New Records and Accounts

A Second Adventive Species of Pinhole-borer on the Islands of Oahu and Hawaii (Coleoptera: Curculionidae: Platypodinae)

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The Platypodinae is presently classified as a subfamily of the weevil family Curculionidae (Alonso-Zarazaga and Lyal 1999, Bouchard et al. 2011), and contains more than 1400 species described in 34 genera and four tribes, occurring primarily in tropical and subtropical regions (Wood 1993). It was traditionally treated as a close relative of the Scolytinae, which are the most diverse subfamily of specialized wood-boring beetles. However, the phylogenetic position of Platypodinae within the weevils remains unclear, and recent molecular phylogenies (e.g., Gillett et al. 2014) now indicate only a distant relationship with Scolytinae, and likely independent origins of the wood-boring specialization. Because of their habit of boring circular entrance holes in dead wood, and on account of their elongate form, platypodines have been known by the common name of "pinhole borers." The vast majority of platypodine species are xylomycetophagous, cultivating symbiotic 'ambrosia' fungi within their galleries, as an obligate food source for their larvae (Jordal 2015, Kirkendall et al. 2015), and therefore are also termed "ambrosia beetles." A consequence of the ambrosia-farming habit is that most platypodines are not host-specific, and are able to inoculate and farm ambrosia fungus in the wood of many different tree families (Jordal 2014). Some species of Platypodinae can be important pests of forests and plantations. Although healthy trees are not generally attacked, stressed plants and recently felled timber can be infested by the beetles (and their associated fungi); the resulting discoloured galleries reduce the value of the lumber (Beaver 2013).

Hitherto, only a single, exotic species of Platypodinae has been widely recorded in the literature from the Hawaiian Islands: *Crossotarsus externedentatus* (Fairmaire 1849) (Nishida 2002), a species that is widespread in tropical forests around the globe (Wood and Bright 1992). A second species, *Euplatypus parallelus* (Fabricius 1801), was first recorded for the state (as *Platypus parallelus*) in an unpublished report from the island of Maui (Howarth and Preston 2002), then subsequently in an updated, published report, where it was listed as uncommon (Howarth, Preston, and Pyle 2012), but has not been widely reported nor included in the current Hawaiian Terrestrial Arthropod Checklist (Bishop Museum 2017). We can now formally record *E. parallelus* from the

island of Oahu, through recent fieldwork there during the second half of 2017, and from the island of Hawaii, through identification of preserved specimens. A total of 22 Hawaiian specimens were studied, as follows.

Material Examined

Newly collected specimens are deposited in the University of Hawaii Insect Museum (UHIM). Specimens were also located in the collection of the State of Hawaii Department of Agriculture (HDOA), Honolulu, and in the collection of the University of Hawaii, Hilo (UHH) (examined by photographs). Digital photographs of a pair of representative specimens of *E. parallelus* from Oahu (Figure 1A and B) were taken with a Nikon D-7100 DSLR camera mounted on an Olympus stereomicroscope. The images were subsequently focus-stacked using Helicon Focus running on an iMac computer.

Hawaii, Oahu, Waianae Mountains, Palikea Ridge trail, 21° 23' 60" N, 158° 5' 60" E, 860 masl, 24.vii.2017, leg. and det. C.P.D.T. Gillett: Lindgren-funnel trap baited with ethanol lure – 1 female specimen (UHIM). Same data as above, except 13.viii.2017 – 1 male specimen (UHIM).

Hawaii, Oahu, Honolulu, Manoa, University of Hawaii campus, roof of Gilmore Hall, 21° 18' 0" N, 157° 48' 36" E, 30 masl, 07.ix.2017, leg. M. Logan and C. Doorenweerd, det. C.P.D.T. Gillett: Mercury vapor light trap – 1 male and 2 female specimens (UHIM).

Hawaii, Hawaii, Kealakekua, 11.ix.2003, leg. M. Ohta, det. G.A. Samuelson: "Boring into dying trunk of pink shower," *Cassia javanica* (Fabaceae) – 9 male, and 2 female specimens (HDOA).

Hawaii, Hawaii, Honomalino, viii.1988, leg. C. Robb, det. G.A. Samuelson: "ex Macnut tree trunk," *Macadamia* sp. (Proteaceae) – 2 male specimens (HDOA).

Hawaii, Hawaii, Captain Cook, 02.xi.2014, leg. Noel Dickinson – 1 female specimen (UHH).

Hawaii, Hawaii, Panaewa, 06.ix – 04.x.2013, leg. J. Zarders: Ethanol trap – 2 male and 1 female specimens (UHH).

