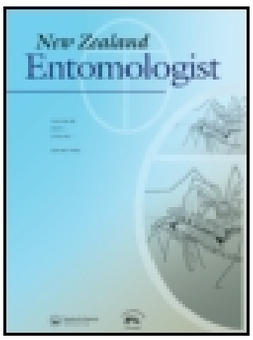

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Establishment of the identity of *Costelytra zealandica* (White 1846) (Coleoptera: Scarabeidae: Melolonthinae) a species commonly known as the New Zealand grass grub

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ABSTRACT

White (1846) described *Rhisotrogus zealandicus* from two syntypes, however no lectotype has since been designated. When the genus *Costelytra* Given 1952 was described, with *Rhisotrogus zealandicus* White 1846 as its type species, Given's description of this species was based on 400 specimens collected at different localities in New Zealand as White's syntypes were not available to him. Later, Given (1960) examined one of the syntypes, stating that it was identical to specimens he used to describe *C. zealandica*, but a lectotype was not designated at this time. So, the aims of this paper are: (i) to provide a detailed description of the external morphology, mouthparts and male genitalia based on the syntypes of *R. zealandicus*; (ii) to compare these type specimens with the description by Given (1952); (iii) to compare the syntypes to establish if they are conspecific; (iv) to designate an appropriate lectotype and (v) to study a representative series of *C. zealandica* collected from throughout New Zealand to establish the status of the taxon currently known as *C. zealandica*. Differences between the syntype specimens, and Given's (1952) description of the New Zealand specimens were found. In addition, White's syntypes are not conspecific. As a result *Costelytra giveni* n. sp. is established and described to represent the species currently known as the 'New Zealand grass grub'.

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KEYWORDS

Costelytra giveni; *Costelytra zealandica*; lectotype designation; New Zealand; pest; taxonomy

Introduction

The Melolonthinae is a very diverse subfamily of Scarabaeidae, with many pest species on all continents. Adult and larval feeding by Melolonthinae results in important economic losses, e.g. the native New Zealand grass grub from the genus *Costelytra*. *Costelytra* was described by Given (1952) after examining 400 adult specimens of grass grub, collected from different localities in New Zealand from Whangarei to Bluff, as well as the Chatham Islands. Given (1952) included six species in this genus: *Costelytra austrobrunneum* Given 1952; *Costelytra brunneum* (Broun 1880); *Costelytra macrobrunneum* Given 1952; *Costelytra piceobrunneum* Given 1952; *Costelytra pseudobrunneum* Given 1952 and the type species *Costelytra zealandica* (White 1846). Currently *Costelytra* includes 11 species, with *C. zealandica* recognised as a serious pest of pastoral land in New Zealand. Hence, this species has been, and remains, the focus of significant studies to develop control strategies (Jackson et al. 1992, 1993, 2001; Jackson & Klein 2006).

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White (1846) described *Rhisotrogus zealandicus* based on two syntypes. When the genus *Costelytra* was described these syntypes were not available to Given (Given 1952). Later, Given (1960) apparently examined only one syntype of *R. zealandicus* and stated that it was identical with the material previously used by him to describe *C. zealandica* (Given 1952). Although he never designated this specimen as the lectotype, the term 'var' was added, in his hand, on a specimen label (Figure 19). He left the other syntype unstudied. In view of these facts, morphological knowledge of the type species, based on the syntype specimens, is essential to correctly establish the identity of *C. zealandica* and the species commonly known as the New Zealand grass grub. The aims of this paper are: (i) to provide a detailed description of the external morphology, mouthparts and male genitalia of the syntype specimens of *C. zealandica* (this description will determine the characteristic features of the species, which is the type species of *Costelytra*, and allow reliable identification of adult specimens of the species); (ii) to compare these types with Given's (1952) description to confirm its validity; (iii) to compare the two syntypes to establish if they are conspecific; (iv) to designate one of the syntypes as the lectotype; and (v) to assess a representative series of specimens from throughout New Zealand to establish the status of the taxon currently known as *C. zealandica*.

Material and methods

The type specimens of *Costelytra zealandica*, the type species of the genus, and *C. brunneum* (Broun 1880) deposited at the Natural History Museum (London) were studied. In addition, 18 specimens of the taxon currently known as *C. zealandica* from throughout New Zealand have been studied to establish its taxonomic status. This series of 18 specimens was lent by the New Zealand Arthropod Collection (Auckland). Label data, exactly transcribed from the specimen labels, is as follows: Specimen 1 (Pretty Br. Nelson 30-11-61), Specimen 2 (Clarence R. 6-12-61. B. B. Given), Specimen 3 (Palmerston N. 14-11-61), Specimen 4 (Hastings 15-11-61), Specimen 5 (Petone 25 Nov. 65 G. Gear), Specimen 6 (Inglewood 14-11-61), Specimen 7 (Stratford 28-11-48), Specimen 8 (Kaikoura 12-12-58), Specimen 9 (Hamilton 23-11-61), Specimen 10 (Collected on bushes, November 1979, Gisborne Francis), Specimen 11 (Gisborne 24-11-61), Specimen 12 (Timaru 15-11-61), Specimen 13 (Oamaru 22-11-61), Specimen 14 (Chatham Is. Waitangi West 7 Nov. 1991 J. S. Dugdale in garden), Specimen 15 (New Zealand SD. Maud Is. Main Bush 31st Dec 1980 Col., P.R. Notman), Specimen 16 (Mt. Albert W. Cottier 4th Nov. 1940), Specimen 17 (Matakana N. Auck. Attr. to light. Dec. 56. N. Roke) and Specimen 18 (Mt. Hikurangi. East Cape 4000. Under log 31-1-58. J.C. Watt).

The mouthparts and the male genitalia of all specimens were removed and cleared in a hot 5% KOH solution. Afterwards, they were studied under immersion in distilled water with a binocular Olympus SZX7. Pictures were captured by an Optika Vision Pro digital camera. The terminology employed to describe the male genitalia in this study is that specified by D'Hotman and Scholtz (1990). According to these authors, the terms used are a combination of Sharp and Muir (1912) and Snodgrass (1935).

