

***Carpophilus* (Coleoptera: Nitidulidae) of New Zealand with
notes on Australian species**

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Abstract

There are approximately 200 species of *Carpophilus* in the world, of which several have become established through the trade routes and are considered economic pests. We cover 11 species of *Carpophilus* that are established (*C. davidsoni*, *C. dimidiatus*, *C. gaveni*, *C. hemipterus*, *C. ligneus*, *C. marginellus*) or regularly intercepted (*C. maculatus*, *C. mutilatus*, *C. obsoletus*, *C. oculus*, *C. truncatus*) in New Zealand. Based on material examined all but *C. ligneus* and *C. oculus* have been reported in Australia. The species are keyed based on adult characters, and provided with adult diagnoses, distribution and host information, and their biological status in New Zealand. The taxonomic status of *C. maculatus* and *C. oculus* are questionable, and the identity of Australian species *C. planatus* requires examination of type material of that species, and of *C. atterimus*, and *C. bakewelli*. A specimen database of over 900 entries of the New Zealand established species (including those on the Kermadec Islands) is provided as supplementary information.

1. Introduction

Carpophilus Stephens, 1930 is a worldwide genus of nitidulid beetle, and is one of two genera (the other is *Urophorus* Murray, 1864) in Australia and New Zealand in the tribe Carpophilini (Carpophilinae), defined by having an external button-like 10th tergite of the male. Like all members of the subfamily, these have an aedeagus with a deeply bilobed tegmen (Kirejtshuk 1986). The classification of *Carpophilus* is confusing because there is no global treatment of the group, apart from the world catalogue of the then 191 known species by Williams et al. (1983). There are six subgenera in the Palaearctic (Jelinek 2005), but not all species have been placed into these groupings. There are several keys available for regional *Carpophilus* (e.g., United States, Connell 1991; Europe, Audisio 1993; Russia, Kirejtshuk 1992; Micronesia, Gillogly 1962 – see Appendix 1) and identification pages posted on the Internet for a few species. These are of limited use for identifying the New Zealand and Australian faunas, mainly because the spread of commerce has introduced new species to these areas and the taxonomy and identification of some groups can be very difficult. New Zealand has no native species of *Carpophilus*, other than two widespread Pacific species present on the remote Kermadec Islands.

Most species are associated with ripe, rotten, and dried fruits and vegetables, but because *Carpophilus* species are known to attack healthy fruits and transmit yeast and bacterial pathogens, they are regarded as important pests of fruit industries. Host and other biological information for New Zealand species has been covered previously by Archibald and Chalmers (1983) in their review of stored product Coleoptera mainly contained in reports by Keall (1981), Manson and Ward (1968) and Richardson (1979). Records included in Archibald and Chalmers (1983) may be based, in part, on misidentifications (see species entries), and we have not been able to locate all of the specimens they used in their study. Kuschel (1990) included data for species occurring in the suburb of Lynfield, Auckland.

Here we cover the introduced and intercepted species of *Carpophilus* of New Zealand and include a key and diagnostic descriptions for the 11 species. A list of important papers is provided in Appendix 1 and a list of Australian species is provided in Appendix 2. A complete specimen database of the established New Zealand species (including the Kermadec Islands) is available as supplementary data (PPIN data are not included in this). There are over 900 entries in the database and all of the NZAC specimens have been bar-coded for rapid information access.

There are no endemic species to New Zealand, except, possibly, the two widespread Pacific species *C. oculatus* and *C. maculatus* present on the distant Kermadec Islands. Established species are defined as those which have reproduced successfully in New Zealand over a number of years and are typically represented in museum collections by multiple by multiple collections from mainland New Zealand. These established species may be widespread but may also be somewhat localised to major fruit production areas such as Marlborough or Neslon. Intercepted (non-established) species are those that have been regularly captured at the border but have not been collected repeatedly in mainland New Zealand.

This study was not completed because of foreseen and unexpected reasons. The project was originally proposed as a 2-year study to include Australian and New Zealand species, but was reduced to a 1-year study (at that point the investigators agreed to disregard larval studies). The problem with the identification of *Carpophilus* was greatly underestimated, and had only become apparent through careful examination of the available specimens by the Milestone 3 (April 2005) when we had obtained approximately 5000 specimens. We have gone through about 2/3 of the New Zealand material and 1/3 of the Australian material and proposed to restrict the study to the New Zealand taxa.

A necessary extension of this study would be to study the Australian species, which requires identification of significantly more museum material than that held in New Zealand collections, and examination of type specimens. We attempted this at the onset of this study, but were unsuccessful due to limited time for the project. There were 5091 total Australian specimens borrowed, and we estimate that about half are unidentified and those that are identified require verification, including some identified by experts who have mixed species in their identifications. We have supplied illustrations for Australian species that were on loan to us, as these may help with the identification of the species in Australasia (see Appendix 2).

In the diagnoses and descriptions of the species, Crosby codes were used for distribution in New Zealand (Crosby et al. 1998) as follows: *North Island*; ND - Northland, AK - Auckland, WO - Waikato, CL - Coromandel, BP - Bay of Plenty, GB - Gisborne, HB - Hawkes Bay, TK - Taranaki, WI - Wanganui, WN - Wellington; *South Island*; NN - Nelson, MB - Marlborough, KA - Kaikoura, MC - Mid Canterbury, SC - South Canterbury, OL - Otago Lakes, SL - Southland, DN - Dunedin. Host data were taken mainly from material we have identified and are derived from specimen labels, but we list sources for additional sources. We also used the Plant Pest Information Network (PPIN) Database, New Zealand Ministry of Agriculture and Forestry, for some of the host data.

2. Excluded species

Four species were represented in MAF collections but were not included in the key and the descriptions because they were not regularly intercepted and/or the identifications could not be confirmed. These are:

Carpophilus freemani Dobson, 1956 (Fig. 23) – 3 specimens, MAF interception from the United States on grapes [identifications dubious and may be *C. mutilatus*; specimens damaged and are females; recorded from Australia (Dobson 1959)]. Brief description, distribution and host list in Audiso (1993).

Carpophilus frivolutus Murray, 1864 (a full adult is shown in Fig. 24) – 1 specimen, MAF field collection from Wairarapa [identification difficult as specimen is teneral and possibly

mislabelled; species described from Australia and introduced to Micronesia]. Brief description and distribution in Gillogly (1962).

Carpophilus lugubris Murray, 1864 (Figs 27, 34) – 1 specimen, MAF interception from the United States on cherries [easily identified by the habitus and deep fovea of ventrite 5 of the male; described from South America and spread throughout the Americas and not recorded from Australia]. Brief description and distribution in Parsons (1943).

Carpophilus planatus Murray, 1864 (Fig. 31) – 1 specimen, MAF interception from Australia [described from Australia, distinguished from most species by the flattened discs of the pronotum and elytra, taxonomic name requires validation].

Initially we were sent a list of all the species of *Carpophilus* from Australia, by R. Storey. Three species not on that list have been intercepted in Australia, but further study of the Australian fauna is necessary to determine if the species are established. These are: *C. brachypterus* (Say, 1825) (described from North America, Fig. 19), *C. flavipes* Murray, 1864 (described from India, Fig. 22), and *C. obesus* Murray, 1864 (described from India, Fig. 29).

3. Key to species

While some *Carpophilus* species are distinctive, others are very difficult to identify, even for specialists. For exact determination of species, it is recommended that series of specimens are collected from the source and that males are dissected. Specimens should be mounted so that dorsal and ventral surfaces are clearly seen and that the hypomeron, mesoventrite, and metaventrite are visible. If specimens can be reared, allow adults to be fully developed so that coloration can be clearly noted. Because key characters like punctation and antennal length may vary among specimens and species, it is critical that a reference collection is available for variable species and that a good microscope is available for use. Elytral coloration can be a problem when confused with the different coloration effects due to wing folding beneath the elytron. Males can be distinguished from females by the presence of a more or less circular supplementary segment on the ventral abdominal apex (Fig. 49, 50). Length is measured from anterior edge of pronotum to posterior edge of elytra. Though no longer included in the genus *Carpophilus*, the closely related genus *Urophorus* is included in the key, because one species has been introduced to New Zealand and Australia.

1. Three abdominal tergites normally exposed in dorsal view (Fig. 14); pronotal bead, viewed laterally, 2× as thick in apical ½ as basal ½ (Fig. 35) *Urophorus humeralis*
- Two abdominal tergites normally exposed in dorsal view (Figs 1–4); pronotal bead not thickened in apical ½ (Figs 15, 16)..... (*Carpophilus* species) 2
2. Pronotum with sides strongly curved basally, posterior angles sinuate before a well-developed tooth (Fig. 5) *ligneus*
- Pronotum with sides parallel to moderately curved basally, posterior angles not sinuate and lacking well-developed tooth (Figs 1–4, 5–10)..... 3
3. Mesosternal disc separated from sides by carinae obliquely extending from apex of prosternum to mesocoxae (Fig. 36) 4
- Mesosternal disc without carinae as above (Fig. 37)..... 5
4. Elytra distinctively patterned with pale humeral and apical patches (Fig. 4) *hemipterus*
- Elytra lacking distinctive pattern as above (Fig. 10), humeral areas sometimes faintly lighter *obsoletus*
5. Metaventrite with axillary space large; axillary line almost straight, extending from the median edge of mesocoxal margin to midpoint to posterior ⅓ of metepisternal suture (Fig. 38); pronotum with disc shining, punctures separated by at least one diameter, setae short, sparse and appressed (Fig. 8) *marginellus*
- Metaventrite with axillary space smaller, axillary line curved, extending from about midpoint of mesocoxal margin to at most midpoint of metepisternal suture (Fig. 39, 40); pronotum with disc shining to dull, punctures usually separated by less than one diameter, setae longer, moderately dense and decumbent 6

