

Two Additional Invasive Scarabaeoid Beetles (Coleoptera: Scarabaeidae: Dynastinae) in Hawaii

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Abstract. Two species of dynastine scarab beetles are reported for the first time on the island of Hawaii: the Pasadena masked chafer, *Cyclocephala pasadenae* (Casey) (Scarabaeidae: Dynastinae: Cyclocephalini) from North America and *Temnorhynchus retusus* (Fabricius) (Scarabaeidae: Dynastinae: Pentodontini) from Africa. The Pasadena masked chafer is established on the island of Hawaii, is a recognized pest of turf grass, and is a concern for agriculture and native Hawaiian arthropod species. *Temnorhynchus retusus* is not known to be an agricultural pest, but its spread on the islands could pose a problem for Hawaiian native species. We provide an overview of each species, characteristics for recognition of these species, and comments on their introduction to the islands.

Key words: *Temnorhynchus retusus*, *Cyclocephala pasadenae*, masked chafer, invasive species

Introduction

Well over 2,500 arthropod species have been introduced to the Hawaiian Islands with continued establishment rates at an alarming ten to twenty species per year (Asquith 1995). In Hawaii, the introduction of non-native animals and plants has caused millions of dollars in crop losses, extinction of native species, destruction of native forests, and \$40.8 million in government spending in 2006 for biosecurity initiatives (Hawaii Department of Land and Natural Resource 2008). Biologists concerned with preserving Hawaiian ecosystems and agriculture must work to suppress invasive species (Rubinoff 2007). Among these invasive species are pests such as the Chinese rose beetle, *Adoretus sinicus* Burmeister, a scarab beetle for which biological control has been largely ineffective (Beardsley 1993). Herein we report two additional scarab beetles for Hawaii, both of which could pose concerns for agricultural biosecurity and native arthropod populations.

Native and Non-native Hawaiian Scarabaeoids

Only one genus of scarabaeoid beetles, *Apterocyclus* Waterhouse (Scarabaeoidea: Lucanidae), is believed to be native to the Hawaiian Islands (Muir 1917). The genus includes the Kauai flightless stag beetle (*Apterocyclus honoluluensis* Waterhouse) and *A. waterhousei* Sharp (Maes 1992, Krajcik 2003). These species are restricted to high elevation native forests on the island of Kauai (Abbott and Petr 1997, Nishida 2002). Both species are of great conservation concern because of their extreme rarity, flightlessness, and known heavy predation by non-native mice (Howden 2008). Few specimens in the genus have been sighted

and/or collected in the past 30 years. One specimen was collected in 1979 and another in 1996 (Abbott and Petr 1997). In 2004, adults and larvae of *A. waterhousei* were collected by Alistair Ramsdale (formerly of Bernice Pauahi Bishop Museum [BPBM]), but attempts at rearing them were unsuccessful (F. Howarth personal communication, 26 January 2009).

Another scarab beetle, *Ataenius pacificus* Sharp (Scarabaeidae: Aphodiinae) was described from Hawaii (specifically Honolulu) and is considered an endemic species (Nishida 2002). This species is also known from Saipan in the Mariana Islands (Cartwright and Gordon 1971). Due to the distribution of this species, it is quite possible that *A. pacificus* is native to another region of the world and was introduced to the Hawaiian Islands (Cartwright and Gordon 1971).

An additional 62 species of scarabaeoids (Scarabaeidae, Lucanidae, Trogidae, Passalidae) have been recorded from the Hawaiian Islands, and 16 of these are listed as adventive to the islands (Nishida 2002). Some scarabs were deliberately introduced to the islands to control cattle feces (e.g., *Onthophagus gazella* (Fabricius) [Scarabaeidae: Scarabaeinae]) and/or hornflies that breed in cattle feces (e.g., *Euoniticellus intermedius* Reiche [Scarabaeinae]).

Destructive Masked Chafer Established in Hawaii

The Pasadena masked chafer, *Cyclocephala pasadenae* (Casey) (Scarabaeidae: Dynastinae: Cyclocephalini) (Fig. 1), has recently become established on the island of Hawaii. The species was first reported 12 April 2007 by tourists whose apartment in Waikoloa near a golf course was being “swarmed” by beetles. On 4 May 2007, a 12-hour light trapping event near the apartment resulted in many specimens. The trap was placed about 15 meters from turf that showed signs of grub damage, but a search for larvae was not allowed by the golf course. Consultation with golf course staff revealed that adult beetles were caught as far back as the mid-1990s. Staff provided anecdotal reports of birds digging into the turf for white grubs (causing more damage than the grubs) and use of white grubs as fish bait.