Taxonomy

The re-description of *Costelytra zealandica* presented here is based on the syntype examined by Given (1960) which is here designated as the lectotype.

Costelytra zealandica (White 1846)

Rhisotrogus zealandicus White 1846. The Zoology of the Voyage of H.M.S. *Erebus* & *Terror*. Insects: 10.

Odontria zealandica (White 1846). Blanchard, 1850. Catalogue de la Collection Entomologique. Classe des Insectes. Ordre des Coléoptères, 1:106

Costelytra zealandica (White 1846). Given, 1952. A revision of Melolonthinae of New Zealand. Part I. The adult beetles.

External morphology **(Figure 1).** Antenna 8 segmented; first and second antennal segments differentiated, but fused without joint; third and fourth also without joint between them; fifth very short without a papillate anterior process; antennal segments 6–8 lamellate, forming antennal club as long as the stem. Clypeus (Figure 2) sides weakly convergent, somewhat truncate, anterior margin not sinuate in the middle, surface gently concave, coarsely punctate and pubescent; clypeal suture sinuate; clypeus and labrum separated by a straight suture. Ocular canthus (the epicranial process of Given, 1952) more prominent in comparison with other species of melolonthines and perpendicular to the lateral edge of the clypeus without forming an angle. Frons and vertex (Figure 2) unarmed, without pubescence except on areas close to eyes, with punctures more scattered than on the clypeus. Frons gently depressed medially just above the clypeal suture. Vertex gently bulbous. Pronotal surface (Figure 3) with conspicuous, long pubescence, irregularly distributed; anterior margin bears a row of long bristles; surface irregularly punctate with micro-punctures on basal part (Figure 4); lateral margins regularly curved, not reflexed, smooth, with scant pubescence; posterior edge flat, not marginate and without pubescence; anterior angles acute normally projected as in other species of melolonthines; posterior angles obtuse and rounded. Scutellum almost smooth with scant and scattered shallow punctures on the lateral sides. Elytra surface hairless; striated with punctures on grooves between striations (Figure 1); lateral margins with pubescence; sutural striae prominent and outlined. Pygidium matt densely punctate, conspicuous pubescence on the apex and hairless on disc. Fore tibiae with three strong teeth on the outer margin, with spurs on the inner margin.

Figure 1. Habitus in dorsal view of *Costelytra zealandica* (Lectotype ♂).

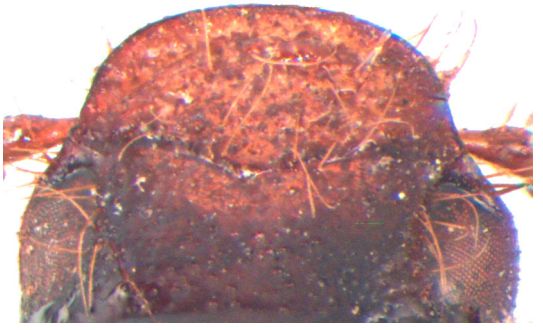


Figure 2. Head in dorsal view of *Costelytra zealandica* (Lectotype ♂).

Mesotibiae with strong transverse carina (Figure 5), shorter on metatibiae (Figure 6). Tibial plates with two free spurs, both together and in lower position in the mesotibiae but one above and one below articulation of tarsus to metatibiae. Shape of hind coxal plate almost rectangular, external free angle fine, straight and sharp (Figure 6). Tarsal claws simple without basal tooth. Abdominal sternites not fused, with scarce pubescence; penultimate ventral sternite with a weakly defined suture separating two areas, one of them less sclerotised (Figure 7).

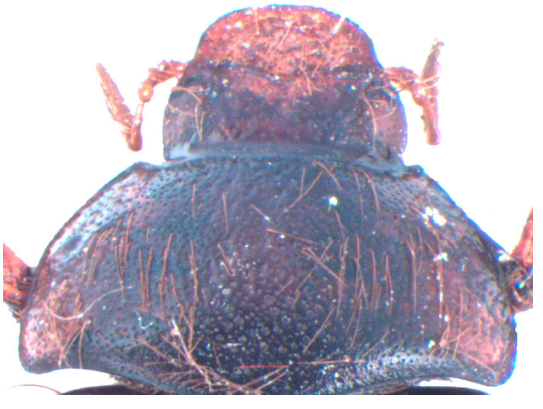


Figure 3. Head and pronotum in dorsal view of *Costelytra zealandica* (Lectotype ♂).

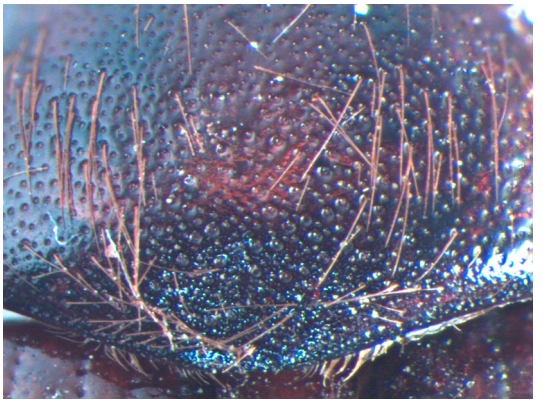


Figure 4. Pronotal surface. Detail of micro-punctures on pronotal basal part of *Costelytra zealandica* (Lectotype ♂).

Figure 5. Mesotibiae with transverse carina of *Costelytra zealandica* (Lectotype ♂).