In addition to the studied specimens, we cite here the records published in the Bishop Museum Technical Report 58, on a survey of arthropods from the environs of Kahului airport, Maui (Howarth and Preston 2002) and subsequently published in a report (Howarth, Preston, and Pyle 2012) containing a photograph of a male specimen of *E. parallelus*.

Hawaii, Maui, Kahului airport environs, Kanaha Pond Wildlife Sanctuary, 20° 53' 57" N, 156° 27' 14" W, 03.iii.2000, F.G. Howarth, D.J. Preston, K. Martz, F. Starr, and J.E. Dockall: Mercury vapor light, keawe (*Prosopis pallida*), *Sesuvium*, native shrubs.

Hawaii, Maui, Kahului airport environs, Aalele dump area, 20° 53' 35" N, 156° 26' 38"W, 15 masl, 28.iii.2000, F.G. Howarth, D.J. Preston, G.A. Samuelson, F. Starr, K. Martz, and J.E. Dockall: Mercury vapor light, keawe woodland (*Prosopis pallida*, *Leucaena*, *Cenchrus*, etc.).

Hawaii, Maui, Kahului airport environs, near Kanaha Pond, near South gate, 20° 53' 36" N,156° 27' 05.2" W, 31.v.2000, D.J. Preston, J.E. Dockall, K. Martz and F. Starr: Mercury vapor light, keawe woodland (*Prosopis pallida*).

Hawaii, Maui, Kahului airport environs, between Kanaha drainage canal and T-shirt factory building, 20° 53' 51" N,156° 26' 54" W, 04.vi.2000, F.G. Howarth, D.J. Preston, J.E. Dockall, R. Takumi and G.A. Samuelson: Mercury vapor and blacklight, *Leucaena*-keawe scrub, mixed weeds.

The dominant trees in the immediate vicinity of where the specimens were collected at Palikea (Oahu) consisted of the exotic *Casuarina equisetifolia* (ironwood), and *Araucaria heterophylla*