Cyclocephala pasadenae is native to the continental United States, where it is abundant in the southwestern quadrant of states, becoming less abundant towards the eastern states (Ratcliffe and Paulsen 2008). This species, along with the other US masked chafers of economic importance, *C. borealis* Arrow and *C. lurida* (Bland), are among the most destructive pests of turf grass in the Midwest, Ohio Valley, and west coast of the United States (Potter 1998, Vittum et al. 1999). In high numbers, larvae cause damage to turf grasses, pastures, and crops due to feeding on roots (Ratcliffe and Paulsen 2008). Adults are nocturnal and may be monitored using light traps at night. The species could have been transported to Hawaii in turf grass (as larvae or adults) or transported inadvertently on ships after being attracted to lights at night on docks or piers. The Hawaii Department of Agriculture Plant Quarantine Branch regulates the importation of grass (in accordance to Hawaii Revised Statutes 4-70-10 and 11). Based on records, there were no permit applications for importation of turf grass into the Waikoloa area or the developments nearby. However, it is possible that turf grass may have entered at another port and was subsequently transferred to the island of Hawaii. Waikoloa, the area of infestation, is 12 km from the deep harbor of Kawaihae where much of the cargo enters the island of Hawaii, so this remains a possibility for an introduction pathway.

Adults of *C. pasadenae* are 12–14 mm in length, elongate oval, tan or light brown, and have a dark “mask” across the frons (see full description in Ratcliffe and Paulsen 2008) (Fig. 1). *Cyclocephala pasadenae* is differentiated from *C. lurida* and *C. borealis* (with which it shares many characteristics) based on the form of the male genitalia (Fig. 2), lack of long setae at the apex of the pygidium, and simple elytral epipleuron in the female (Ratcliffe and Paulsen 2008). The antennal club is longer in the male than in the female. Also, the



1. *Cyclocephala pasadenae*, male



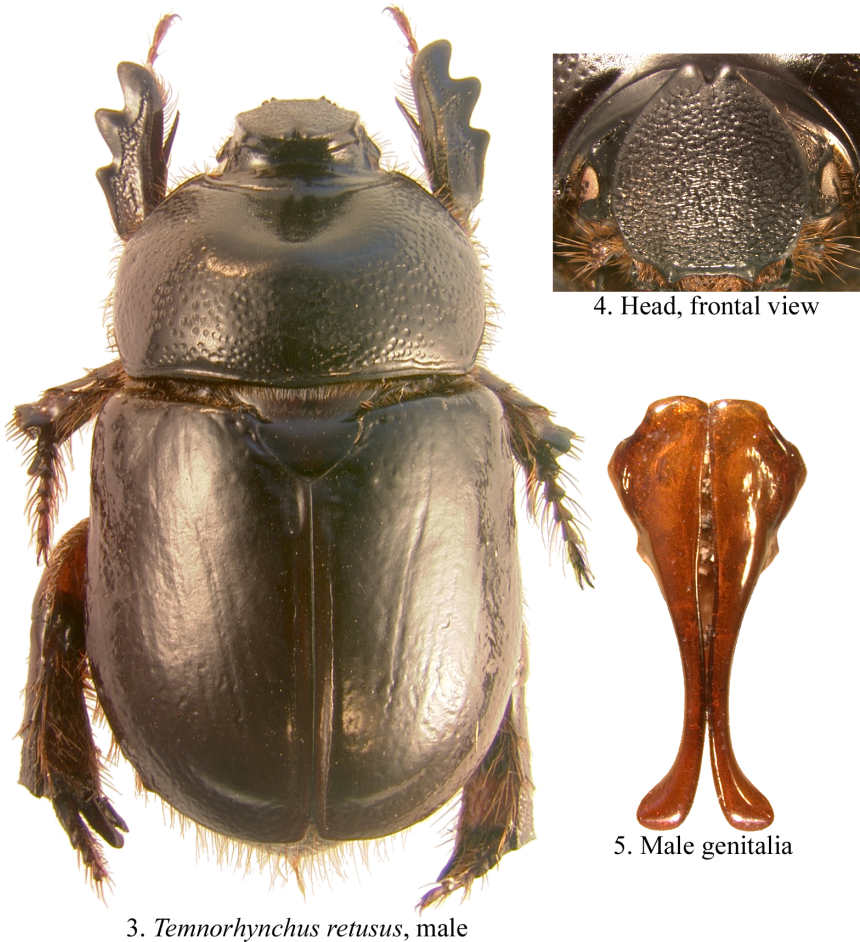
2. Male genitalia

Figures 1–2. *Cyclocephala pasadenae*. (1) Male habitus. (2) Male genitalia.

protarsus and claw are enlarged in the male and simple in the female.