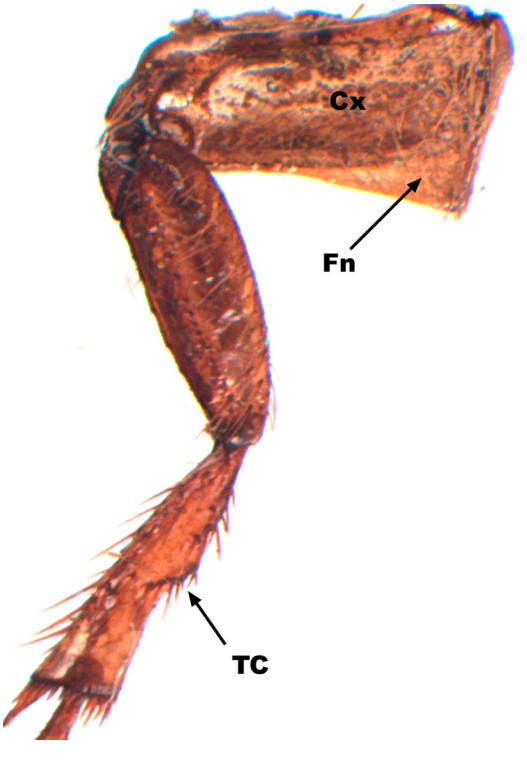


Figure 6. Hind leg of *Costelytra zealandica* (Lectotype ♂). Metacoxa (Cx), transverse carina (Tc), fine (Fn).

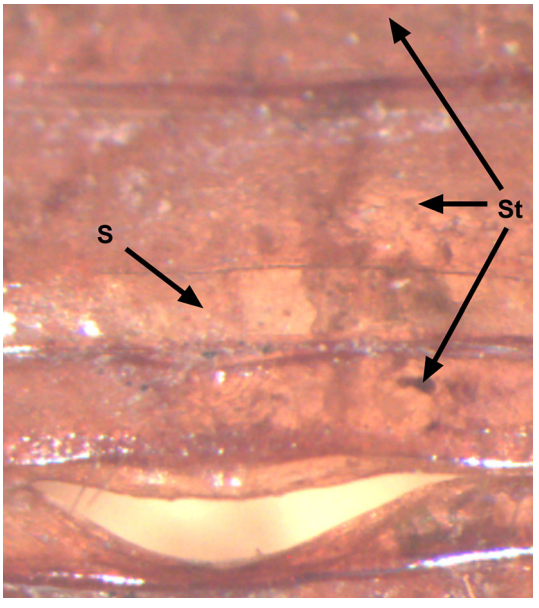


Figure 7. Abdominal sternites of *Costelytra zealandica* (Lectotype ♂). Soft suture (s); sternites not fused (St).

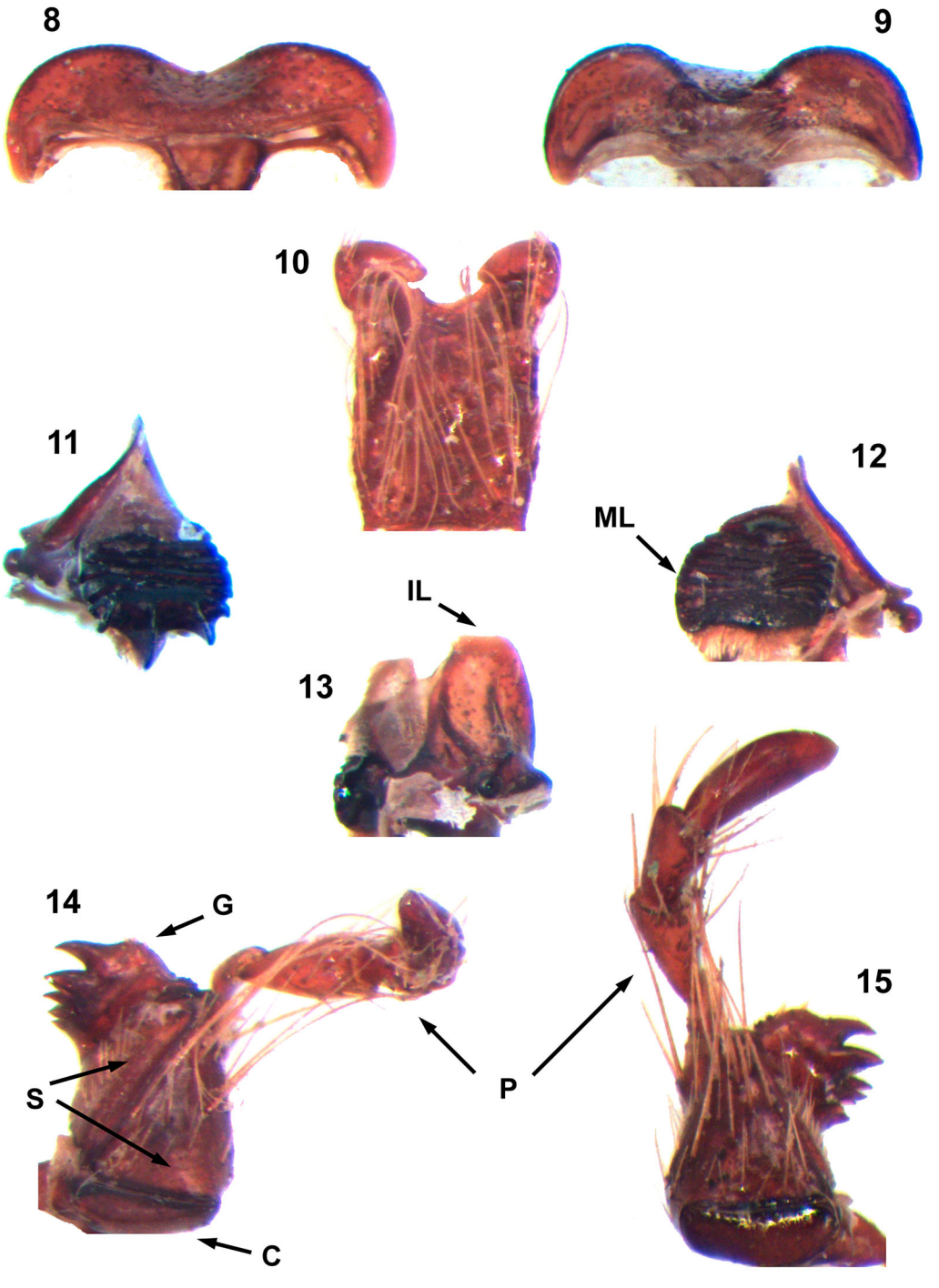
Mouthparts (**Figures 8–5**). Labrum (Figures 8, 9) wider than long, with the anterior margin sinuated, not visible before the clypeus as viewed from above. Mentum (Figure 10) longer than wide, rectangular and with plentiful pubescence. Mandible (Figures 11–13) with reduced incisor lobe and molar lobe wrinkled. Maxillae well developed, galea armed with strong teeth (Figures 14, 15).