6. Prosternum densely to weakly punctate and hypomeron moderately to densely punctate, punctures deeply impressed, edges distinct (Figs 17, 18)..... 7
 - Prosternum smooth to granulate, with at most scattered punctures; hypomeron smooth to granulate 9
7. Hypomeron densely punctate (Fig. 17), punctures deeply impressed, edges distinct; antennal segment 3 about 1.3 x length of segment 2 (Fig. 42) *dimidiatus* (Fig. 2)
 - Hypomeron weakly punctate; antennal segment 3 at most 1.1× length of segment 2 8
8. Antennal segment 3 about 1.1× length of segment 2; male metatibia abruptly expanded from basal $\frac{1}{3}$ (Fig. 45); male mandibles symmetrical, right mandible unmodified *truncatus* (Fig. 13)
 - Antennal segment 3 less than 1× length of segment 2 (Fig. 43); male metatibia gradually expanded (Fig. 44); male mandibles asymmetrical with right mandible strongly elbowed (Fig. 46) *mutilatus* (Fig. 9)
9. Metaventrite with axillary line approaching anterior $\frac{1}{4}$ of metepisternal suture then running parallel with suture (Fig. 39), becoming obsolete at about midpoint; mesoventrite and metaventrite usually darker than prosternum and abdomen (Fig. 15); pronotum strongly convex, disc densely punctate (Fig. 1), punctures separated by 1 diameter or less and deeply impressed; female 9th tergite truncate with weak median tubercle at apex (Fig. 47) *davidsoni*
 - Metaventrite with axillary line meeting metepisternal suture at about anterior $\frac{1}{4}$ to $\frac{1}{3}$ (Fig. 41); ventral surface usually unicolorous (Fig. 16); pronotum moderately convex (Fig. 16), disc punctation variable, often separated by more than 1 diameter and moderately to weakly impressed; female 9th tergite rounded or, if truncate, without median tubercle at apex (Fig. 48)..... 10
10. Body usually unicolorous red-brown (Fig. 3, 16); elytra without distinctive pattern; pronotum subparallel, sides straight between basal and apical $\frac{1}{4}$; female 9th tergite moderately upturned at apex (Fig. 48), apex extending well beyond last ventrite *gaveni*
 - Body colour variable (Figs 6, 7, 11, 12); elytra usually with distinctive pattern; pronotum convergent apically, sides weakly to moderately curved; female 9th tergite flat at apex, apex barely extending beyond last ventrite 11
11. Elytra with a lighter elongate sutural patch and transverse basal patch usually joining to form a ‘T’ pattern (Figs 6, 7); lateral lobe of aedeagus with apex rounded in lateral view (Fig. 56)..... *maculatus*
 - Elytra usually with a pale ring enclosing a dark discal ‘eye spot’ on each elytron (Fig. 11, 12); lateral lobe of aedeagus in lateral view with apex variable - recurved (*C. o. oculatus*), pointed (*C. o. gilloglyi*) or emarginate (*C. o. cheesmani*) (Figs 59–61) *oculatus*

4. Diagnostic descriptions

GENUS *CARPOPHILUS* STEPHENS 1930

Diagnosis: *Carpophilus* species can be distinguished from other Nitidulidae by the males having an external button-like 10th tergite of the male and abdominal segments 9 and 10 visible in dorsal view. The genus *Urophorus*, which was once included in *Carpophilus*, has abdominal segments 8–10 exposed in dorsal view.

Description: Length 1.5–5.5 mm. Shape ovate to oblong, moderately convex to weakly flattened. Colour variable, ranging from pale brown to black, some species with distinctive patterning on the elytra. Surfaces moderately dull to shining. Usually clearly but shallowly punctured with fine, decumbent pubescence. Labrum separated from clypeus by a clypeolabral suture. Frontoclypeal suture absent. Antennae with a distinct, flattened, 3-segmented club. Elytra short and truncate, exposing two abdominal tergites. Pygidium transverse. Second and third abdominal ventrites shorter than first and fourth. Last ventrite of male deeply emarginate to allow the reception of the supplementary sclerite. Tarsal formula 5-5-5.

***Carpophilus davidsoni* Dobson**

(Figs 1, 15, 47, 51)

Carpophilus davidsoni Dobson, 1952: 256

Description: Length 1.8–2.4 mm. Body subparallel. Colour variable, dark to light brown, tan, red-brown; unicolorous or not; head and pronotum darker than elytra in coloured specimens; elytron sometimes paler in basal $\frac{2}{3}$; mesoventrite and metaventrite often darker than prosternum and abdomen. Vestiture of decumbent golden setae; average length of elytral setae about as long as eye. **Head.** Antennomere 3 length about equal to 2. Male mandibles symmetrical. **Prothorax.** Pronotum with sides evenly arcuate, anterior angles obtusely rounded; posterior angles broadly rounded, not produced into a distinct tooth; disc strongly convex; punctures strongly impressed on disc, separated by 1 diameter or less; granulate microsculpture clearly present between punctures; micropunctures absent. Pronotal carina narrowly explanate, not sinuate in anterior $\frac{1}{3}$. Prosternum and hypomeron granulate and impunctate. Prosternal process with apex rounded and not greatly expanded laterally behind procoxae. **Elytra.** Punctures weakly impressed, separated by 1–2 diameters; granulate microsculpture present. **Mesoventrite and metaventrite.** Mesoventrite punctate; discal carinae absent. Metaventrite with axillary space present to a level of $\frac{1}{4}$ the length of the metepisternum, posterior edge extending to $\frac{1}{2}$ the length of the metepisternum. **Tergum 9.** Male unmodified, female truncate with weak median tubercle at apex. **Male genitalia.** Parameral base narrow, outer angle rounded, apex acute. **Legs.** Male metatibia not strongly dilated at base.

Comments: Dobson (1952) provides a key to separate the species *C. davidsoni*, *C. dimidiatus*, *C. maculatus* and *C. mutilatus* and (Dobson 1964) provides information to separate *C. gaveni* from *C. davidsoni* and *C. maculatus*. The species is very similar to *C. gaveni*, but can be distinguished from that species by the following combination of external characters: pronotum with anterior angles rounded, metaventrite darker than pronotum, axillary space continuing posteriorly to a level beyond midline (the line becomes weak posteriorly and may be difficult to see), apex of female tergum 9 strongly upturned. Confirmation for species identification is best done by dissection of male genitalia.

This species was described from Leeton and Dubbo, New South Wales, by Dobson (1952) and the first record of this species in New Zealand is from 1941 in Auckland (Kuschel 1990). It has been intercepted in New Zealand from produce from Australia. The species is placed in the subgenus *Myothorax* and Gillogly (1962) redescribed the species and provided distribution and host information.

Distribution: Australia and New Zealand (Williams et al. 1983). **New Zealand:** ND, AK, WO, CL, BP, HB, WN.

Status in New Zealand: Introduced and established.

Host associations (Gillogly 1962; Kuschel 1990): *Ligustrum sinense* (Chinese privet) flowers, rockmelon, banana traps, boysenberries, *Solanum acritulatum*, apple, *Acacia* rust galls, potatoes, stonefruit, raspberry, sweetcorn, rotten lemon, *Prunus persica* (peach/nectarine), *Prunus* sp., *Citrus unshiu* (*Satsuma mandarin*), *Diospyros kaki* (persimmon), strawberries, grapes, pineapple, pears, *Ravenala* seeds (?travelers palm, *Ravenala madagascariensis*).

***Carpophilus dimidiatus* (Fabricius)**

(Figs 2, 42, 52)

Nitidula dimidiata Fabricius, 1792: 261

Carpophilus pusillus Stephens, 1830: 51

Carpophilus auropilosus Wollaston, 1854: 117

Description: Length 1.6–1.8 mm. Body subparallel. Colour dark to light brown, not unicolorous; head and pronotum darker than elytra; apical $\frac{1}{3}$ of elytron darker; metaventrite and pronotum similarly coloured in most specimens. Vestiture of decumbent golden setae; average length of elytral setae as long as eye. **Head.** Antennomere 3 about $1.3\times$ length of segment 2. Male mandibles symmetrical. **Prothorax.** Pronotum with sides evenly arcuate, anterior angles obtusely rounded; posterior angles broadly rounded, not produced into a distinct tooth; disc strongly convex; punctures strongly impressed on disc, separated by 1–3 diameters; granulate microsculpture clearly present between punctures; micropunctures absent. Pronotal carina narrowly explanate, not sinuate in anterior $\frac{1}{3}$. Prosternum and hypomeron densely and strongly punctured. Prosternal process with apex rounded and not greatly expanded laterally behind procoxae. **Elytra.** Punctures relatively strongly impressed, separated by 1 diameter; granulate microsculpture present. **Mesoventrite and metaventrite.** Mesoventrite punctate; discal carinae absent. Metaventrite with axillary space present to a level of $\frac{1}{4}$ the length of the metepisternum, posterior edge extending to $\frac{1}{2}$ the length of the metepisternum. **Tergum 9.** Male and female unmodified. **Male genitalia.** Parameral base broad, outer angle rounded, apex rounded. **Legs.** Male metatibia not strongly dilated at base.

Comments: Dobson (1952) provides a key to separate the species *C. davidsoni*, *C. dimidiatus*, *C. maculatus* and *C. mutilatus* and later (Dobson 1959) differentiates *C. dimidiatus* from *C. mutilatus*. The species is very similar to *C. mutilatus* and *C. truncatus*, but can be easily distinguished from these species by the elongate antennomere 3, from *C. mutilatus* by the reduced axillary space and absence of sexual dimorphism of the mandibles, and from *C. truncatus* by the unmodified metatibia. Confirmation for species identification is best done by having series of males and females and dissection of male genitalia.

This species was described from Asia (western India) and the first record of this species in New Zealand is from the 1870s in Greymouth (Kuschel 1990). The species has been intercepted from Australia, Hong Kong, Peru and Indonesia. Descriptions, geographic distribution, and host information are treated in Gillogly (1962) and Audisio (1993) and also the adult, larva and pupa are redescribed by Hinton (1945). This species is placed in the *Carpophilus* subgenus *Myothorax*.

Distribution: Cosmopolitan (including Australia) (Hinton 1945, Williams *et al.* 1983). **New Zealand:** AK, WN, MC, DN.

Status in New Zealand: Introduced and established.

Host Associations (Hinton 1945; Dobson 1959; Gillogly 1962; Archibald & Chalmers 1983; Kuschel 1990): Almonds, bagged sugar, stored copra, stored pepper, chocolate, stored maize, cocoa beans, candle nuts, yams, corn, *Lablab purpureus* (hyacinth bean), *Cocos nucifera* (Coconut palm), hazel nuts, lychee, dried bananas, Brazil nuts, *Zizyphus* sp. (includes lote fruit, Indian jujube Chinese date), *Allium sativum* (garlic) seeds, dried apricots, spices, jalapeno chillies, bananas, bean seeds, figs, rice, blackberry, *Arachis hypogaea* (peanut, groundnut).