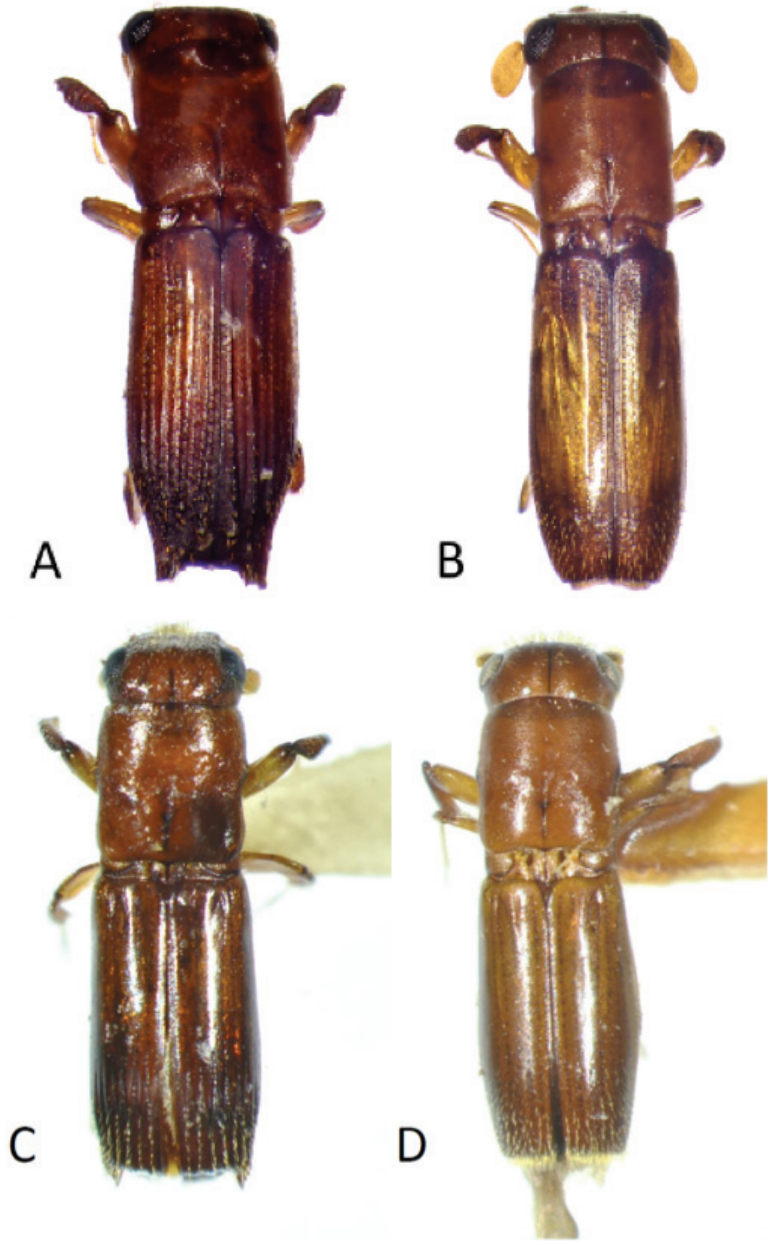

Figure 1. Species of Platypodinae recorded from Hawaii. (A) Male and (B) female of *Euplatypus parallelus* collected on Oahu in September 2017. (C) Male and (D) female of *Crossotarsus externedentatus* collected on Hawaii. Specimens deposited in UHIM. Photographs by C.P.D.T. Gillett.

(Cook pine), with some scattered native *Metrosideros polymorpha* (ohia lehua). The vegetation in the vicinity of the University of Hawaii campus consists of a broad mix of pantropical invasive and ornamental species (http://manoa.hawaii.edu/landscaping/plantmap.php).

Diagnosis and Identification

Both species of platypodine presently occurring on Hawaii are sexually dimorphic. The males are easily identified by their projecting elytral apices, which have very distinctive species-specific morphology, allowing them to be easily distinguished from each other. The apical quarter of the elytra of *E. parallelus* males is rather abruptly narrowed, with the external elytral apices projected into comparatively blunt, and slightly divergent teeth (Figure 1A). In contrast, the apical quarter of the elytra of male *C. externedentatus* is only gradually, and comparatively less narrowed, with the external elytral apices projected into longer and sharper, slightly convergent teeth (Figure 1C). Both sexes can be distinguished by the following characters, modified from the dichotomous key in Wood (1993):

Euplatypus parallelus (Figure 1A and B): Metasternum and metepisternum near metacoxa usually weakly or not impressed for reception of femur; anterior margin of impressed area not carinate or armed by row of small spines; surface of impressed area with some setae present.

Crossotarsus externedentatus (Figure 1C and D): Metasternum and metepisternum near metacoxal impressed for reception of femur; anterior margin of impressed area either carinate or armed by series of small spines (sometimes absent in females); surface of impressed area glabrous.

Discussion

Because *E. parallelus* was recently found at two widely separated, and highly dissimilar localities (Figures 2 and 3) on Oahu, namely, a forested mountainous area containing both native and introduced plants, and a distinctly urban environment (surrounded by forested hills) harbouring almost uniquely exotic plants, it is reasonable to conclude that the species is already well established on

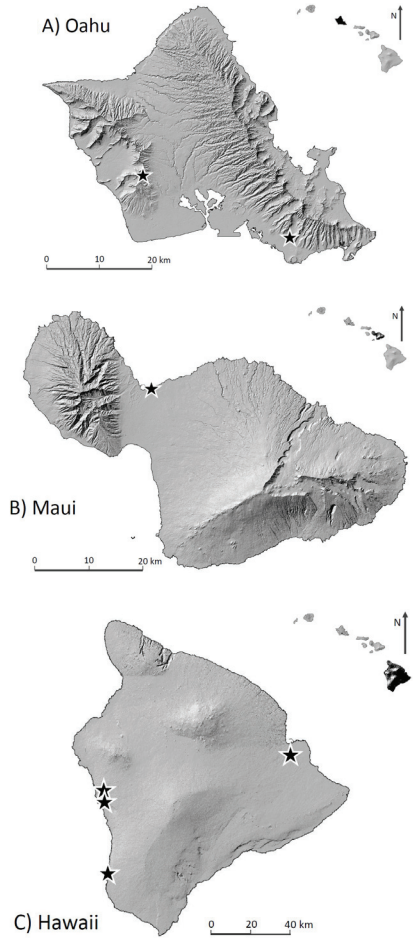

Figure 2. Map showing localities where *Euplatypus parallelus* has been recorded on the islands of (A) Oahu, (B) Maui, and (C) Hawaii. Collection localities indicated by black stars.