Male genitalia (**Figures 16–18**). Tegmen (parameres and phallobase) with parameres slender, shorter than phallobase (approximately half) (Figure 16), bilaterally symmetrical in dorsal view (Figure 17); apex of parameres blunt in dorsal view with scattered punctures and inconspicuous pubescence. Phallobase similar to that described in *Melolontha melolontha* and *Rhizotrogus* by Krell (1996) and by Coca-Abia and Martín-Piera (1998) respectively. Phallobase with weak dorsal constriction; basal ostium of phallobase without sclerotised structures. Endophallus (Figure 18) joined to parameres by reduced temones (structure extending into basal piece) without dorsal plate as that described by Sanmartín and Martín-Piera (2003) in Pachideminae; internal sac of endophallus with a sclerotised structure and conspicuous setae (Figure 18).

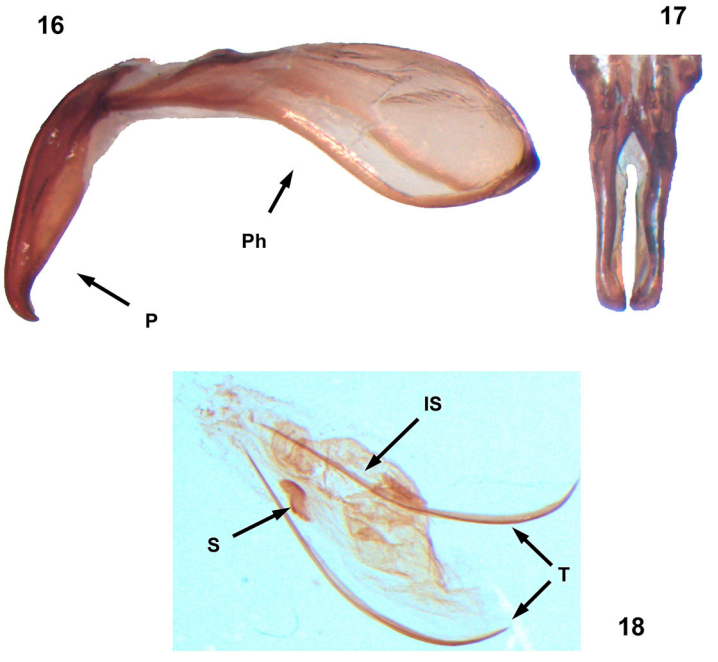
Distribution. Endemic to New Zealand, known only from the type locality: Port Nicholson (Wellington) (White 1846).

Lectotype and paralectotype designation

Costelytra zealandica was described by White (1846) from two male specimens currently held in the Natural History Museum, London (BMNH), labelled as syntype and type. The specimen studied by Given (1960) labelled as syntype has been considered to be the type of *Costelytra zealandica*, but was never designated as such. Here, we designate this syntype as the lectotype of *Rhisotrogus zealandicus* White, in order to fix the taxonomic concept of *R. zealandicus*, the type species of *Costelytra* Given. It is labelled as follows (Figure 19): 1) white round handwritten: n. zeal on reverse 45 95; 2) white and blue round printed: Syntype; 3) white handwritten (White's hand): Rhisotrogus zealandicus var. White. Zool. Ereb. & Terror; 4) white handwritten (Given's hand): C. zealandica var. det. B. Given; 5) red printed: *Costelytra zealandica*. Lectotype. Coca-Abia, det. 2016.



Figures 8–15. Mouth parts of *Costelytra zealandica* (Lectotype ♂). Labrum in dorsal (8) and ventral (9) view. Mentum in ventral view (10). Mandibles: right (11) and left (12) in lateral view; left in dorsal view (13). Incisor lobe (IL), molar lobe (ML). Maxilla: left (14) and right (15) in ventral view. Galea (G), stipes (S), cardo (C), palpi (P).



Figures 16–18. Male genitalia of *Costelytra zealandica* (Lectotype ♂). Tegmen in lateral view (16): Parameres (P) and phallobase (Ph). Parameres in dorsal view (17). Endophallus (18): internal sac (Is), sclerotised structures (S) and temones (T).

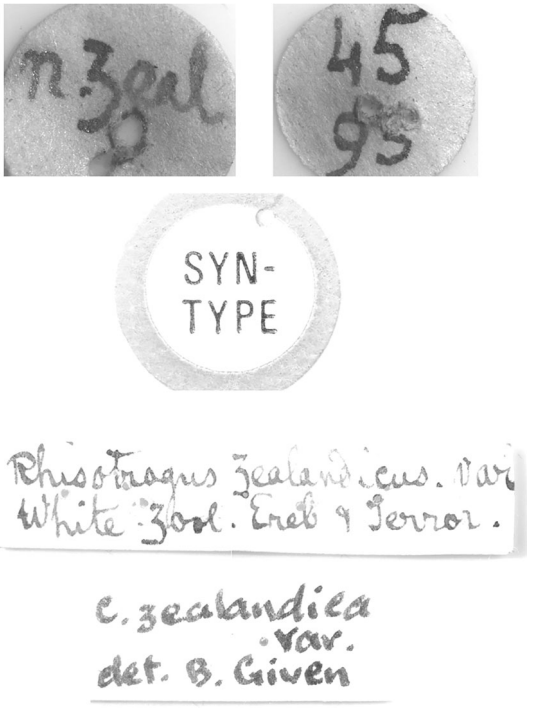


Figure 19. Labels of *Costelytra zealandica* (Lectotype ♂).

