

Trogidae (Coleoptera: Scarabaeoidea) in forensic entomology: occurrence of known and new species in Queensland, Australia

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Running title: New species of Australian Trogidae

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Abstract

During studies of necrophagous insect succession in pig carcasses that were used as surrogates for human corpses, Trogidae were found to be fairly common at the carcasses at a study site in south-east Queensland. During the identification of the species, one of the regular visitors to the carcasses was found to be undescribed (*Omorgus (Omorgus) bachorum* **sp. nov.**). It is described in this paper. Also, while comparing the undescribed species to that of specimens in the Queensland Museum collection, another undescribed species was discovered, which is also described in this paper (*Omorgus (Omorgus) undaraensis* **sp. nov.**). One new synonym, *Omorgus incognitus* Strümpher & Scholtz, 2011 syn. nov., is also proposed; bringing the total number of Australian species of *Omorgus* Erichson, 1847 to 57.

Keywords

Brachyptery, decomposition, insect succession, keratin feeders, post-mortem intervals.

Introduction

The use of insects for estimating post-mortem intervals of human corpses has long been implemented in medico-legal investigations of death (Tabor *et al.* 2004). The development rates of forensically-important blowflies (Diptera: Calliphoridae) can be used to estimate post-mortem intervals from a couple of days to several months (Goff, 2009). Insect colonization of carrion follows predictable patterns through the decomposition process (Early & Goff, 1986; Goff, 2009; Villet, 2011). Blowflies are amongst the first arrivals in the early stages of decomposition, and are soon followed by various predatory beetles that feed on the huge numbers of larvae that quickly develop. When most of the soft tissue has been consumed, various other insect taxa arrive that feed on the remaining skin, hair, cartilage and bones. The final successional stage is reached with the arrival of the keratin-feeders, mostly beetles of the family Dermestidae (hide- and skin-beetles) and Trogidae (keratin beetles). The latter exhibit a remarkable feeding specialisation; adults and larvae of all known species are considered specialist keratin-feeders and able to digest keratin, unlike the dermestids, for example, where in some of the carcass-associated species adults and larvae feed on soft tissue as well as keratin, while in others only the larvae feed on animal remains, the adults on pollen (Waterhouse, 1957).

The Trogidae is a small family of about 300 species worldwide (Scholtz, 1982; Smith, 2003; Pittino, 2006; 2012, Zidek 2013). They primarily inhabit temperate and arid or savanna regions. Currently there are three recognised genera in the family; *Trox* Fabricius 1775, *Polynoncus* Burmeister 1876, *Omorgus* Erichson 1847. All native trogid species in Australia belong to the genus *Omorgus*. Australian Trogidae are fairly well studied and have been revised by Haaf (1954) and Scholtz (1986a; see also Scholtz, 1986b). The number of described species currently stands at 55 (Strümpher & Scholtz, 2011), of which two were introduced (Scholtz 1986a). One of the introduced species, *O. suberosus* (Fabricius), a New World native, is now fairly widespread in eastern and south-western Australia. The other exotic species is the virtually cosmopolitan Holarctic species, *Trox scaber* (Linnaeus), which has established in south-eastern mainland Australia (Strümpher & Scholtz, 2011).

Although Trogidae represent a well-established guild of keratin-feeders on virtually any source of keratin, human corpses, because of their relatively hairless condition compared to most other animal carcasses, do not usually attract the same numbers of these beetles as do bird and other mammal remains. However, during a recent forensic study (Farrell in prep) using pig carcasses as a surrogate for human corpses, on a peri-urban site at Lilyvale (approximately 140km west of Brisbane: S27°26'00.61", E151°53'18.17") in south-east

Queensland, Trogidae were frequent and abundant visitors to the carcasses. Several species were encountered and amongst them was an unnamed species which we describe here. While the specimens were being identified and compared to specimens in the Queensland Museum collection, one specimen of another undescribed species was found so this, too, is described in this paper. Since Scholtz's (1986a) revision of the Australian trogid fauna, two papers containing descriptions of new Australian species (Kawai, 2009; Strümpher & Scholtz, 2011) have been published. The recent tracing of Kawai's (2009) obscure paper revealed taxonomic duplication, and as a result, one new synonym was discovered; the synonymy is formalised in this paper.