***Carpophilus gaveni* Dobson**

(Figs 3, 16, 41, 48, 53)

Carpophilus gaveni Dobson, 1964, 71

Description: Length 2.0–2.1 mm. Body subparallel. Colour variable, brown to light brown, tan, red-brown; often unicolorous; head and pronotum sometimes darker than elytra; elytron sometimes darker in apical $\frac{2}{3}$ and along margins; metaventrite and pronotum similarly coloured. Vestiture of decumbent golden setae; average length of elytral setae shorter than eye. **Head.** Antennomere 3 length about equal to 2. Male mandibles symmetrical.

Prothorax. Pronotum parallel-sided, anterior angles narrowly rounded; posterior angles broadly rounded, not produced into a distinct tooth; disc moderately convex; punctures strongly impressed on disc, separated by 1 diameter or less; granulate microsculpture clearly present between punctures; micropunctures absent. Pronotal carina narrowly explanate, not sinuate in anterior $\frac{1}{3}$. Prosternal process with apex rounded and not greatly expanded laterally behind procoxae. Prosternum and hypomeron granulate and impunctate. **Elytra.** Punctures weakly impressed, separated by 1–2 diameters; granulate microsculpture present.

Mesoventrite and metaventrite. Mesoventrite rugose to indistinctly punctured; discal carinae absent. Metaventrite with axillary space present to a level of $\frac{1}{4}$ the length of the metepisternum, posterior edge extending at most to $\frac{1}{3}$ the length of the metepisternum.

Tergum 9. Male unmodified; female broadly rounded and moderately upturned with apex, extending well beyond last tergite. **Male genitalia.** Parameral base relatively broad, outer angle rounded, apex subacute. **Legs.** Male metatibia not strongly dilated at base.

Comments: Dobson (1964) provides information to separate *C. gaveni* from *C. davidsoni* and *C. maculatus*. The species is very similar to *C. davidsoni*, but can be distinguished from that species by the following combination of external characters: pronotum with anterior angles right angled, metaventrite similar colour to pronotum, axillary space not continuing posteriorly to a level beyond midline, apex of female tergum 9 weakly upturned. Confirmation for species identification is best done by dissection of male genitalia.

This species was described from Glenorie, New South Wales, by Dobson (1964) and the first record of this species in New Zealand is from 1929 in Whangarei (Kuschel 1990). It has been intercepted in New Zealand from produce from Australia. The species is placed in the subgenus *Myothorax*.

Distribution: Australia and New Zealand (Williams et al. 1983). **New Zealand:** ND, AK, WO, BP, GB, HB, NN.

Status in New Zealand: Introduced and established.

Host associations (Kuschel 1990): Rotten fruits and vegetables, sweet corn, rotten oranges, banana trap, in tunnels of *Pittosporum* bark, peach fruit, ripe nectarines, *Prunus persica* (peach/nectarine), quinces, *Langanuria*, ripe raspberries, *Malus sylvestris* (crabapple), *Vitis vinifera* (grape), windfall almonds, rotten apples, apples, windfall mixed seedling apples, rotten pears, rotten quince, boysenberry, *Blighia sapida* (ackee, akee, or ahee).

Carpophilus hemipterus (Linnaeus)

(Figs 4, 36, 54)

Dermestes hemipterus Linnaeus, 1758: 358

Silpha bimaculata Linnaeus, 1767: 569

Nitidula flexuosa Herbst, 1790: 246

Nitidula quadriguttata Thunberg, 1794: 70

Nitidula cadaverina Fabricius, 1801: 354

Stenus ficus Fabricius, 1801: 603

Cateretes dimidiatus Heer, 1841: 413

Cateretes pictus Heer, 1841: 413

Carpophilus brevicornis Germain, 1856: 397

?*Carpophilus aterrimus* Macleay, 1873: 161

Description: Length 1.8–2.1 mm. Body obovate to subparallel. Colour dark brown with pale maculae on humeral and apical areas on the elytra. Vestiture of decumbent golden or black setae; average length of elytral setae shorter than eye. **Head.** Antennomere 3 length about equal to 2. Male mandibles symmetrical. **Prothorax.** Pronotum with sides evenly arcuate, converging anteriorly and widest near base; anterior angles obtusely rounded; posterior angles obtusely angulate; disc weakly convex; punctures strongly impressed on disc, separated by 1–2 diameters; microsculpture absent, glabrous between punctures with sparse micropunctures. Pronotal carina narrowly explanate, not sinuate in anterior $\frac{1}{3}$. Prosternal process with apex evenly arcuate and expanded laterally behind procoxae, with median longitudinal carina. Prosternum and hypomeron punctate. **Elytra.** Punctures strongly impressed, separated by 1 diameter or less; granulate microsculpture present. **Mesoventrite and metaventrite.** Mesoventrite with disc separated from lateral region by carinae extending from prosternal process to mesocoxae; discal area divided by median longitudinal carina. Metaventrite with axillary space poorly developed and present to a level of $\frac{1}{5}$ the length of the metepisternum. **Tergum 9.** Male unmodified; female apex weakly truncate and moderately deflexed. **Male genitalia.** Parameral base broad, outer angle rounded, apex acute. **Legs.** Male metatibia not strongly dilated at base.

Comments: This species has a very diagnostic colour pattern (Fig. 4) and can be easily distinguished from the similar species *C. obsoletus* and *C. planatus* by the presence of biconvex carinae on the mesoventrite (Fig. 36).

Carpophilus hemipterus was redescribed in Gillogly (1962) and Audisio (1993) who also included information on distribution and hosts. The species was redescribed, along with its immatures, by Hinton (1945) who also listed *Carpophilus aterrimus* Macleay, 1873 as a synonym. However, based on a syntype specimen examined in Australia identified as *C. aterrimus* the synonymy with *C. hemipterus* is questionable.

This species was described from South America (Surinam) and the first record of this species in New Zealand is from the 1880s in Christchurch (Hutton 1904). It has been intercepted in New Zealand from produce from Australia. This species is placed in the subgenus *Carpophilus*.

Common name: Dried fruit beetle.

Distribution: Cosmopolitan (including Australia) except for Arctic and colder temperate regions (Connell, 1991; Williams et al. 1983). **New Zealand:** ND, AK, BP, TK, WI, WN, NN, MB, MC, SC, DN, SL.

Status in New Zealand: Introduced and established.

Host associations (Hinton 1945; Dobson 1959; Gillogly 1962; Archibald & Chalmers 1983; Kuschel 1990): Apple (dried and rotten), rockmelon, flour, pumpkin flowers, papaya, lemon peel, persimmon, pineapple, bagged sugar, iris bulbs, oranges, water chestnuts, *Citrus sinensis* (orange), *Prunus persica* (peach/nectarine) , nectarines, *Vitis vinifera* (grape/raisins), *Allium sativum* (garlic), rotten garlic bulbs, *Ficus carica* (common fig), dried figs, rice, dates, dried citrus peel, molasses, tomato, dates, shallots, orchids, *Zizyphus* sp. (includes lote fruit, Indian jujube Chinese date), tea, onion, bhindi, dried apricots, taro, chocolates.

***Carpophilus ligneus* Murray**

(Figs 5, 55)

Carpophilus ligneus Murray, 1864: 351

Carpophilus decipiens Horn, 1879: 279

Description: Length 1.8–2.1 mm. Body parallel. Colour red to dark brown with pale elytra. Vestiture of decumbent golden setae; average length of elytral setae shorter than eye. **Head.** Antennomere 3 length about equal to 2. Male mandibles symmetrical. **Prothorax.** Pronotum with sides strongly rounded and widest in basal $\frac{1}{3}$; anterior angles obtusely rounded; posterior angles broadly rounded, weakly sinuate before a well-defined tooth; disc flattened; punctures strongly impressed on disc, separated by 1 diameter or less; microsculpture present between punctures; micropunctures absent. Pronotal carina relatively widely explanate, not sinuate in anterior $\frac{1}{3}$. Prosternum and hypomeron rugose. Prosternal process with apex rounded and not greatly expanded laterally behind procoxae. **Elytra.** Punctures weakly impressed, separated by 1–2 diameters; granulate microsculpture present and stronger compared to pronotum. **Mesoventrite and metaventrite.** Mesoventrite rugose; discal carinae absent. Metaventrite with axillary space poorly developed and present to a level of $\frac{1}{5}$ the length of the metepisternum. **Tergum 9.** Male with apex upturned; female unmodified. **Male genitalia.** Parameral base relatively broad, outer angle angulate, apex acute and anvil shaped. **Legs.** Male metatibia not strongly dilated at base.

Comments: This species has a very diagnostic habitus that is relatively flattened (Fig. 5) and can be easily distinguished from all the other species by the presence of a well-defined tooth at the posterior angles of the pronotum.

This species was described from Central America (Nicaragua), is widespread in the Americas, and the earliest collections in New Zealand date from 1921 in Auckland and Nelson. Redescriptions, distribution and host data are presented in Hinton (1945) and Audisio (1993). This species is not reported from Australia and has not been located in borrowed material. This species is placed in the subgenus *Ecnomorphus* Motschulsky.

Biological reasons why this species has not been introduced to Australia is not clear. In New Zealand it has been found on dried, fermenting, and decaying fruits and it is conceivable, based on its virtually worldwide distribution that it should have been introduced to Australia. Because most host records are rather general, a detailed study of this species in the field to provide a list of fruit varieties would be useful.

Distribution: Africa, Asia, Central America (Guatemala, Mexico, Nicaragua, Panama), Europe (Britain, France, Germany), Oceania, South America, USA (Hinton 1945; Williams et al.; 1983 Audisio 1993). **New Zealand:** ND, AK, WO, BP, NN, MB, KA, MC, DN, SL.

Status in New Zealand: Introduced and established.

Host associations (Hinton 1945; Dobson 1959): Rimu, dried and fermenting apples, ripe bananas, refined sugar, rotten wood, rotten seaweed, fruit, Golden Queen peaches.