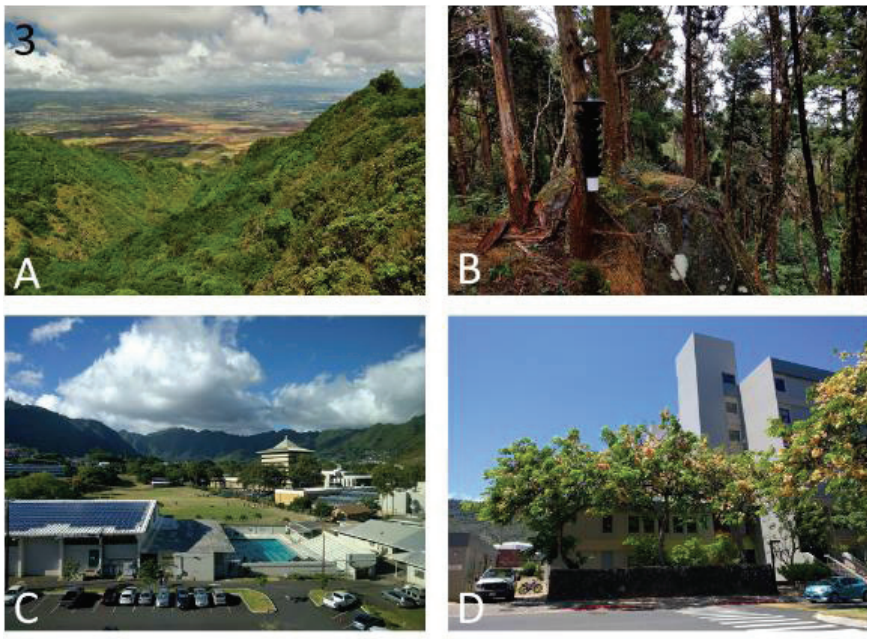

Figure 3. Locations where *Euplatypus parallelus* has been collected on the island of Oahu. (A) The forested hillside on Palikea Trail, in the Waianae mountains. (B) Lindgren-funnel trap in place at the collecting locality. (C) View of the forested Manoa valley hillsides surrounding the university campus. (D) Gilmore Hall at the University of Hawaii at Manoa campus, Honolulu. Photographs by C.P.D.T. Gillett.

Oahu. That *E. parallelus* has not apparently been recorded again on Maui since 2000 is somewhat intriguing, especially given the renewed interest and efforts in sampling and monitoring bark beetles since the arrival of the coffee berry borer (*Hypothenenus hampei* Ferrari 1867) as an invasive pest of coffee on Hawaii in 2010 (Burbano et al. 2011) and the advent of the fungal disease rapid ohia death, which may be at least partially vectored by bark beetles.

Although *E. parallelus* is native to the Neotropical Region, it is now one of the most widespread platypodines, with a pantropical distribution that includes introductions to Africa, Madagascar, Australia and tropical Asia (Wood and Bright 1992; Beaver 1999, 2013). It has recently rapidly spread in the Oriental Region, probably due to the intensification of the international trade in timber following the Second World War (Beaver 2013), and is now very widely distributed there. Therefore, the present discovery of *E. parallelus* in the Hawaiian Islands is not surprising, and is possibly evidence of a continuation of its rapid advance through Asia; it should be expected in due course on other Hawaiian Islands. In the continental United States, *E. parallelus* was recently recorded from Texas (Atkinson and Riley 2013), and has otherwise been previously reported from Florida (Atkinson and Peck, 1994) and California (Atkinson 2017).

Euplatypus parallelus is highly polyphagous, having been recorded from more than 60 host species, in 21 plant families in

Africa alone, including both broad-leaved and coniferous trees (Schedl 1965). These have included species of considerable commercial value such as *Eucalyptus*, rubber, pines, and tropical fruit trees (Beaver 2013). Whilst the majority of attacks are secondary, upon living trees that have been previously stressed by fire, drought, pathogens, or other causes (Beaver 2013), primary attacks on apparently healthy trees are not unknown (e.g., Bumrungsri et al. 2008). In some cases, an association has been made between attacks by beetles, the presence of pathogenic fungi, and the subsequent death of trees, although the precise role of *E. parallelus* as a vector of pathogenic fungi in such cases remains unclear (Beaver 2013).

As yet, little is known of the preferred plant host(s) for *E. parallelus* in the Hawaiian Islands beyond the label data on specimens collected in Hawaii Island from *Macadamia* sp. (Proteaceae) and *Cassia javanica* (Fabaceae). Because of the highly polyphagous nature of the species elsewhere in its range, there exists a possibility that *E. parallelus* may potentially develop into a pest of either the already fragile indigenous and endemic Hawaiian flora, or a pest of commercially or ornamentally important introduced trees, or both. Therefore, an awareness of the presence of this potential pest on the Hawaiian Islands, together with vigilant monitoring is recommended, to both establish its present area of occupancy, and in order to keep track of any future expansion in distribution.

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