Materials and methods

Study site

Lilyvale lies on the western slopes of the Great Dividing Range at an altitude of about 520m above sea level. The area is transformed open eucalypt woodland and open grass country. The region receives most of its rainfall (900-1000 mm/year) in summer. Average temperatures at the study site range between 17-31°C in summer, 11-26°C in autumn, 2-19°C in winter and 11-27°C in spring. Winter frosts are common.

Terminology

Morphological terminology follows Scholtz (1986a). Specimens were examined using Zeiss dissecting microscopes. Images of specimens were taken with a Canon EOS 550D and 100mm macro lens. Focus stacking was performed using the software Helicon Focus version 5.3.

Systematics

Institutions to which specimens belong, or in which they have been deposited, are abbreviated as follows:

QM Queensland Museum, Fortitude Valley, Australia

UPSA Department of Zoology & Entomology, University of Pretoria, South Africa

Genus: *Omorgus* Erichson, 1847.

Sub-genus: *Omorgus* (*Omorgus*) Erichson,

Omorgus (*Omorgus*) *bachorum* **sp. nov.** (Figs 1, 2a-c)



Fig 1: Adult habitus of *Omorgus bachorum*.

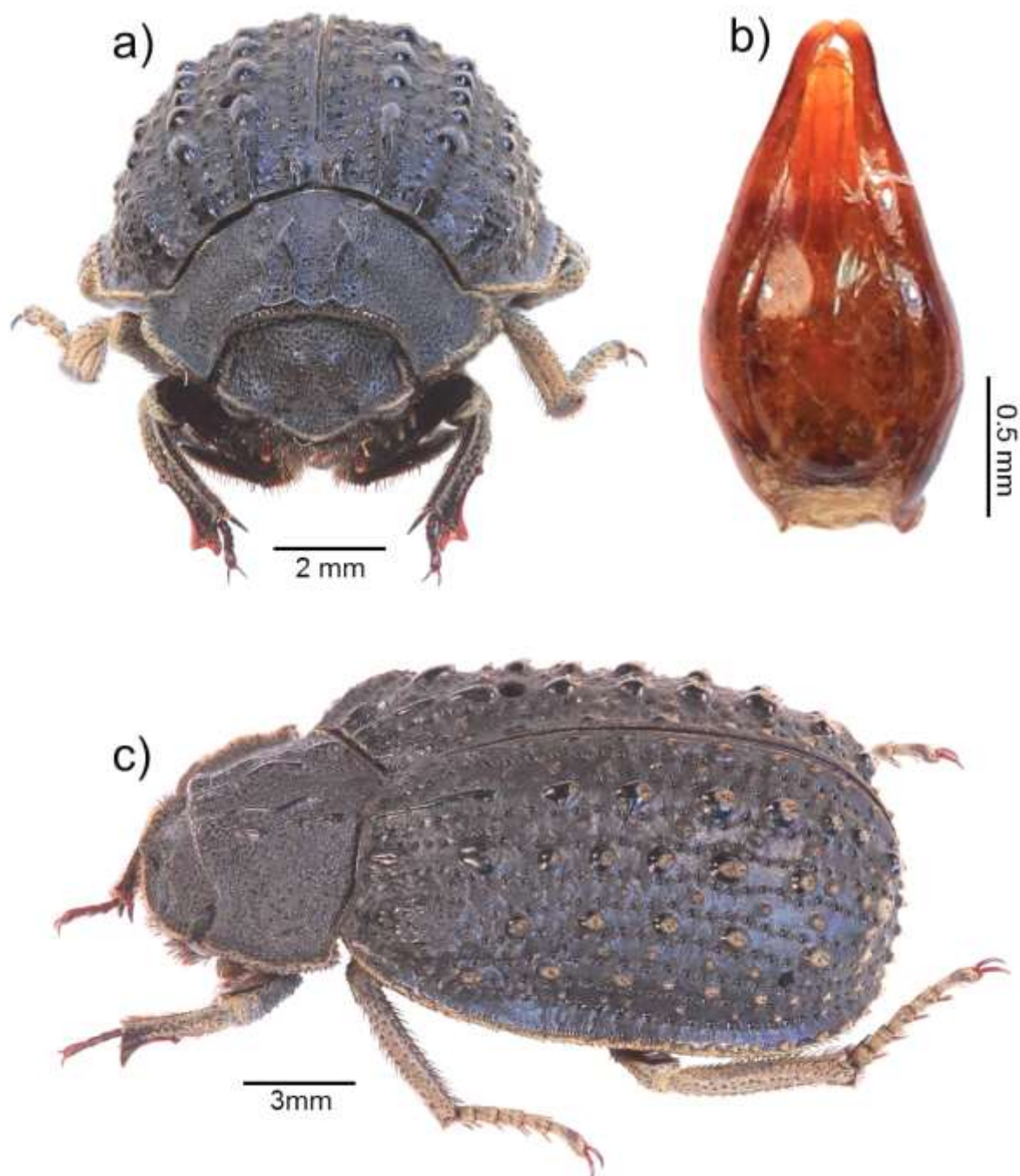


Fig 2: *Omorgus bachorum* sp. n. a) pronotum and head of adult habitus, b) dorsal view of aedeagus, c) lateral view of adult habitus.

Type material examined: Holotype (♂ QM: T196162) and 25 Paratypes (14♂, 3♀, QM: T191163-196; 6♂, 2♀, UP) with the following data: Australia, QLD, 27.434°S - 151.888°E, Lilyvale, nr Oakey, 530m. 05.iv-04.xii.2012. J. Farrell, ex pig carcass. H35383; Paratype (1♀, QM: T196180) with the following data: Australia, QLD, 28°19'S 150°30'E, Bendidee Nat. Pk., 21-22Mar2003. J. Haines, 235m. dung trap, brigalow, wilga. 51141.