***Carpophilus maculatus* Murray**

(Figs 6, 7, 56)

Carpophilus maculatus Murray, 1864: 372

Carpophilus vittiger Murray, 1864: 373

Description: Length 1.6–2.0 mm. Body subparallel. Colour variable, tan, light to dark brown; rarely unicolorous; pronotum sometimes infuscate with pale margins or a dark macula; elytron with broad sutural pale macula extending to humeral areas in basal $\frac{1}{4}$, often forming a ‘T’ pattern, and sometimes only a broad apical fascia; metaventricle and pronotum similarly coloured. Vestiture of decumbent golden setae; average length of elytral setae slightly shorter than eye. **Head.** Antennomere 3 length about equal to 2. Male mandibles symmetrical. **Prothorax.** Pronotum with sides moderately curved and weakly convergent anteriorly; anterior angles obtusely rounded; posterior angles broadly rounded, not produced into a distinct tooth; disc moderately convex; punctation variable, punctures relatively strongly impressed on disc, separated by 1 diameter or less or separated by 1–2 diameters; granulate microsculpture clearly present between punctures; median impunctate strip present in most specimens; micropunctures absent. Pronotal carina widely or narrowly explanate, not sinuate in anterior $\frac{1}{3}$. Prosternum and hypomeron with granulate microsculpture and impunctate, or weakly rugose. Prosternal process with apex subrounded and not greatly expanded laterally behind procoxae. **Elytra.** Punctures weakly to slightly impressed, separated by 1 diameter or less; granulate microsculpture present. **Mesoventrite and metaventricle.** Mesoventrite rugose to indistinctly punctured; discal carinae absent. Metaventricle with axillary space present to a level of $\frac{1}{3}$ the length of the metepisternum, line at side sometimes absent to weakly impressed. **Tergum 9.** Male and female unmodified; smaller females may have a slightly depressed apex. **Male genitalia.** Parameral base relatively broad, outer angle angulate subapically, apex subacute. **Legs.** Male metatibia not strongly dilated at base.

Comments: Dobson (1952) provides a key to separate the species *C. davidsoni*, *C. dimidiatus*, *C. maculatus* and *C. mutilatus* and later (Dobson 1964) provides information to separate *C. maculatus* from *C. gaveni*.

Carpophilus maculatus is a highly variable species that can be distinguished from the closely related *C. oculatus* by its colour pattern (compare Figs 6, 7 and 11, 12) and also by dissection of the male genitalia, though the genitalia are very similar to the subspecies *C. oculatus gillogly* Dobson which it is sympatric with, even on the remote Kermadec Islands. There are subtle differences among these two species (see species key) and there are some characters that may be fixed within island populations (e.g., pronotal carina widely explanate in Niue). The overlapping variation between *C. maculatus* and *C. oculatus* suggests that these are the same species, but additional research is necessary.

This species was described from French Polynesia and is regularly intercepted in New Zealand (Archibald & Chalmers 1983) from produce originating from Pacific Islands. We have found no evidence of establishment of this species in New Zealand. The species was redescribed by Hinton (1945) and Gillogly (1962) who also included distribution and host information. This species is placed in the subgenus *Myothorax* Murray (Jelinek 2005).

Distribution: French Polynesia, Indo-Australian Region, Pacific Islands USA (Hawaii, not recorded from continental USA) (Hinton 1945; Williams et al. 1983; Connell 1991).

Status in New Zealand: Intercepted; present on Kermadec Islands.

Host associations (Hinton 1945; Dobson 1959; Gillogly 1962; Archibald & Chalmers 1983):
Coconuts, pineapple.

***Carpophilus marginellus* Motschulsky**

(Figs 8, 38, 57)

Carpophilus marginellus Motschulsky, 1858

Carpophilus nitens Fall, 1910: 125

Description: Length 2.3–2.5 mm. Body subparallel, with sides of prothorax and elytra contiguous. Colour red to dark brown, unicolorous; infuscate in some specimens. Vestiture of short appressed golden setae; average length of elytral setae much shorter than eye. **Head.** Antennomere 3 length about equal to 2. Male mandibles symmetrical. **Prothorax.** Pronotum with sides parallel to anterior $\frac{1}{3}$, convergent apically; anterior angles obtusely rounded; posterior angles obtusely angulate, not produced into a well-defined tooth; disc convex; punctures strongly impressed on disc, separated by 1 diameter or less; weak microsculpture present between punctures, but areas glabrous; micropunctures absent. Pronotal carina narrowly explanate, not sinuate in anterior $\frac{1}{3}$. Prosternum and hypomeron rugose to granulate. Prosternal process with apex subacute and not weakly expanded laterally behind procoxae, with 2 lateral longitudinal sutures. **Elytra.** Punctures strongly impressed anteriorly, separated by 1 diameter or less; granulate microsculpture present and stronger compared to pronotum. **Mesoventrite and metaventrite.** Mesoventrite rugose; with a median longitudinal carina present on disc. Metaventrite with axillary space well developed and present to a level beyond middle of metepisternum; axillary line almost straight. **Tergum 9.** Male with unmodified, or with weak depressions near apex in some specimens; female unmodified. **Male genitalia.** Parameral base somewhat narrow, outer angle evenly arcuate, apex acute. **Legs.** Male metatibia not strongly dilated at base.

Comments: This species is very distinctive by having a brown to reddish brown colour pattern (Fig. 8) with a glabrous cuticle and the body parallel-sided with the prothoracic and elytral outlines contiguous. The large axillary space is also very distinctive for this species (Fig. 38).

This species was described from Asia and the first record of this species in New Zealand is from 1935 in Nelson (Kuschel 1990). The adult was redescribed by Hinton (1945), Gillogly (1962), and Audisio (1993). This species is placed in the subgenus *Carpophilus*.

Distribution: Nearly cosmopolitan, (Hinton 1945), including Australia, Africa, Argentina, China (Western), Europe, India (Western), Malagasy Republic, and USA (Williams et al. 1983; Audisio 1993). **New Zealand:** ND, AK, WO, WI, CL, BP, GB, HB, WN, NN, OL.

Status in New Zealand: Introduced and established.

Host associations (Hinton 1945; Dobson 1959; Kuschel 1990): Tomatoes, swedes, lemons, sweet corn, decaying fruit, copra, dahlias, tunnels in *Pittosporum* bark, iris bulb, babaco, *Kentia* seed, palm seed, cucumber, cut flowers, pineapples, Golden Queen peaches, rotting maize, feijoa.

***Carpophilus mutilatus* Erichson**

(Figs 9, 37, 39, 43, 44, 46, 58)

Carpophilus mutilatus Erichson, 1843: 258

Carpophilus luridus Murray, 1864: 377

Carpophilus pilosellus Motschulsky, 1858: 41

Description: Length 1.5–1.8 mm. Body parallel. Colour variable, unicolorous light tan to brown; elytron with broad central pale area extending to humeral areas in basal $\frac{1}{4}$ (similar to *C. maculatus*); metaventrite and pronotum not similarly coloured, with ventrites darker than the dorsum. Vestiture of decumbent golden setae; average length of elytral setae distinctly shorter than eye. **Head.** Antennomere 3 length about equal to 2. Male mandibles asymmetrical, right mandible strongly elbowed. **Prothorax.** Pronotum with sides weakly curved, convergent anteriorly; anterior angles obtusely angled; posterior angles broadly rounded, not produced into a distinct tooth; disc moderately convex; punctures moderately impressed on disc, separated by 1 diameter or less; granulate microsculpture clearly present between punctures; micropunctures absent. Pronotal carina narrowly explanate, not sinuate in anterior $\frac{1}{3}$. Prosternum rugose, hypomeron granulate. Prosternal process with apex subrounded and not greatly expanded laterally behind procoxae. **Elytra.** Punctures weakly to slightly impressed, separated by 1–3 diameters; granulate microsculpture present. **Mesoventrite and metaventrite.** Mesoventrite rugose; discal carinae absent. Metaventrite with axillary space present to a level of $\frac{1}{3}$ the length of the metepisternum. **Tergum 9.** Male unmodified, female with slightly depressed subacute apex, some abruptly constricted apically. **Male genitalia.** Parameral base relatively broad, outer angle arcuate, apex subacute. **Legs.** Male metatibia not strongly dilated at base.

Comments: This species is similar to *C. dimidatus* (see Dobson 1959), small specimens of *C. maculatus*, and *C. truncatus*, and can be distinguished from the species by the combination of: length of antennomere 2 slightly shorter than 3 (Fig. 43), asymmetrical male mandibles, axillary space relatively small, and non-dilated male metatibiae. Dobson (1952) provides a key to separate the species *C. davidsoni*, *C. dimidiatus*, *C. maculatus* and *C. mutilatus* and later (Dobson 1956) provides information to separate *C. freemani* from *C. mutilatus*. Dobson (1954a) redescribed *C. mutilatus*. Dissections of males may be important for exact determination of this species.

This species was described from western India and the first record of this species in New Zealand was by Hutton (1904). We have examined specimens that were intercepted from produce originating from Australia. We find no evidence of establishment of this species in New Zealand, contrary to the findings of Archibald and Chalmers (1983). *Carpophilus mutilatus* did not fit the criteria of an established species as indicated in the introduction. There was a PPIN record for the species but we were unable to locate that specimen in borrowed material and we could not validate the record.

Redescription of adults, distribution, and host information are included in Gillogly (1962) and Audisio (1993). This species is placed in the subgenus *Myothorax* Murray.

Common name: Confused sap beetle.

Distribution: Cosmopolitan (Williams et al. 1983), including Australia.

Status in New Zealand: Intercepted.

Host associations (Dobson 1959; Archibald & Chalmers 1983): *Prunus persica* (peach/nectarine), grapes, quince, oranges, arrowroot flower, island chestnuts, lentil seeds.

***Carpophilus obsoletus* Erichson**

(Figs 10, 40, 49, 50, 62)

Carpophilus obsoletus Erichson, 1843

Carpophilus immaculatus Lucas, 1849: 217

Carpophilus cribellatus Motschulsky, 1858: 41

Carpophilus sericeus Motschulsky, 1858: 41

Carpophilus strigipennis Motschulsky, 1858: 41

Description: Length 1.8–2.2 mm. Body subparallel. Colour chocolate to dark brown, elytra may be lighter. Vestiture of decumbent silver setae; average length of elytral setae shorter than eye. **Head.** Antennomere 3 length about equal to 2. Male mandibles symmetrical.

Prothorax. Pronotum with sides moderately curved, converging anteriorly and widest near base; anterior angles obtusely rounded; posterior angles obtusely angulate, not produced into a tooth; disc convex; punctures large and ovate and strongly impressed on disc, separated by less than 1 diameter; microsculpture and small micropunctures sparsely present, glabrous between punctures. Pronotal carina somewhat explanate, sinuate in anterior $\frac{1}{3}$ in some specimens. Prosternum punctate, hypomeron rugose. Prosternal process with apex evenly arcuate and expanded laterally behind procoxae. **Elytra.** Surface undulate, punctures at disc of similar size, punctures ovate and strongly impressed, separated by less than 1 diameter; granulate microsculpture present. **Mesoventrite and metaventrite.** Mesoventrite rugose with disc separated from lateral region by carinae extending from prosternal process to mesocoxae; discal area divided by median longitudinal carina. Metaventrite without axillary space. **Tergum 9.** Male apex apiculate; female narrowly rounded and often weakly upturned at apex. **Male genitalia.** Parameral base relatively narrow, outer angle evenly arcuate, apex acute. **Legs.** Male metatibia not strongly dilated at base.