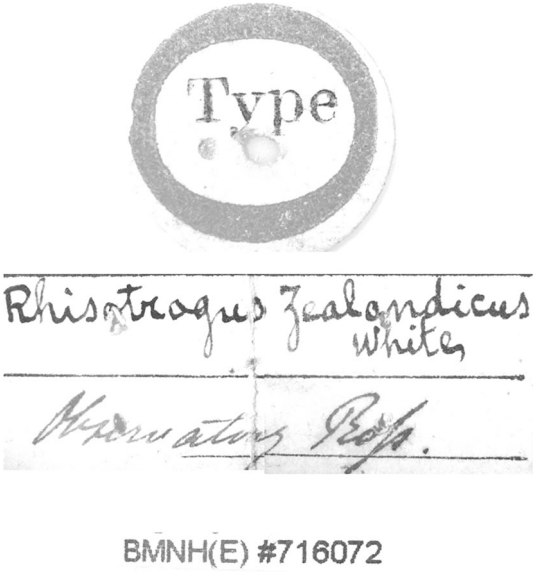


Figure 20. Labels of *Costelytra zealandica* (Paralectotype ♂).

Details recorded in the Accessions Register associated with the lectotype are: August 15th 1845. 20 Coleoptera. New Zealand (N. Isld.). Purchase of W. Earl. Remarks: £2:14 Bill book p. 168.

Lectotype preserved dry; right elytron broken; four legs preserved without tarsi, two of them (second and third) glued on labels. Mouth parts and male genitalia removed and glued on labels. Internal sac of aedeagus on a micro-slide joined to specimen. The lectotype is chosen as it best fits the original description on the basis of colour, and it is the only one of the syntypes labelled by Given.

The other syntype specimen becomes a paralectotype and is labelled as follows (Figure 20): (1) white and red round printed: Type; (2) white handwritten (White's hand): *Rhisotrogus zealandicus* White, (in a different hand) Observatory followed by an illegible word); (3) white printed: BMNH(E) #716072; (4) red printed: *Costelytra zealandica*. Holotype. Coca-Abia, det. 2004; (5) Red printed: *Costelytra zealandica*. Paralectotype. Coca-Abia, det. 2016. This specimen is entered onto the database of Natural History Museum (London), labelled as type and with the number BMNH(E) #716072. Although this specimen was labelled by Coca-Abia in 2004 as Holotype, this status was never published and it is now apparent that there were two syntypes. However, after reviewing both syntypes, the other specimen was chosen to be the lectotype and this specimen becomes a paralectotype. Paralectotype preserved dry; two legs (first and second right) preserved without tarsi, second leg glued on a label; third right tibiae and tarsus and left tarsus missing. Mouth parts and male genitalia removed and glued on labels. Internal sac of aedeagus on a micro-slide joined to specimen.

Determination of the identity of the species commonly known as 'New Zealand grass grub'

As noted above, *Costelytra zealandica* was not described by examination of the syntype specimens, as these were unavailable at the time, but from a series of 400 specimens collected at different localities in New Zealand from Whangarei to Bluff and the Chatham Islands (Given 1952). Later, Given (1960) studied a type specimen and stated that it was identical to his description published some years before (Given 1952). We have found discrepancies between the description (Given 1952) and the type specimen of *C. zealandica* studied by Given (1960), and designated as the lectotype herein. The differences are as follows and are shown in Table 1.

Table 1. Differences between lectotype of *Costelytra zealandica* and Given's description (1952).

Character	Lectotype	Given's description
Clypeal surface	gently concave	raised discally
Vertex	bulbous and punctate	smooth
Fifth antennal segment	without process	with papillate anterior process
Ocular canthus	gently prominent	very prominent
Pronotum	discal setae and micropunctures on the base	bare and uniformly finely punctate
Pronotal posterior margin	flat and not marginate	depressed and very narrowly marginate
Pygidium	opaque	transparent

According to Given (1952), *C. zealandica* has the clypeal surface raised discally and the vertex smooth. On the contrary, the lectotype shows a clypeal surface gently concave and vertex bulbous and punctate (Figure 2). Likewise, the appearance of the fifth antennal segment described by Given (1952) differs from the lectotype in that it lacks any process. The ocular canthus described by Given (1952) is very prominent, but is weakly prominent in the lectotype (Figure 2). In addition, the pronotum described by Given (1952) is bare and uniformly finely punctate, in contrast, the lectotype has discal setae and possesses micropunctures on the pronotal base (Figures 3 and 4). Moreover, the pronotal posterior margin as described by (Given 1952) is depressed and very narrowly marginate; however, the lectotype is flat and not marginate. Furthermore, Given (1966) considers the transparency of the pygidium as a diagnostic character of *C. zealandica*, but the lectotype does not show this feature.

In addition to these differences between the published description and the lectotype we have compared the two type specimens (lectotype and paralectotype) and find them to differ by the following (Table 2): paralectotype shows clypeus rounded with sides strongly convergent, not truncate; straight clypeal suture; clypeal surface flat; ocular canthus gently prominent and obliquely truncate exteriorly; frons flat, not depressed medially just above the clypeal suture (Figure 21); pronotum disc bare, uniformly punctate, without micropunctures and posterior edge marginate (Figure 22); scutellum with a few scattered punctures; hind coxal plate triangular, with free angle extended and

Table 2. Differences between lectotype of *Costelytra zealandica* and Given's description (1952).

Character	Lectotype	Paralectotype	New Zealand specimens
Clypeus shape	truncate anteriorly with sides gently convergent	not truncate, rounded anteriorly with sides strongly convergent	truncate anteriorly with sides almost parallel
Clypeal suture	sinuate	straight	sinuate
Clypeal surface	gently concave	flat	convex in the middle
Ocular cantus	gently prominent, not truncate	gently prominent, obliquely truncate exteriorly	strongly prominent, abruptly truncate
Frons	gently depressed	flat	strongly depressed medially
Pronotal pubescence	conspicuous on disc	disc bare	disc bare
Pronotal punctures	irregularly punctate	uniformly punctate	uniformly punctate
Pronotal posterior edge	not marginate	marginate	marginate
Scutellum	with punctures grouped on lateral sides	with a few scattered punctures	smooth
Elytral sutural striae	disappearing almost in the end	disappearing almost in the end	disappearing before the end
Free angle of hind coxal plate	straight and sharp	extended and rounded	gently curved caudally
Penultimate abdominal sternite	with an area less sclerotised	with a narrow membrane	with an area less sclerotised
Last abdominal sternite	without ornament	with an ornament	without ornament
Pygidium	matt	matt	transparent
Parameres in lateral view	straight	bent toward the phallobase	straight
Parameres in dorsal view	bilaterally symmetrical	bilaterally asymmetrical	bilaterally symmetrical
Endophallum	with a sclerotised structure	with a sclerotised structure	without sclerotised structures

Figure 21. Head in dorsal view of *Costelytra zealandica* (Paralectotype ♂).

rounded (Figure 23); penultimate ventrally visible sternite posteriorly with a narrow membrane (Figure 24); last abdominal sternite with an ornament (Figure 24), male genitalia with parameres bent toward the phallobase (Figure 25); asymmetrical in dorsal view (Figure 26) and endophallus with a stronger sclerotised structure (Figure 27).