Diagnosis

O. bachorum is a distinct species which can be reliably distinguished from morphologically similar species (e.g. *O. euclensis* (Blackburn), *O. eyrensis* (Blackburn), *O. alternans* (MacLeay) and *O. mentitor* (Blackburn)) by the virtual absence of the latero-basal tubercles and by the evenly rounded discal area of the pronotum. Furthermore, *O. bachorum* has prominent, round glabrous tubercles on the even numbered costae on the elytra. The other similar species have the tubercles more elongate and acute apically or when round, not as highly raised as the new species.

Description

Description of the new species is limited to characters with known diagnostic value (Scholtz, 1986a). The external morphology of males and females is identical.

Size: Length: 17.3 - 19.2 mm, width: 7.9 - 8.7 mm (n = 27).

Colour: Dark grey to black.

Head: Clypeus triangular, slightly deflexed, apex pointed, margin reflexed; surface of clypeus and frons punctuate, frons with two rounded tubercles; antennal scape pointed with long black setae; pedicel attached subapically; club dark grey to black.

Pronotum: surface punctuated; sides broad and flat; total pronotal width narrower than the elytra; median discal area slightly raised; ridges and tubercles not prominent and without distinct latero-basal tubercles, median depression shallow; lateral margins attenuated anteriorly, and evenly curved with no distinct incisions, anterior and basal margins with stiff, short setae, basal angle rounded.