Comments: This species is distinctive by having a unicolorous brown or chocolate colour (Fig. 10) with large punctation dorsally and male with tergum 9 apiculate. It is most similar to *C. planatus*, but can be distinguished from this species by having a convex pronotum and the surfaces of the elytra are uneven.

This species was described from Asia (Thailand) and has been intercepted in New Zealand from produce originating from Australia, Asia and the Pacific islands. There are 6 specimens collected by C.E. Clark from 1924 to 1941 in the North Island (ND, AK, WO) and a single specimen collected in 1962 (ND). But we have seen no recent specimens, which suggests that this species is not established. Redescriptions of the adult, distribution, and host information are included in Hinton (1945), Gillogly (1962), and Audisio (1993). This species is placed in the subgenus *Carpophilus*.

Distribution: Africa, China (Western), Central America, Europe, Iran, Japan, Malagasy Republic, USA (Williams et al. 1983; Connell 1991).

Status in New Zealand: Intercepted.

Host associations (Dobson 1959: Archibald & Chalmers 1983): Papaya, dried banana, shallots, pepper, *Cocos nucifera* (Coconut palm), yam, taro, coffee beans, hemp, annatto, (*Bixa orellana*) seeds, plantain, taro, tea leaves, copra, pawpaw, pineapple, *Phoenix dactylifera* (date palm), cocoa beans, cocoa, *Zizyphus* fruit (includes lote fruit, Indian jujube Chinese date), dried fruit, garlic, rice, peanuts, hides, lychees, raisins, grapes, rotten wheat, peppers.

***Carpophilus oculatus* Murray**

(Figs 11, 12, 59–61)

Carpophilus oculatus Murray, 1864

Carpophilus oculatus oculatus Murray, 1864 (subspecies)

Carpophilus oculatus gilloglyi Dobson 1993a (subspecies)

Carpophilus oculatus cheesmani Dobson 1993a (subspecies)

Description: Length 1.8–2.3 mm. Body subparallel. Colour very variable, tan, light to dark brown; rarely unicolorous (some island populations); pronotum infusate with pale margins or a dark macula or unicolorous; elytron with central dark macula surrounded by pale circle, extending almost to darker supraepipleural dark area, sutural areas dark; metaventricle and pronotum similarly coloured. Vestiture of decumbent golden setae; average length of elytral setae distinctly shorter than eye. **Head.** Antennomere 3 length nearly as long as or equal to 4+5. Male mandibles symmetrical. **Prothorax.** Pronotum with sides weakly curved, weakly convergent anteriorly; anterior angles narrowly curved; posterior broadly rounded, not produced into a distinct tooth; disc strongly to moderately convex; punctation variable, punctures relatively strongly or weakly impressed on disc, separated by 1 diameter or less or separated by 1–2 diameters; glabrous to granulate with microsculpture clearly present between punctures; median impunctate strip present in most specimens; micropunctures absent. Pronotal carina narrowly explanate, not sinuate in anterior $\frac{1}{4}$. Prosternum and hypomeron with granulate microsculpture and impunctate, or weakly rugose. Prosternal process with apex subrounded and not greatly expanded laterally behind procoxae. **Elytra.** Punctures weakly to slightly impressed, separated by 1 diameter or less; granulate microsculpture present. **Mesoventrite and metaventricle.** Mesoventrite rugose to indistinctly punctured; discal carinae absent. Metaventricle with axillary space present to a level of $\frac{1}{3}$ the length of the metepisternum, line at side sometimes absent to weakly impressed. **Tergum 9.** Male and female unmodified. **Male genitalia.** Parameral base broad, outer angle angulate subapically or not, apex acute, subacute, rounded. **Legs.** Male metatibia not strongly dilated at base.

Comments: *Carpophilus oculatus* is a highly variable species that has been divided into three subspecies by Dobson based on genitalic differences and colour pattern. *Carpophilus oculatus oculatus* is widespread (Cook Islands, Fiji, Marquesus, Society Islands, and Tonga) and has been introduced to Hawaii. *Carpophilus oculatus gilloglyi* is also widespread (Cook Islands, Fiji, Kermadec Islands, Niue, and Tonga). *Carpophilus oculatus cheesmani* is restricted to New Hebrides. These subspecies can be distinguished from the closely related *C. maculatus* by colour pattern (compare Figs 6, 7 and 11, 12) and also by dissection of the male genitalia (apart from *C. oculatus gilloglyi*, see Comments for *C. maculatus*). Apart from colour, we have noticed variation in punctation and width of the pronotal carinae (from weakly to moderately explanate).

This species was described from the Society Islands (Bora-Bora) with interceptions in New Zealand. The species is widespread in the Pacific and Micronesia (Gillogly 1962; Dobson 1993a), including the Kermadec Islands. We have found no evidence of establishment of this species in mainland New Zealand, but the species has been intercepted from produce originating from Pacific islands. Redescription of the adult, distribution, and host data are included in Gillogly (1962). This species is placed in the subgenus *Myothorax* Murray.

Distribution: *Carpophilus o. oculatus* – Cook Islands, Society Islands, Tonga, USA (Hawaii) (Dobson 1993a). *Carpophilus o. gilloglyi* – Cook Islands, Fiji, New Zealand (Kermadec Islands), Niue, Society Islands, Tonga (Dobson 1993a). *Carpophilus o. cheesmani* – New Hebrides [Vanuatu] (Dobson 1993a).

Status in New Zealand: *Carpophilus o. oculatus* intercepted. *Carpophilus o. gilloglyi* native, Kermadec Islands only.

Host associations (Gillogly 1962; Dobson 1993a): Yams (*Discorea* sp.), dried fruit, kava root, taro (*Colocasia* sp.), copra, *Cocos nucifera* (Coconut palm), *Corombola*, chestnut (*Inocarpus edulis*), cut flowers, *Capsicum* sp., vegetables.

***Carpophilus truncatus* Murray**

(Figs 13, 45, 63)

Carpophilus truncatus Murray, 1864: 381, 397

Carpophilus floridanus Fall, 1910: 122

Carpophilus halli Dobson, 1954: 299

Carpophilus pilosellus Motschulsky, 1858: 41

Description: Length 1.6–1.8 mm. Body subparallel. Colour unicolorous light to red brown; apical $\frac{1}{3}$ of elytron darker; metaventrite and pronotum similarly coloured. Vestiture of decumbent or suberect golden setae; average length of elytral setae about as long as eye.

Head. Antennomere 3 about $1.1\times$ length of segment 2. Male mandibles symmetrical.

Prothorax. Pronotum with sides moderately curved, anterior angles obtusely rounded; posterior angles broadly rounded, not produced into a distinct tooth; disc moderately convex; punctures impressed on disc, separated by 1 diameter; granulate microsculpture clearly present between punctures; micropunctures absent. Pronotal carina narrowly explanate, not sinuate in anterior $\frac{1}{3}$. Prosternum strongly punctured; hypomeron rugose. Prosternal process with apex rounded and not greatly expanded laterally behind procoxae. **Elytra.**

Punctures moderately impressed, separated by 1 diameter; granulate microsculpture present.

Mesoventrite and metaventrite. Mesoventrite punctate; discal carinae absent. Metaventrite with axillary space present to a level of $\frac{1}{2}$ the length of the metepisternum. **Tergum 9.** Male and female unmodified. **Male genitalia.** Parameral base barrow, outer angle evenly arcuate, apex acute. **Legs.** Male metatibia abruptly expanded from basal $\frac{1}{3}$.

Comments: This species is similar to *C. dimidatus* and small specimens of *C. maculatus* and can be distinguished from the species by the combination of: length of antennomere 2 slightly shorter than 3, symmetrical male mandibles, well developed axillary space, and basally constricted male metatibiae. Dissections of males may be needed for exact determination of this species.

This species was described from Madagascar and the first interception record of this species in New Zealand is from 1954 (intercepted from coconut husk in Timaru). We find no evidence of establishment of this species in New Zealand, though it has been intercepted from produce originating from Pacific islands. Redescription of the adult, distribution, and host information is given in Gillogly (1962) and Audisio (1993). Jelinek (2005) lists *C. pilosellus* as a synonym of *C. truncatus* and we follow his treatment of the species name. This species is placed in the subgenus *Myothorax* Murray.

Distribution: Australia, China, India (Western), Japan, Malagasy Republic, Micronesia, North, Central and South America, Philippines (Williams et al. 1983 as *C. pilosellus*).

Status in New Zealand: Intercepted.

Host associations (Gillogly 1962): Copra, coconut husks, prepared bananas, dried bread fruit, rice.

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6. References

- Archibald RD, Chalmers I 1983. Stored product Coleoptera in New Zealand. *New Zealand Entomologist* 7: 371–397.
- Audisio P 1993. Fauna d'Italia. Vol. XXXII. Coleoptera: Nitidulidae – Kateretidae. Bologna, Edizioni Calderini. 971 p.
- Connell WA 1991. Sap beetles (Coleoptera: Nitidulidae). In: Gorham JR ed. 1991. Insect and mite pests in food, an illustrated key. Volume 1. United States Department of Agriculture Handbook No. 655. Washington D.C., U.S. Government Printing Office. Pp. 151–174.
- Crosby TK, Dugdale JS, Watt JC 1998. Area codes for recording specimen localities in the New Zealand subregion. *New Zealand Journal of Zoology* 25: 175–183.
- Dobson RM 1952. A new species of *Carpophilus* Stephens (Col., Nitidulidae) from Australia. *The Entomologist's Monthly Magazine* 88: 256–258.
- Dobson RM 1954a. The species of *Carpophilus* Stephens associated with stored products. *Bulletin of Entomological Research* 45: 389–402.
- Dobson RM 1954b. A note on the anatomy and morphology of the external genitalia of *Carpophilus obsoletus* Er. (Coleoptera: Nitidulidae). *Proceedings of the Royal Entomological Society of London, B* 29: 45–50.
- Dobson RM 1956. A new species of *Carpophilus* Stephens (Col., Nitidulidae) associated with stored products. *The Entomologist's Monthly Magazine* 92: 41–42.
- Dobson RM 1959. Notes on taxonomy and occurrence of *Carpophilus* Stephens (Col., Nitidulidae) associated with stored products. *The Entomologist's Monthly Magazine* 95: 156–158.
- Dobson RM 1964. A new species of *Carpophilus* Stephens (Coleoptera: Nitidulidae) from New South Wales. *Proceedings of the Royal Entomological Society of London, B* 33: 71–72.
- Dobson RM 1993a. A reappraisal of *Carpophilus oculatus* Murray 1864, (Coleoptera: Nitidulidae) with descriptions of two new subspecies. *Storkia* 2: 26–29.
- Dobson RM 1993b. New species and subspecies of *Carpophilus* Stephens (Coleoptera: Nitidulidae) from the Australasian region. *Storkia* 2: 1–12.
- Gillogly LR 1962. Coleoptera: Nitidulidae. *Insects of Micronesia* 16: 133–188.
- Hinton HE 1945. A monograph of beetles associated with stored products. *Bulletin of the British Museum of Natural History* 1: 1–433.
- Hutton FW 1904. *Index Faunae Novae Zealandiae*. London, Dulau. 372 p.