A representative series (18 specimens) of the taxon currently known throughout New Zealand as *C. zealandica* was studied and found to differ from both the lectotype and paralectotype of *C. zealandica*. These differences are shown in Table 2 and lie in the head (clypeus, ocular canthus and frons); pronotum (pubescence, surface appearance and posterior edge); scutellum (surface appearance); elytral apices (sutural striae); metacoxa (shape); last abdominal sternites (ornaments

Figure 22. Habitus in dorsal view of *Costelytra zealandica* (Paralectotype ♂).

Figure 23. Free angle (black arrow) of hind coxal plate of *Costelytra zealandica* (Paralectotype ♂).

and membranous areas), pygidium (transparency) and male genitalia (parameres shape and endophallus). However, the external morphology of these 18 specimens (Figure 28) closely matches the features published by Given (1952) to describe *C. zealandica*. The features related to clypeus (raised discally), frons (depressed medially) (Figures 29, 30), epicranial process (very prominent) (Figure 29) (Given, 1952) and transparency of the pygidium (Given, 1966) are strongly evident in each specimen of the series examined. These details indicate that the New Zealand specimens studied herein and those studied by Given (1952) do not correspond with those of *C. zealandica*. Hence, we describe the species *Costelytra giveni* n. sp. to designate these specimens and to distinguish them from those of *C. zealandica*.

Costelytra giveni n. sp.

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Material examined and types designation. *Holotype.* A male specimen in the New Zealand Arthropod Collection (NZAC) (Auckland) is designated as holotype labelled as follow: (1) white handwritten: Petone 25 Nov. 65 G. Gear; (2) yellow printed: NZ Artropod Collection NZAC Private Bag 92170 Auckland New Zealand; (3) white printed: Specimen 5 Coca-Abia, 2016; (4) red printed: Holotype *Costelytra giveni* Coca-Abia, det., 2016. This specimen is described and figured below.

Paratypes. (NZ Artropod Collection NZAC Private Bag 92170 Auckland New Zealand): Specimen 1 (Pretty Br. Nelson 30-11-61), Specimen 2 (Clarence R. 6-12-61. B. B. Given), Specimen 3 (Palmerston N. 14-11-61), Specimen 4 (Hastings 15-11-61), Specimen 6 (Inglewood 14-11-61), Specimen 7 (Stratford 28-11-48), Specimen 8 (Kaikoura 12-12-58), Specimen 9 (Hamilton 23-11-61), Specimen

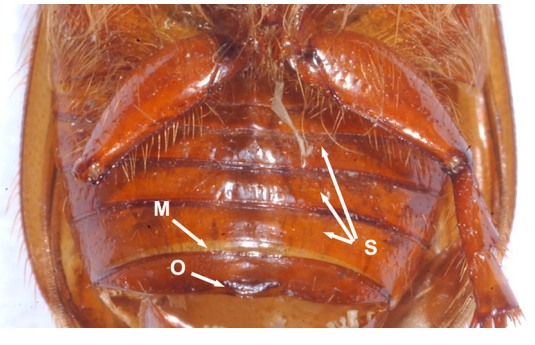
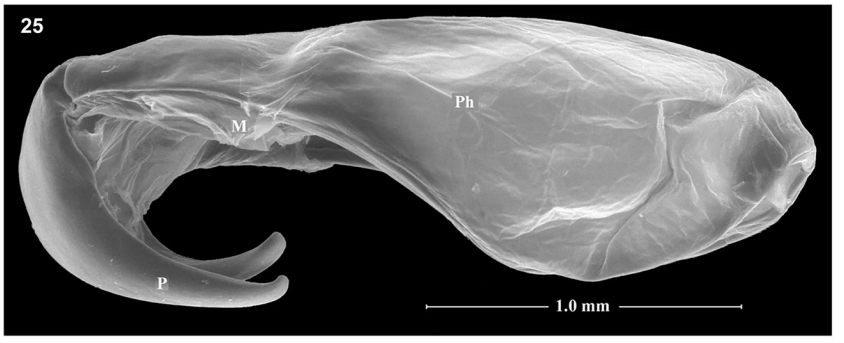
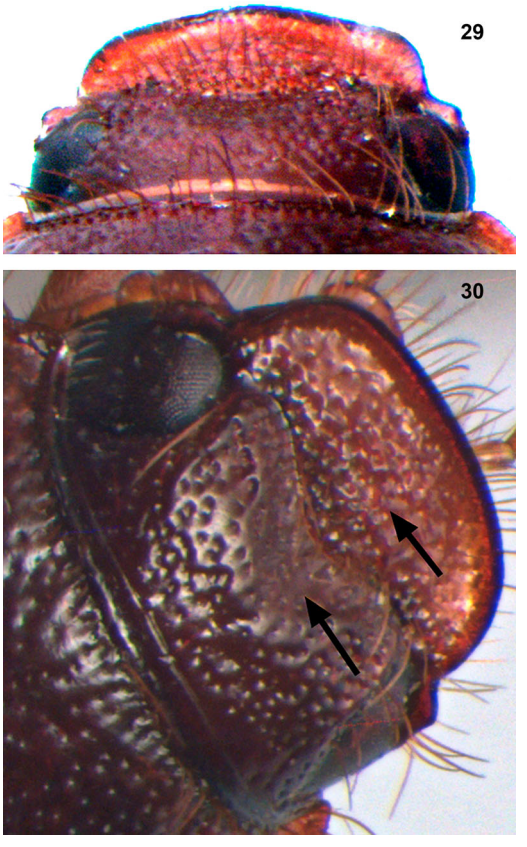


Figure 24. Abdominal sternites of *Costelytra zealandica* (Paralectotype ♂). Sternites (S); membranous area (M) and ornament (O).