Elytra: humeral calli distinct, scutellum hastate; sides narrow; lateral margins tomentose and with short setae evenly spaced along margin; sutural margin slightly raised and glabrous, with elongated to round tubercles spaced irregularly over the anterior $\frac{1}{3}$ of margin, distal $\frac{2}{3}$ of sutural margin with small round tubercles, all tubercles on margin often with posterior tomentosity and short setae. Even numbered costae prominent, and characterised by large round glabrous tubercles irregularly spaced (especially the 2nd and 4th costae), all tubercles have a small posterior tomentose area and often with tuft of short setae; costa 2 with short,

broadly rounded and glabrous basal ridge; costa 4 lacks distinct basal ridged, but often with prominent elongate and glabrous basal tubercle; odd numbered costae distinguishable as slightly raised, small round tomentose tubercles, often with one or more short setae; intercostal area with evenly spaced round punctures; one or more irregular nitid patches present laterally; elytral profile convex, attaining maximum height in middle.

Legs: fore tibia slightly bifid, with setose dorsal keel; lateral tibial margin with one distinct median tooth; tibial spur as long as first three tarsal segments; basal segment of tarsus visible in dorsal view; meso- and metatarsi sparsely setosed.

Male genitalia: Aedeagus typical trilobite type, simple median lobe, apex pointed, not projecting beyond parameres and lateral lobes symmetrical (Fig 2b).

Distribution: Known from only two localities in Queensland, Australia (Fig 5).

Etymology: This new species is named after the Bach family in appreciation for their hospitality and technical assistance during Julianne Farrell's field work. All the specimens, except for one, in the type series were collected on their property at Lilyvale, Queensland.

Omorgus (Omorgus) undaraensis **sp. nov.** (Figs 3, 4a, b)

Type material examined: Holotype (♀ QM: T196181) with the following data: Australia, QLD, 18°14'S – 144°38'E, Undara NP, Wind Tunnel, 08Dec2002-08Feb2003, G. Monteith, vine scrub, 11250.

Diagnosis

O. undaraensis is a very distinct rotund, brachypterous species. It appears to be most similar to *Omorgus ovalis* (Haaf) but can be distinguished from the latter by the appearance of the pronotum and elytra. *O. undaraensis* has the pronotal disc evenly rounded, ridges and tubercles only slightly raised and pronotal margins evenly curved without indentations, whereas *O. ovalis* has the pronotal disc raised, acutely ridged and pronotal margin distinctly indented; *O. undaraensis* has lateral elytral margin smooth, while *O. ovalis* has lateral elytral margin irregular. *O. undaraensis* also bears superficial resemblance to *Omorgus nigroscobinus* (Scholtz) and *Omorgus mariettae* (Scholtz), but can easily be distinguished from the latter species by differences in pronotal and elytral sculpture.



Fig 3: Adult habitus of *Omorgus undaraensis*.