- Jelinek, J. 2005. Nitidulidae. *In*: Catalogue of Palaearctic Coleoptera (Löbl, I. and A. Smetana, eds.). Stenstrup, Apollo Books (in press).
- Keall JB 1981. Interceptions of insects, mites, and other animals entering New Zealand 1973-1978. Levin, Plant Health Diagnostic Station, Ministry of Agriculture and Fisheries. 661 p.
- Kirejtshuk AG 1986. On the polyphyly of the Carpophilinae with description of a new subfamily, Cillaeinae (Coleoptera: Nitidulidae). *The Coleopterists Bulletin* 40: 217–221.
- Kirejtshuk AG 1992. Family Nitidulidae. *In*: Ler PA ed. Key to the insects of the far east of Russia, vol. 3. Coleoptera, part 2. [In Russian]. Pp. 114–209.
- Kuschel G 1990. Beetles in a suburban environment: a New Zealand case study. The identity and status of Coleoptera in the natural and modified habitats of Lynfield, Auckland (1974–1989). DSIR Plant Protection Report 3. 119 p.+ 230 figs.
- Manson DCM, Ward A 1968. Interceptions of insects, mites, and other animals entering New Zealand 1955-65. Wellington, Government Printer. 407 p.
- Parsons CT 1943. A revision of Nearctic Nitidulidae (Coleoptera). *Bulletin of the Museum of Comparative Zoology* 92: 119–278 + 13 pls.
- Richardson CA 1979. Interceptions of insects, mites, and other animals entering New Zealand 1973-1978. Levin, Plant Health Diagnostic Station, Ministry of Agriculture and Fisheries. 473 p.
- Williams RN, Fickle DS, Kehat M, Blumberg D, Klein MG 1983. Bibliography of the genus *Carpophilus* Stevens (Coleoptera: Nitidulidae). Ohio State University, Ohio Research and Development Centre Research Circular 278. 95 p.

Appendix 1. General information and keys to *Carpophilus* species

Archibald & Chalmers (1983)

Lists *Carpophilus* species recorded from New Zealand, their status, distribution, host and interception records.

Audisio (1993)

Key (in English, remainder in Italian), illustrations, descriptions, ecology and distribution of *Carpophilus* species in Europe.

Connell (1991)

Keys and illustrations to adults and larvae of species in North America.

Dobson (1954a)

Key, illustrations and selected descriptions of *Carpophilus* species in Britain. Records origins and hosts for species intercepted into Britain.

Dobson (1959)

Lists species of *Carpophilus* and their hosts.

Dobson (1993b)

Describes new species from Australia and the Pacific Islands.

Gillogly (1962)

Key, illustrations, descriptions, and hosts of *Carpophilus* species in the Pacific.

Hinton (1945)

Keys to adults and selected larvae and pupae of species of *Carpophilus* commonly associated with stored products. Describes and gives distribution and host information for selected species.

Parsons (1943)

Key, illustrations, descriptions, ecology and distribution of *Carpophilus* species in North America.

Williams et al. (1983)

Lists all literature on *Carpophilus* from 1758 to 1982 and includes sections on species distributions, bionomics, and hosts.

Appendix 2. *Carpophilus* species recorded from Australian and New Zealand.

Key to notation:

- AU** Species recorded from Australia
NZ Species recorded from New Zealand
‡ Intercepted species (not known to be established in New Zealand)

Note that the species listed in the introduction require verification of their presence in Australia (i.e., *C. brachypteris*, *C. flavipes*, *C. freemani*, *C. obesus*).

Carpophilus (Carpophilus) aterrimus Macleay, W.J., 1873 – **AU**

Carpophilus (Carpophilus) delkeskampi Hisamatsu, 1963
(subsp. *australiensis* Dobson, 1993b) (Fig. 21) – **AU**

Carpophilus (Carpophilus) hemipterus (Linné, 1758) – **AU, NZ**

Carpophilus (Carpophilus) marginellus Motschulsky, 1858 – **AU, NZ**

Carpophilus (Carpophilus) obscurus Macleay, W.J., 1873 (Fig. 30) – **AU, NZ**

Carpophilus (Carpophilus) obsoletus Erichson, 1843 – **AU, NZ (‡)**

Carpophilus (Carpophilus) planatus Murray, 1864 (Fig. 31) – **AU, NZ**

Carpophilus (Ecnomorphus) ligneus Murray, 1864 – **NZ**

Carpophilus (Microxanthus) frivolus (Murray, 1864) (Fig. 24) – **AU**

Carpophilus (Microxanthus) gentilis (Murray, 1864) – **AU**

Carpophilus (Microxanthus) luridipennis (Macleay, W.J., 1873) (Fig. 28) – **AU**

Carpophilus (Myothorax) australis (Murray, 1864) – **AU**

Carpophilus (Myothorax) bakewelli (Murray, 1864) – **AU**

Carpophilus (Myothorax) davidsoni Dobson, 1952 – **AU, NZ**

Carpophilus (Myothorax) dimidiatus (Fabricius, 1792) – **AU, NZ**

Carpophilus (Myothorax) gaveni Dobson, 1964 – **AU, NZ**

Carpophilus (Myothorax) kuscheli Dobson, 1993b (Fig. 25) – **AU** [Norfolk Island]

Carpophilus (Myothorax) maculatus Murray, 1864 – **AU, NZ (‡)**

Carpophilus (Myothorax) mutilatus Erichson, 1843 – **AU, NZ (‡)**

Carpophilus (Myothorax) oculatus Murray, 1864 – **NZ (‡)**

(subsp. *gilloglyi* Dobson, 1993a – **NZ** [Kermadec Islands])

Carpophilus (Myothorax) pilipennis Macleay, W.J., 1871 – **AU**

Carpophilus (Myothorax) truncatus Murray 1864 – **AU, NZ (‡)**

Carpophilus (Myothorax) ustulatus (Murray, 1864) (Fig. 33) – **AU**

Carpophilus (Stauroglossicus) cairnsensis Dobson 1993b (Fig. 20) – **AU**

Carpophilus (Stauroglossicus) convexiusculus Macleay, W.J., 1871 – **AU**

Carpophilus (Stauroglossicus) loriae Grouvelle, 1906 (Fig. 26) – **AU**

Carpophilus (Stauroglossicus) terminalis (Murray, 1864) (Fig. 32) – **AU**

Carpophilus (ungrouped) armstrongi Dobson, 1993b – **AU**



1 *Carpophilus davidsoni*



2 *Carpophilus dimidiatus*



3 *Carpophilus gaveni*



4 *Carpophilus hemipterus*

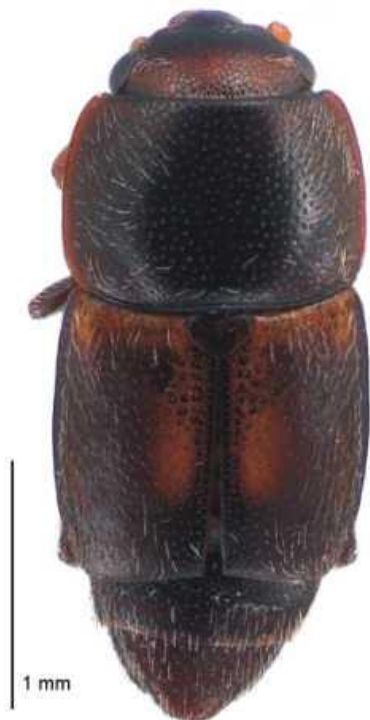
Figs 1–4. Dorsal images: 1, *C. davidsoni*; 2, *C. dimidiatus*; 3, *C. gaveni*; 4, *C. hemipterus*.



5 *Carpophilus ligneus*



6 *Carpophilus maculatus*



7 *Carpophilus maculatus*



8 *Carpophilus marginellus*

Figs 5–8. Dorsal images: 5, *C. ligneus*; 6, *C. maculatus*; 7, *C. maculatus*; 8, *C. marginellus*.



9 *Carpophilus mutilatus*



10 *Carpophilus obsoletus*



11 *Carpophilus oculatus*



12 *Carpophilus oculatus*

Figs 9–12. Dorsal images: 9, *C. mutilatus*; 10, *C. obsoletus*; 11, *C. oculatus*; 12, *C. oculatus*.



13 *Carpophilus truncatus*



14 *Urophorus humeralis*



15 *Carpophilus davidsoni*



16 *Carpophilus gaveni*

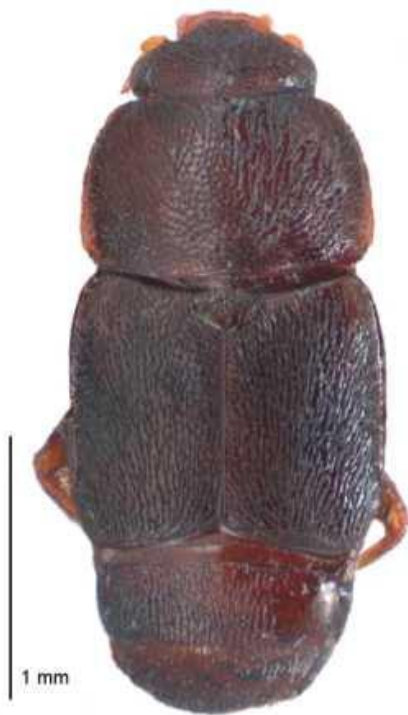


17 *Carpophilus dimidiatus*



18 *Carpophilus mutilatus*

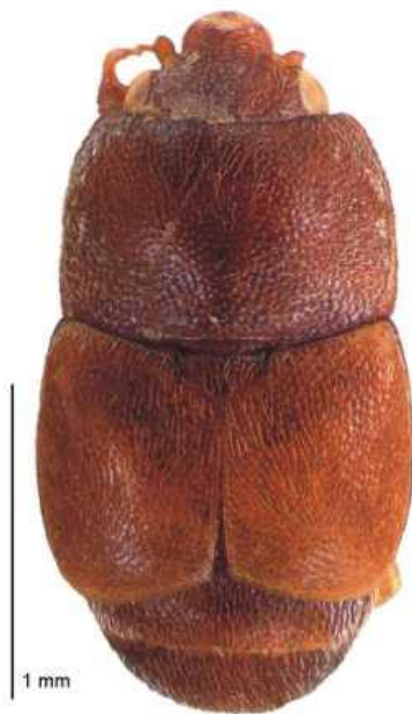
Figs 13–18. Dorsal images: 13, *C. truncatus*; 14, *C. humeralis*. Lateral images: 15, *C. davidsoni*; 16, *C. gaveni*. Ventral images of prothorax: 17, *C. dimidiatus*; 18, *C. mutilatus*.



