternite (not shown) and a short metasternum (compare Figs 16 and 19). Members of Pseudoliodini typically have a well-developed median carina on the mesosternum which is often contiguous with a vaulted median portion of the metasternum (Fig. 16; this area is poorly developed in one subgenus of Pseudcolenis). Instead of having a typical carinate mesosternum, Zelodes bears a flattened triangulate process between the mesocoxae (Fig. 19) and its development may be associated with wing reduction in this genus.

A more detailed analysis of form associated with hind wing loss for New Zealand Leiodidae would be interesting because of the variable body forms present in the fauna. Moreover, the unusual habits among New Zealand taxa, such as the relatively fast- running and flight capable species of Zearagytodes (Camiarinae) associated with polypore fungi, suggest that the different body forms may correlate with gait speed and performance.

Acknowledgements

I am indebted to Al Newton and Stewart Peck for cultivating my interests in Leiodidae by supplying unpublished keys and catalogues, and they, along with Ivan Löbl, supplied comparative material on which this study is based. Willy Kuschel helped vicariously with this project because of his interests in the family that resulted in a well sorted reference collection complete with manuscript names for undescribed genera. Birgit Rhode provided excellent SEM photographs and Grace Hall helped extensively in the field and assisted with data entry. Identification of the polypore host of Colenisia zelandica was made by Peter Buchanan and habitus and line drawings were done in part by Des Helmore and Catherine Lawton. John Marris drew my attention to the specimen of Colenisia collected from the Three Kings Islands and Robert Hoare commented on a draft of the manuscript and also assisted in the field. This work was made possible by funds provided by FRST (contract C09617).

References

Carlton CE, Robison HW. 1999. Diversity of litter-dwelling beetles in the Ouachita Highlands of Arkansas, U.S.A. (Insecta: Coleoptera). Biodiversity and Conservation 7: 1589-1605.

Chandler DS, Peck SB. 1992. Diversity and seasonality of leiodid beetles (Coleoptera: Leiodidae) in an old-growth forest and a 40-year-old forest in New Hampshire. Environmental Entomology 21: 1283-1293.

Daffner H. 1983. Revision der paläarktischen Arten der Tribus Leiodini Leach (Coleoptera, Leiodidae). Folia Entomologica Hungarica 44: 9-163.

Daffner H. 1986. Die Arten der Gattung Colenisia Fauvel, 1903, von den Melanesischen Inseln (Col. Leiodidae Pseudoliodini. Acta Coleopterologica 2: 9- 20.

Daffner H. 1988. Monographische Bearbeitung der Gattung Pseudcolenis Reitter, 1884 (Coleoptera, Leiodidae, Pseudoliodini). Revue Suisse de Zoologie 95:

151-179.
Daffner H. 1989. Monographische Bearbeitung der Gattung Ansibaris Reitter, 1883 (Coleoptera, Leiodidae, Pseudoliodini). Revue Suisse de Zoologie 96: 117-126.
Daffner H. 1990. Allocolenisia n. gen. mit zwei neuen
44 Arten aus Indien und Thailand (Coleoptera, Leiodidae, Pseudoliodini). Revue Suisse de Zoologie 97: 1003-1008.
Daffner H. 1991. Die Arten der Gattung Colenisia Fauvel, 1903, aus Südindien und Sri Lanka (Coleoptera, Leiodidae, Pseudoliodini). Revue Suisse de Zoologie 98: 389-406.
Darlington PJ. 1936. Variation and atrophy of flying wings of some carabid beetles (Coleoptera). Annals of the Entomological Society of America 29: 136-179.
Holloway BA. 1963. Wing development and evolution of New Zealand Lucanidae (Insecta: Coleoptera). Transactions of the Royal Society of New Zealand 3: 99-116.
Klimaszewski J, Watt JC. 1997. Coleoptera: family-group review and keys to identification. Fauna of New Zealand 37. Lincoln, Canterbury, New Zealand. Manaaki Whenua Press. 199 p.
Kuschel G. 1990. Beetles in a suburban environment: A New Zealand case study. The identity and status of Coleoptera in natural and modified habitats of Lynfield, Auckland (1974-1989). DSIR Plant Protection Report 3.
Leschen RAB. 1988. Coleoptera/Basidiomycete relationships: Arkansas fauna. Masters Thesis, University of Arkansas, Fayetteville.
Newton AF. 1984. Mycophagy in Staphylinoidea (Coleoptera). Pp. 302-353 In: Wheeler Q & Blackwell M. (eds) Fungus-Insect Relationships: Perspectives in Ecology and Evolution. Columbia University Press.
Newton, AF. 1998. Phylogenetic problems, current classification and generic catalog of world Leiodidae (including Cholevidae). Phylogeny and Evolution of Subterranean and Endogean Cholevidae (=Leiodidae Cholevinae), Proceedings of XX International Congress of Entomology Firenze, 1996. Bollettino del Museo Regionale di Scienze Naturali, Torino 1998, 41-177.
Peck SB. 1973. A systematic revision and the evolutionary biology of the Ptomaphagus (Adelops) beetles of North America (Coleoptera; Leiodidae; Catopinae), with emphasis on cave-inhabiting species. Bulletin of the Museum of Comparative Zoology 145: 29-162.
Peck SB. 1998. Revision of the Colenis of America north of Mexico (Coleoptera: Leiodidae; Leiodinae; Pseudoliodini). Canadian Entomologist 130: 55-65.
Portevin G. 1926. Les Liodidae de l'Inde. Encyclopédie Entomologique (B), Coleoptera 1: 75-83.
Roff DA. 1990. The evolution of flightlessness in insects. Ecological Monographs 60: 389-421.
Růžička J. 1994. Seasonal activity and habitat associations of Silphidae and Leiodidae: Cholevinae (Coleoptera) in central Bohemia. Acta Societatis Zoologicae Bohemoslovacae 58: 67-78.
Thayer MK. 1992. Discovery of sexual dimorphism in Staphylinidae (Coleoptera): Omalium flavidum, and a discussion of wing dimorphism in insects. Journal of the New York Entomological Society 100: 540-573.
Topp W, Engler I. 1980. Species packing in Catopidae (Col.) of a beech stand. Zoologische Angewandt, Jena 205: 39-42.
Wheeler QD. 1986. Rediscovery and cladistic placement of the genus Cainosternum (Coleoptera: Leiodidae). Annals of the Entomological Society of America 79: 377- 383.
Zablotny JE, Leschen RAB. 1996. Two new genera of flightless Languriidae (Coleoptera: Cucujoidea) from the Australo-Pacific. Coleopterists Bulletin 50: 382-390.