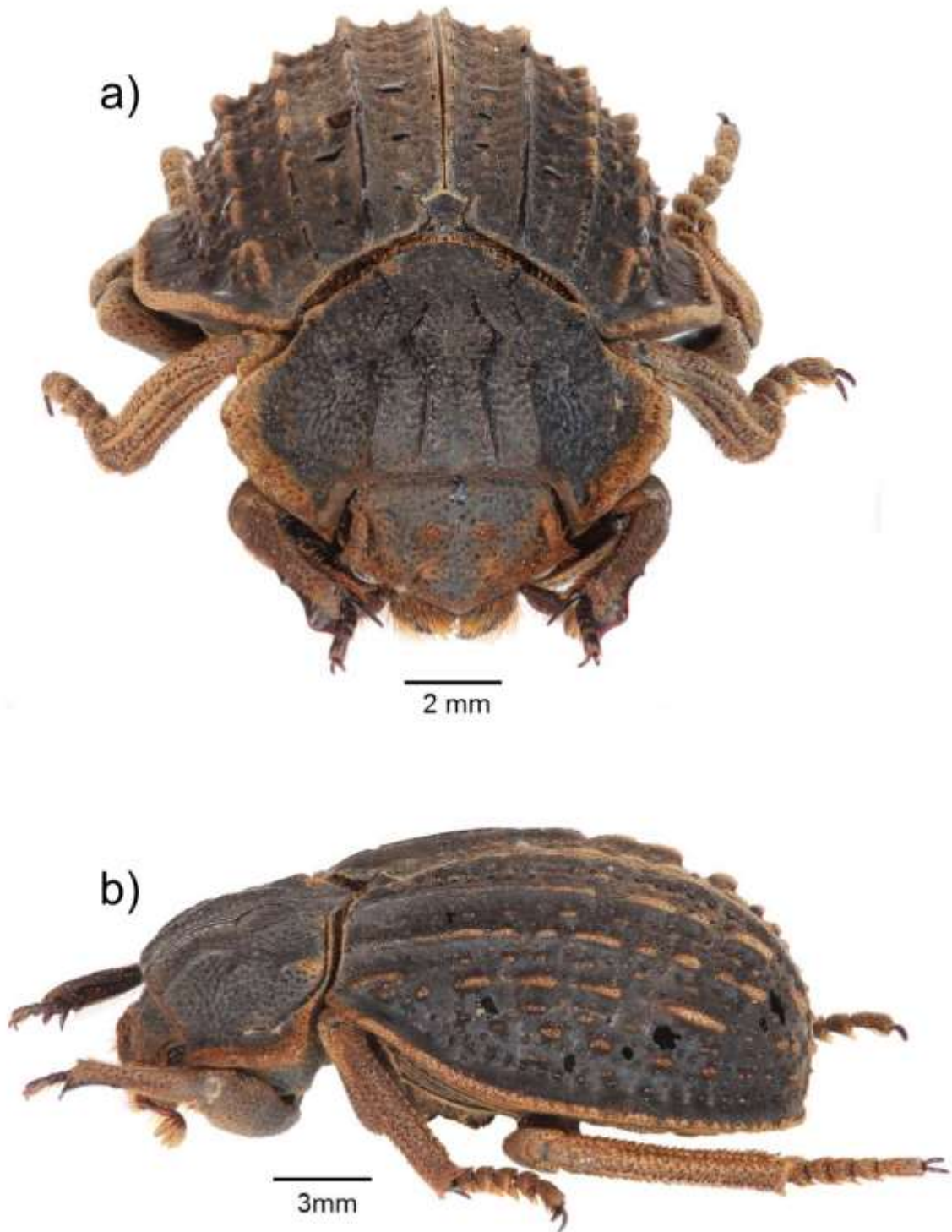


Fig 4: *Omorgus undaraensis* sp. n. a) pronotum and head of adult habitus, b) lateral view of adult habitus.

Description

Description of the new species is limited to the characters with known diagnostic value (Scholtz, 1986a). Male specimens are unknown to us.

Size: Length: 14.1 mm, width: 9.0 mm (n=1).

Colour: Dark brown.

Head: Clypeus triangular, only slightly deflexed, apex pointed, margin reflexed; surface of clypeus and frons punctuate with slight tomentosity, each punctures with a short seta; frons bituberculate; antennal scape stout, approximately same length as the rest of the antenna, scape with long fulvous setae; club fulvous.

Pronotum: surface punctuated; sides broad and tomentose; lateral margins attenuated anteriorly, evenly curved with no distinct incisions, total pronotal width narrower than the elytra; evenly rounded discal area with longitudinal ridges and tubercles, median discal area slightly raised; two distinct latero-basal tubercles present; basal angle rounded.

Elytra: not fused; humeral angle rounded, calli absent; scutellum hastate, distinctly concave with posterior margins setose; sides very broad; lateral margin smooth with a fine setal fringe; sutural margin slightly raised, anterior ½ indistinctly ridged, second ½ of sutural margin with distinct elongated setose ridges; even numbered costae prominent; second costa fused for 1/3 elytra length into sharply keeled ridge with glabrous crest, thereafter tuberculate, tubercles ridged and tomentose; rest of even-numbered costae with raised elongated tubercles irregularly spaced; odd-numbered costae distinguishable as slightly raised small round velutinous/setose tubercles and sparsely spaced irregular nitid patches; intercostae with evenly spaced round punctures; elytral profile convex attaining maximum height in the middle.