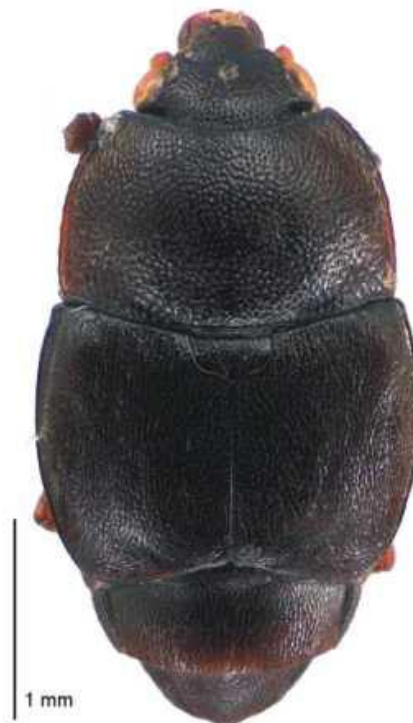
19 *Carpophilus brachypterus*



20 *Carpophilus cairnsensis*



21 *Carpophilus delkeskampi*



22 *Carpophilus flavipes*

Figs 19–22. Dorsal images: 19, *C. brachypterus*; 20, *C. cairnsensis*; 21, *C. delkeskampi*; 22, *C. flavipes*.



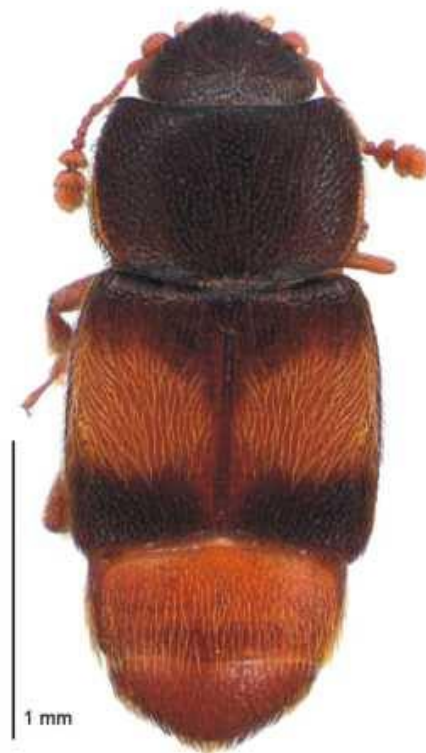
23 *Carpophilus freemani*



24 *Carpophilus frivolus*



25 *Carpophilus kuscheli*



26 *Carpophilus loriae*

Figs 23–26. Dorsal images: 23, *C. freemani*; 24, *C. frivolus*; 25, *C. kuscheli*; 26, *C. loriae*.



27 *Carpophilus lugubris*



28 *Carpophilus luridipennis*



29 *Carpophilus obesus*



30 *Carpophilus obscurus*

Figs 27–30. Dorsal images: 27, *C. lugubris*; 28, *C. luridipennis*; 29, *C. obesus*; 30, *C. obscurus*.



31 *Carpophilus planatus*



32 *Carpophilus terminalis*



33 *Carpophilus ustulatus*

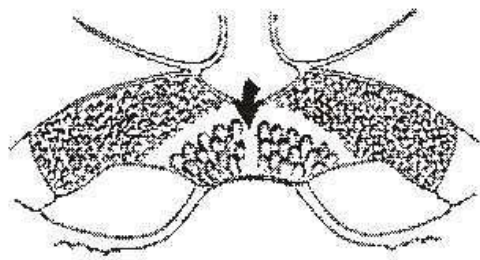


34 *Carpophilus lugubris*

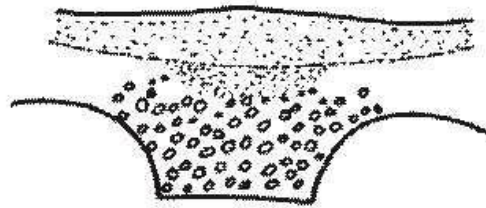


35 *Urophorus humeralis*

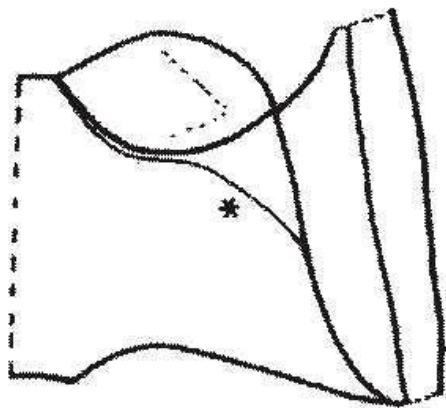
Figs 31–35. Dorsal images: 31, *C. planatus*; 32, *C. terminalis*; 33, *C. ustulatus*. Apex of male ventrite 5: 34, *C. lugubris*. Lateral view: 35, *U. humeralis*.