Figures 25–27. Male genitalia of *Costelytra zealandica* (Paralectotype ♂). Tegmen in lateral view (25): connective membrane (M), parameres (P), phallobase (Ph). Parameres in dorsal view (26). Endophallus (27).

Figure 28. Habitus in dorsal view of specimen no. 5 from New Zealand series (Holotype ♂ of *Costelytra giveni*).



Figures 29–30. Head in dorsal (29) and lateral (30) view of specimen no. 5 from New Zealand series (Holotype ♂ of *Costelytra giveni*). Black arrows indicate the clypeal bulge and frontal depression.

10 (Collected on bushes, November 1979, Gisborne Francis), Specimen 11 (Gisborne 24-11-61), Specimen 12 (Timaru 15-11-61), Specimen 13 (Oamaru 22-11-61), Specimen 14 (Chatham Is. Waitangi West 7 Nov. 1991 J. S. Dugdale in garden), Specimen 15 (New Zealand SD. Maud Is. Main Bush 31st Dec 1980 Col., P.R. Notman), Specimen 16 (Mt. Albert W. Cottier 4th Nov. 1940), Specimen 17 (Matakana N. Auck. Attr. to light. Dec. 56. N. Roke) and Specimen 18 (Mt. Hikurangi. East Cape 4000. Under log 31-1-58. J.C. Watt). All of them labelled as Paratype *Costelytra giveni* Coca-Abia, det., 2016.

Description. *Habitus.* Relatively small sized (9–11 mm), in comparison with other species of melolonthines; brown beetles (Figure 28), body compact, surface glabrous except on the head and ventral part of thorax, also with long bristles along pronotal and elytral margins, abdominal sternites and anal plate; with punctured disc of head, pronotum and elytral inter-striae; no visible secondary sexual dimorphism in the antennal club.

Head. Clypeus with quadrangular shape, parallel sides, anterior margin elevated and with a bulge in the middle of the surface. This bulge lines up with a medial depression at the frons just above the clypeal suture (Figures 29, 30). Clypeus closely punctate (Figure 30), rough on the bulge; with long bristles (Figure 29), densest next to the clypeal suture, that is sinuate. Ocular canthus short, strongly prominent and abruptly interrupted (Figure 29). Frons and vertex densely punctate, without pubescence except some hairs close to the eyes; frons depressed in the middle, vertex dome-shaped (Figure 30).

Antennae. 8-articulate, trilamellate, the lamellae more or less the same size in both sexes.

Thorax. Pronotal surface uniformly punctate and hairless, with long bristles, only along anterior and lateral margins; anterior and posterior edges marginate; lateral margins smooth, anterior and posterior angles acute and obtuse respectively. Ventral surface of the thorax clothed with long hairs. Scutellum smooth.

Elytra. Hairless, only with marginal bristles, striae smooth and interstriae densely punctate, but not coarsely (Figure 28). Sutural striae outlined, becoming narrower toward the apices and disappearing before the end of the elytra (Figure 31).

Abdomen. Sternites with a transversal row of conspicuous bristles; anal plate with a row of bristles on posterior edge. Pygidium of transparent appearance, irregularly punctate, surface hairless but with long bristles on distal edge (Figure 31).

Legs. Fore-tibia tridentate in both sexes, with a spur on inner edge and a longitudinal row of punctures with long bristles on its dorsal face. Metatibiae with two dorsal carinae interrupted laterally, the second stronger than the first. Metatibial plates with two free spurs placed on internal face, above and below the articulation of the tarsus. Posterior edge of metacoxa gently curved caudally.

Aedeagus. Tegmen (Figures 32–34) with parameres slender, shorter than phallobase (approximately half), bilaterally symmetrical in dorsal and frontal views (Figure 32, 33), apex of the parameres acute in lateral view (Figure 34) and blunt in frontal view (Figure 33). Phallobase without a weak dorsal constriction; basal ostium without sclerotised structures (Figure 34). Endophallus joined to the parameres by temones; without sclerotised structures and with very conspicuous setae (Figure 35).

Etymology. This species is named in honour of Bruce Given for his major contribution to the systematics of New Zealand Melolonthinae.

Identity of the paralectotype of *Rhisotrogus zealandicus*

The paralectotype of *C. zealandica* differs from the lectotype, the description by Given (1952), and also from the series of New Zealand specimens examined here. This raises questions as to the identity of this specimen. When Given (1952) re-described *C. brunneum* he stated it to be similar to *C. zealandica* except that, in the first species, the clypeus is more evenly rounded, clypeal suture less acute, pronotal anterior angles rather more prominent, scutellum sparsely punctate and genital claspers strongly curved and blunt tipped. All of these features that Given (1952) used to describe *C. brunneum* have also been found in the paralectotype of *C. zealandica* studied here. In addition, when *C. brunneum* was described (Broun, 1880), the short description given by the author, mentions features of the head and prothorax similar to those of the paralectotype of *C. zealandica*. When compared with a type specimen of *C. brunneum*, the paralectotype was found to be similar, but not identical. The differences between them are significant and lie in the hind coxal plate (triangular in the paralectotype and rectangular in *C. brunneum*), last abdominal sternite (with ornament in the paralectotype and smooth in *C. brunneum*) and the appearance of the sclerotised structure in the endophallus (smooth in the paralectotype and rough in *C. brunneum*). At this time we cannot specify the identity of the paralectotype, however it is more closely related to *C. brunneum* than *C. zealandica*.