Legs: fore tibia not distinctly bifid, with dorsal keel; lateral margin with 1 small median tooth; tibial spur as long as first 4 tarsal segments; meso- and metatarsi with short setal brushes.

Male genitalia: Unknown

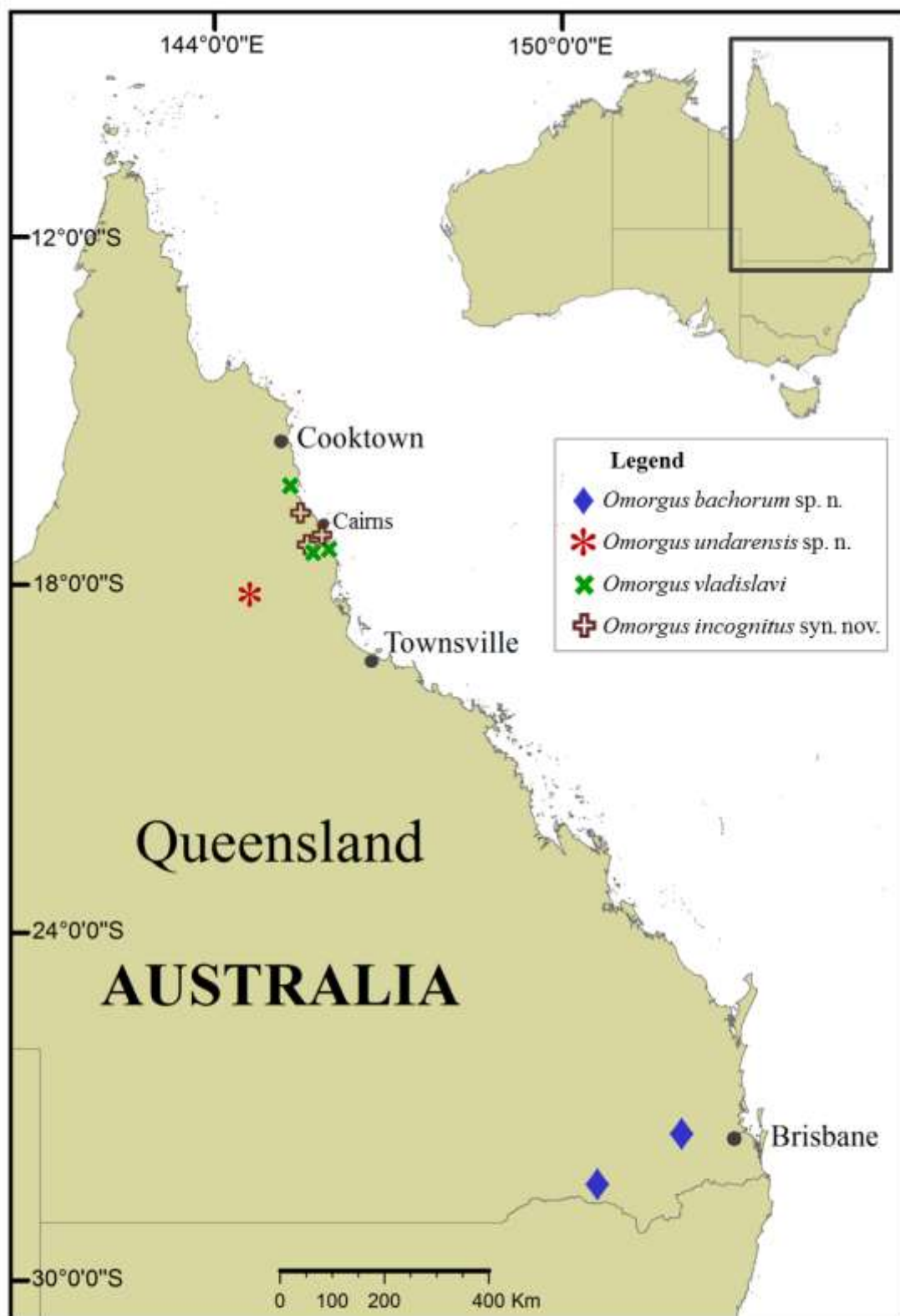


Fig. 5: Distribution map of *Omorgus* spp. in Australia: *O. bachorum* sp. n., *O. undarensis* sp. n., *O. incognitus* syn. nov. and *O. vladislavi*.