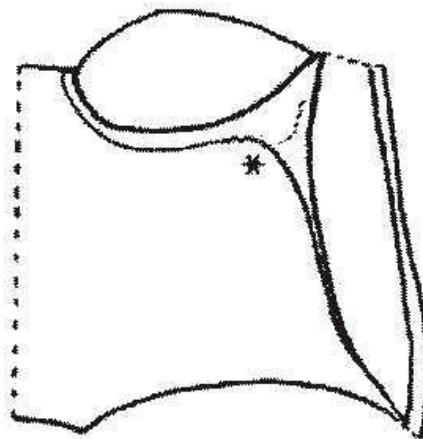
36 hemipterus



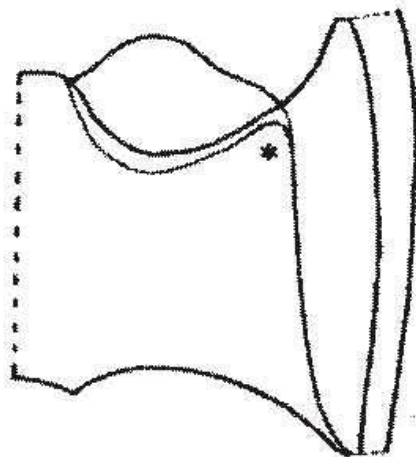
37 mutilatus



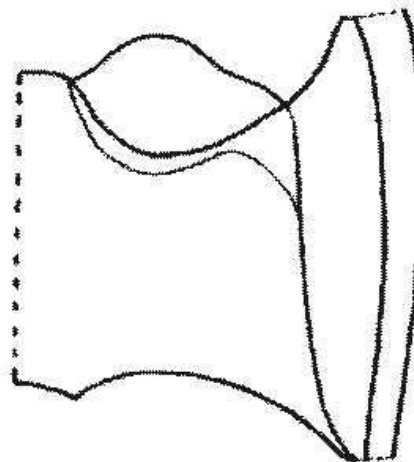
38 marginellus



39 mutilatus

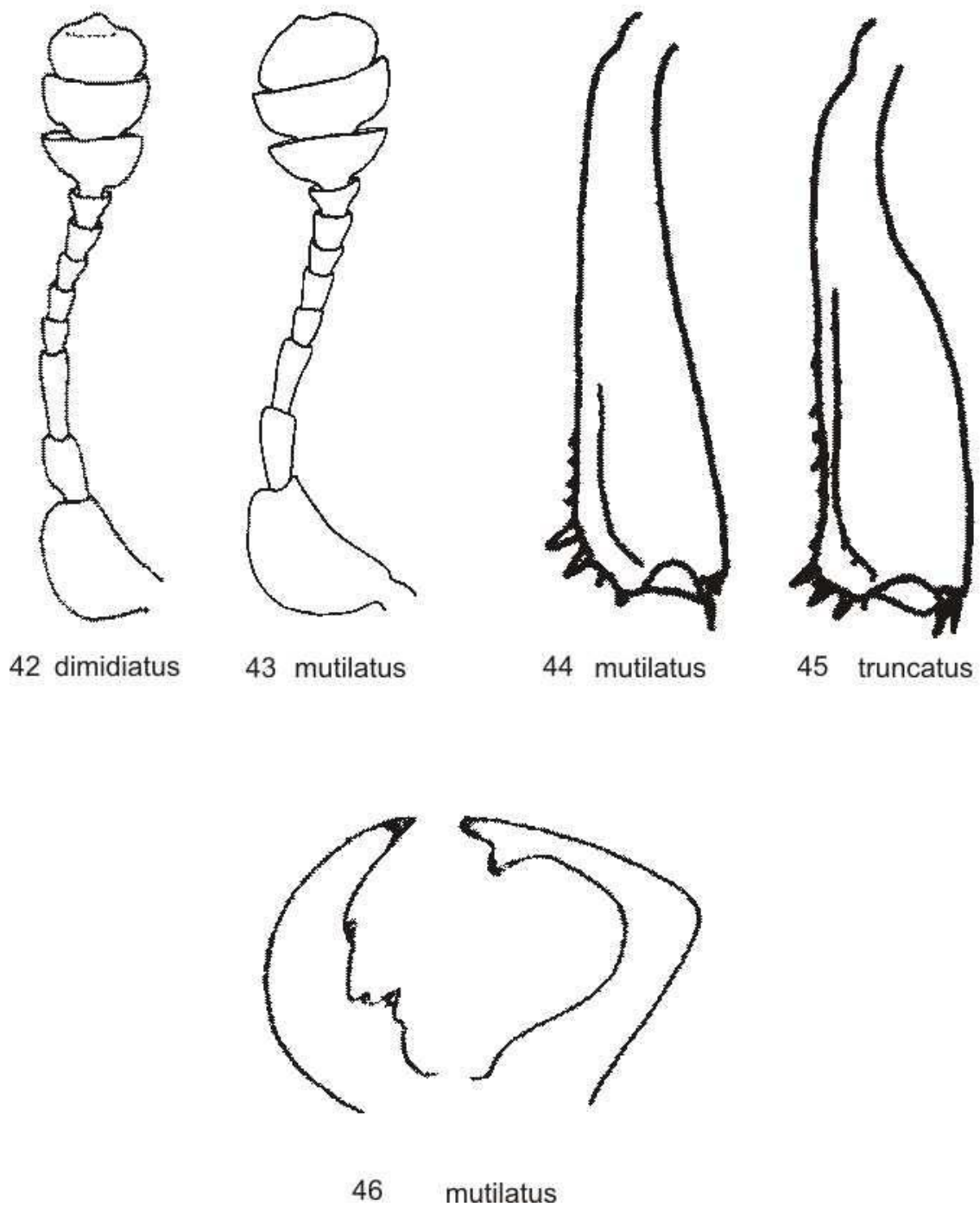


40 obsoletus

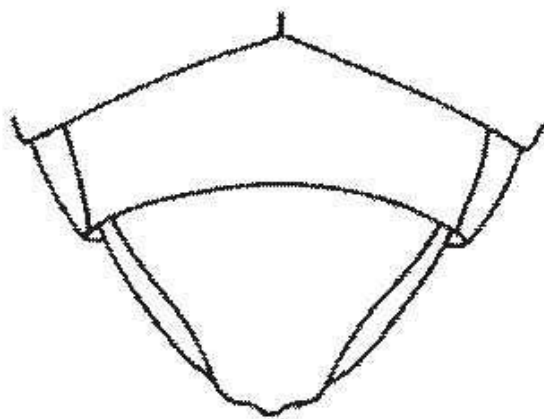


41 gaveni

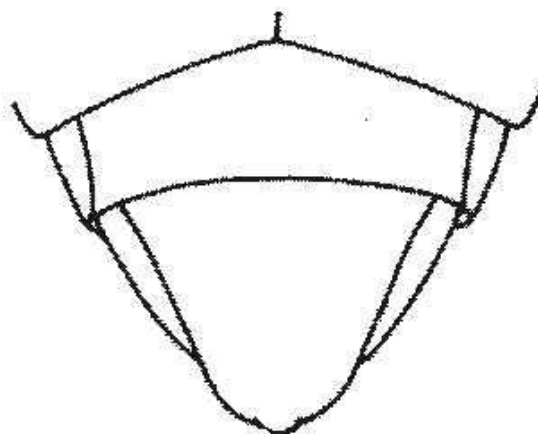
Figs 36–41. Ventral views of sterna: 36, mesoventrite of *C. hemipterus* (modified from Connell 1991); 37, mesoventrite of *C. mutilatus* (modified from Audisio 1993); 38, metaventrite of *C. marginellus* (modified from Audisio 1993); 39, metaventrite of *C. mutilatus* (modified from Audisio 1993); 40, metaventrite of *C. obsoletus* (modified from Audisio 1993); 41, metaventrite of *C. gaveni* (modified from Audisio 1993).



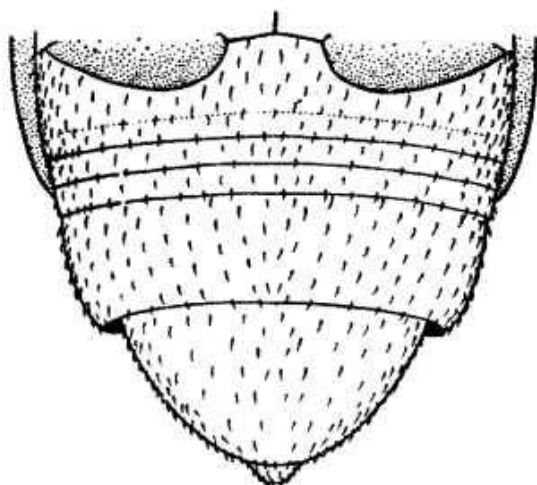
Figs 42–46. Antennae: 42, *C. dimidiatus* (modified from Audisio 1993); 43, *C. mutilatus* (modified from Audisio 1993). Metatibiae of males: 44, *C. mutilatus* (modified from Audisio 1993); 45, *C. truncatus* (modified from Audisio 1993). Mandibles of male: 46, *C. mutilatus* (modified from J. C. Watt, unpublished).



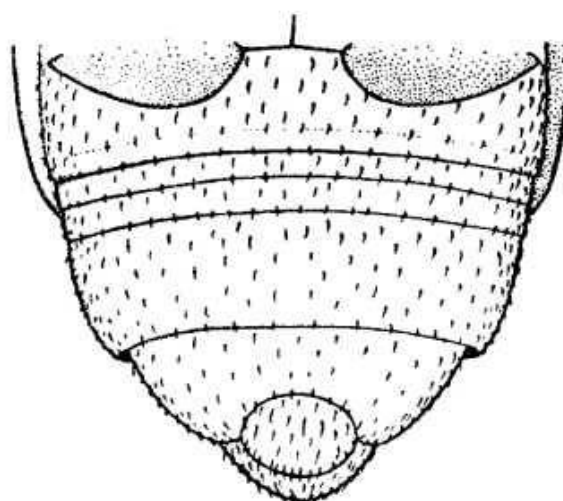
47 *davidsoni*, ♀



48 *gaveni*, ♀

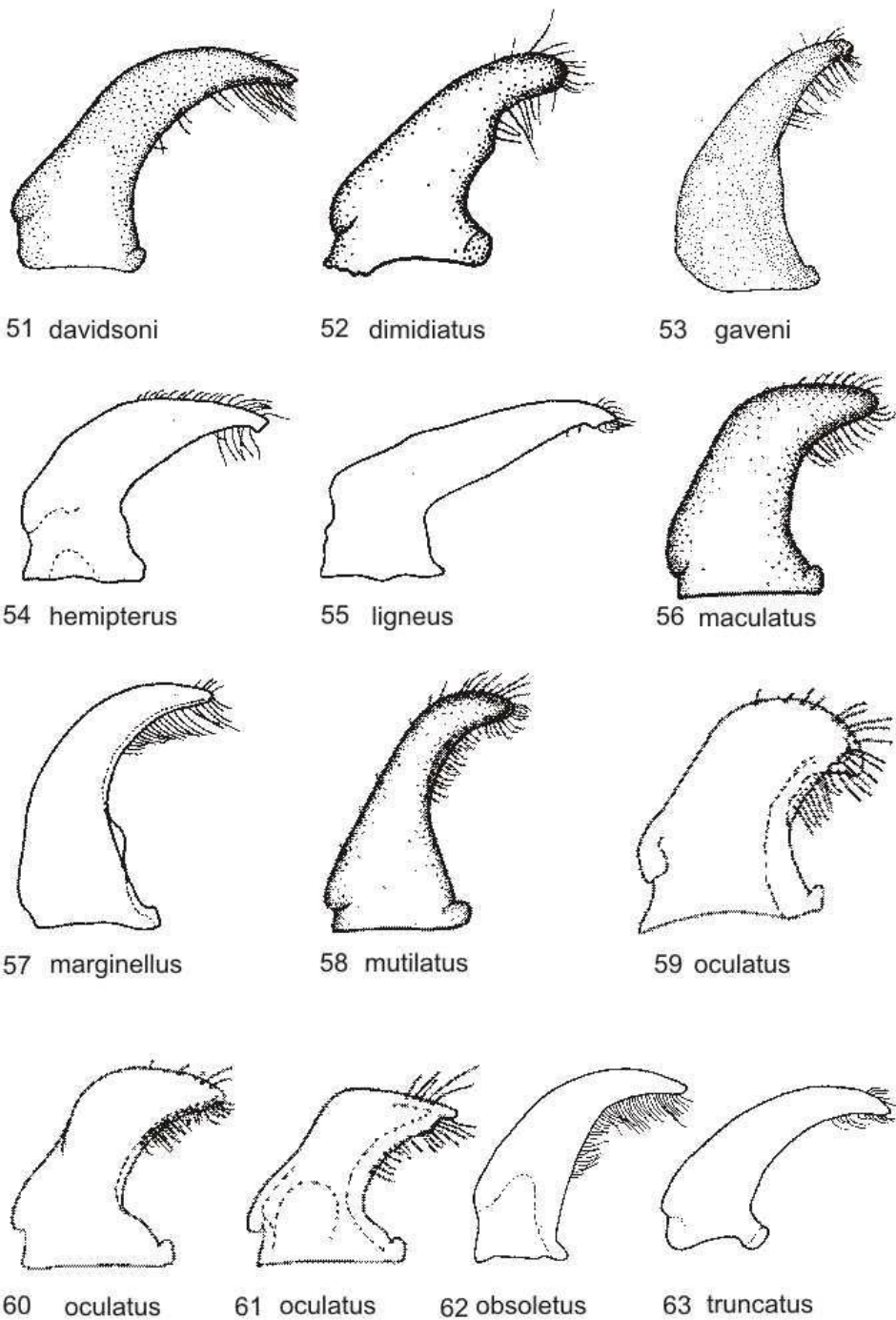


49 *obsoletus*, ♀



50 *obsoletus*, ♂

Figs 47–50. Abdomen: Dorsal view of female apex: 47, *C. davidsoni* (modified from Dobson 1964); 48, *C. gaveni* (modified from Dobson 1964). Ventral views of the abdomen of *C. obsoletus* (modified from Dobson 1954b). 49, female; 50, male.



Figs 51–63. Lateral views of parameres: 51, *C. davidsoni* (modified from Dobson 1952); 52, *C. dimidiatus* (modified from Dobson 1952); 53, *C. gaveni* (modified from Dobson 1964); 54, *C. hemipterus* (modified from Audisio 1993); 55, *C. ligneus* (modified from Audisio 1993); 56, *C. maculatus* (modified from Dobson 1952); 57, *C. marginellus* (modified from Audisio 1993); 58, *C. mutilatus* (modified from Dobson 1952); 59, *C. oculatus* (subspecies *oculatus*, modified from Dobson 1993a); 60, *C. oculatus* (subspecies *gilloglyi*, modified from Dobson 1993a); 61, *C. oculatus* (subspecies *cheesmani*, modified from Dobson 1993a); 62, *C. obsoletus* (modified from Audisio 1993); 63, *C. truncatus* (modified from Audisio 1993).