Discussion and conclusions

The starting point for this investigation was an attempt to place the genus *Costelytra* Given into the wider classification of the Melolonthinae (Coca-Abia 2007). In the course of this work it was found that the type material of *Rhisotrogus zealandicus* White, the type species of the genus *Costelytra*, did

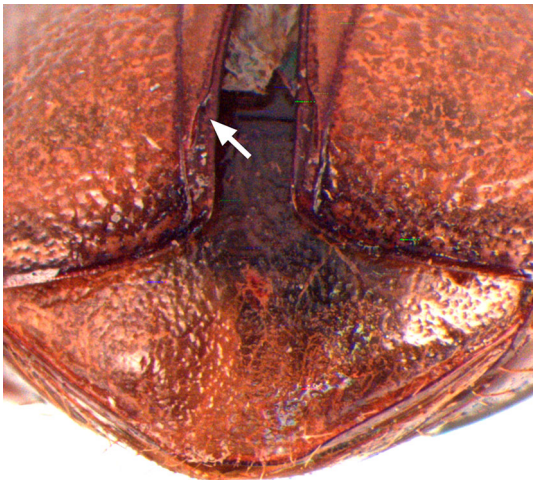
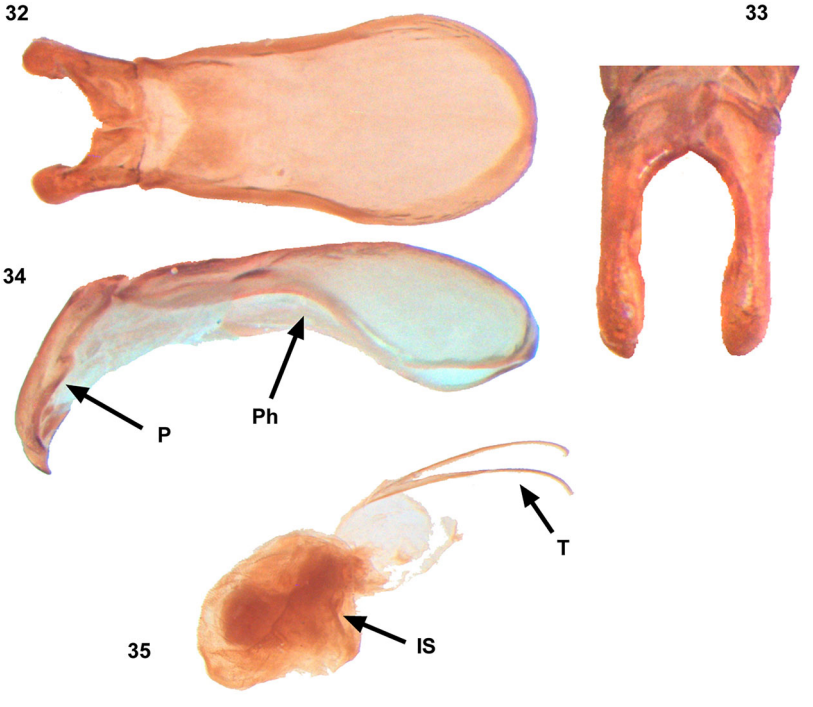


Figure 31. Elytral apex and pygidium of specimen no. 5 from New Zealand series (Holotype ♂ of *Costelytra giveni*). White arrow indicates where the elytral striae narrow.



Figures 32–35. Male genitalia of specimen no. 5 from New Zealand series (Holotype ♂ of *Costelytra giveni*). Tegmen in dorsal view (32). Parameres in dorsal view (33). Tegmen in lateral view (34): parameres (P) and phallobase (Ph). Endophallum (35): internal sac of aedeagus (IS) and temones (T).

not match the published description of the species (Given 1952). Therefore, the purpose of this paper was to resolve some of the issues surrounding the identity of *Costelytra zealandica* (White) and the species known in New Zealand as 'New Zealand grass grub'.

Our approach has been to establish a comprehensive description of *C. zealandica*, the type species of the genus, based on an assignment of a lectotype. This description determines the features that characterise *C. zealandica* and should allow reliable identification of adult specimens of this species. One of the two specimens used by White (1846) in his description of *Rhisotrogus zealandicus* has been designated as the lectotype. The specimen chosen as the lectotype is the one that Given (1960) used to compare with New Zealand material believed to be *C. zealandica*. The only original data attached to the other specimen in the type series is White's determination and, in a different hand, the word 'Observatory' followed by an illegible word. We have also determined that the lectotype and paralectotype of *C. zealandica* are not conspecific. The paralectotype is similar to, but not conspecific (based on present knowledge), with *C. brunneum*.

We found significant differences between Given's (1952) description of *C. zealandica* and the lectotype. Therefore, the 400 specimens studied by Given (1952) are not *C. zealandica* and Given's (1952) description does not characterise this species. Although the description by Given (1952) does not match the lectotype, it does match the specimens studied by Given (1960).

A representative series (18 specimens) from around New Zealand, of the taxon currently known as the New Zealand grass grub, have been studied and described. The external morphology and male genitalia of these specimens agree with the description and figures in Given (1952), but differ from the lectotype and paralectotype of *C. zealandica*. This means that the specimens studied here and those studied by Given (1952) are not *C. zealandica* as established here, and the name *C. giveni* is proposed for these specimens. The identity of the paralectotype of *C. zealandica*, although similar to *C. brunneum*, is left unresolved.

In hindsight, the results of these investigations should not be such a surprise. The natural habitat of the 'New Zealand grass grub' was presumably native tussock grasslands, but it has since become one of the most serious pests of introduced pastoral grassland. Both of these habitats would have been rare or lacking around Port Nicholas (Wellington) in 1840, so *Costelytra* specimens collected at this time from there are more likely to have been shrubland or forest species. What is perhaps more surprising is that it has not been possible to associate either of the two species represented by the syntypes with known species of *Costelytra*.

This paper has rectified a serious problem with the identity of one of New Zealand's most important pasture pest species and provided it with a new name, *Costelytra giveni*. It also provides a comprehensive description for the type species of the genus *Costelytra*. This should provide a sound basis for a better understanding of the taxonomy of *Costelytra*.

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Disclosure statement

No potential conflict of interest was reported by the authors.

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