Distribution: Known only from the type locality in northern Queensland, Australia (Fig 5).

Etymology: The species is named for the Undara Volcanic National Park in North Queensland where this new species was collected.

Omorgus (Omorgus) vladislavi Kawai, 2009

Type material: Holotype (♂ QM: T169557) with the following data: Innisfail env. (S17°40'270" E146°02'010"), 43m in altitude, North Queensland, Australia, 28. XII. 2004, Vladislav Malý leg. Allotype: ♀, Cape Tribulation, N.P., Daintree section (S16°12'127" E149°04'124"), 85m in altitude, North Queensland, Australia, 29.XII.2004 - 7.I.2005, Vladislav Malý leg. Paratypes: 1♂, same locality as the allotype, Štefan Dolák leg.; 1♂, Tully G[e]orge N.P., Queensland, Australia, 7-10. I. 2008, Štefan Dolák leg.

Omorgus (Omorgus) incognitus Strümpher & Scholtz, 2011, p. 141; **syn. nov.**

Type material: Holotype (♂ QM: T196182) with the following data: Australia, Northern Queensland, Mt. Fisher S.F., Milla Milla, 10 November 1979, A. Walford-Huggins. Paratype (1♀ QM: T196183): Australia, Northern Queensland, Upper Mulgrave River, 1-3 December 1965, G. Monteith. Paratypes (2♀ UPSA) with following data: N.E. Australia, Kuranda, 8 October 1987.

Remarks:

Strümpher & Scholtz (2011) described *O. incognitus* from four specimens, discovered amongst unsorted QM material. At the time, neither the authors, nor the curators of the beetle collection at the QM were aware of the description of the species, *O. vladislavi*, Kawai, 2009 from Australia published in an obscure journal. The type was only recently returned to the QM. Subsequent comparison of Kawai's (2009) description and accompanying figures of *O. vladislavi* to specimens of *O. incognitus* shows them to be the same species. The important diagnostic features shared by both species include the (1) velutinous tomentosity covering the pronotum and elytra, (2) absence of ridges and tubercles on the odd numbered costa on the elytra, (3) the very distinct morphology of the male genitalia and (4) similar distribution patterns.

Omorgus incognitus Strümpher & Scholtz, 2011:141 is therefore synonymised with *O. vladislavi* Kawai, 2009: 73.

Discussion

In the forensic carcass decomposition study (Farrell in prep) that led to the direct and indirect discovery of these new species, the ones that visited the carcasses (*O. bachorum*, *O. suberosus*, *O. subcarinatus* (MacLeay), *O. candidus* (Harold) and *O. euclensis* (Blackburn)) did so during wet and dry seasons, although numbers were highest during the rainy season. This is also similar to the phenology of southern African species in dry savanna (Scholtz & Caveney, 1988, 1992) and is probably fairly typical for the group as a whole. Furthermore, most individuals visited the carcasses during the late stages of decay. Five stages were described (after Goff, 2009): fresh, bloat, decay, post-decay and skeletonised. These are fairly descriptive terms and provide a good idea of the state of the carcass but the details of each will be presented in Farrell (in prep). A total of 243 trogids were collected at the carcasses over the two-year course of the study; of these, a majority (193) was present at carcasses in the “post decay” and “skeletonised” stages, between about 10 days minimum (after rain) and 120 days post-mortem. Only one individual was collected on “fresh” carcasses and 15 on “bloated” carcasses, providing more, although currently anecdotal, evidence that trogids are mostly found in late to very late stages of carcass decomposition.

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