Natural history of the species is fairly well known. Adult beetles do not feed and are readily attracted to lights at night. The life cycle is one year, and the larvae (c-shaped, white grubs) feed on plant roots. Larvae were described by Ritcher (1966). The third instar larvae are 23–25 mm in length.

Twelve voucher specimens, all collected 4 May in Waikoloa are deposited in the collections of the United States National Museum (currently at the University of Nebraska State Museum). Additional voucher specimens are deposited in the Hawaii Department of Agriculture's Taxonomy Reference Library and at the Bernice Pauahi Bishop Museum.



Figures 3–5. *Temnorhynchus retusus*. (3) Male habitus. (4) Head, frontal view. (5) Male genitalia.

***Temnorhynchus retusus* Introduced to Hawaii**

Another scarab, *Temnorhynchus retusus* (Fabr.) (Scarabaeidae: Dynastinae: Pentodontini) (Fig. 3), was reported from Mauna Lani in Waikoloa on 8 August 2007. Adults were taken in seashore paspalum (*Paspalum vaginatum* Sw.) (Poaceae), a grass species that is native to tropical and subtropical regions of North and South America and is known to have a high tolerance for salinity. The plant species is also used for turf in South Africa, Australia, and New Zealand. In the continental United States, seashore paspalum is found along coastal regions from Texas to Florida and North Carolina. *Temnorhynchus retusus* is native to eastern Africa from Sudan to South Africa and Namibia (Krell 1993) and is adventive in eastern and western Australia (Allsopp 1987, Krell and Hangay 1998). It was reported from

Albany, Western Australia, in 1985 (Allsopp 1987) and from New South Wales in 1984 (Krell and Hangay 1998) where beetles were collected in cultivated gardens and watered lawns with a majority of non-native, ornamental plants.

The mechanism for the species' transport to Hawaii is not known. Development along the Kona and Kohala coastlines has seen increasing use of wood and materials from South-east Asia and Africa that could provide a pathway for introduction. Soil on pallets could also facilitate introduction of larvae. It was hypothesized that establishment in Australia may have been facilitated by introduction with rooted plants from southern Africa and supported by the presence of non-native vegetation (Krell and Hangay 1998, Garden et al. 2006). Allsopp (1987) hypothesized that the species was transported from South Africa to Australia in soil used as ship's ballast prior to the 1940s. If this is true, Allsopp suggested that the species went undetected in Australia for over four decades because of the species' unusual flight period (activity beginning in September), weak attraction to light traps, poor dispersal ability, or restricted environmental preferences.

Temnorhynchus retusus has not been reported as an agricultural pest in any part of its native range. In Australia, however, it is a successful invader and possesses traits that allow it to successfully become established and spread rapidly (Krell and Hangay 1998). Instead of being a threat to agricultural security, the spread of the species throughout Hawaii may cause declines by displacing native arthropods (Asquith 1995). Urbanization and associated introduction of non-native flora for landscaping has caused the inadvertent introduction of non-native arthropods and corresponding declines in native arthropods (McIntyre 2000).

Adults of *T. retusus* are moderately large (16–20 mm in length), black rhinoceros beetles (Fig. 3). They are easily identified based on the form of the head (Fig. 4) in both males and females which, according to Krell (1994), is unique within the Dynastinae. Male genitalia also assist in confirming identification (Fig. 5). Adult *T. retusus* feed on grasses and are only weakly attracted to lights (Krell and Hangay 1998). The larvae are large, c-shaped white grubs (about 36 mm in the third instar) that are associated with sandy soils, where they feed on roots of grasses and other garden plants (Prins 1984). Larvae and pupae were described by Prins (1984).

One voucher specimen that was collected in Hawaii is deposited at the United States National Museum (currently at the University of Nebraska State Museum).

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