

The Citizen Scientist Survey of Large Coleoptera on Lord Howe Island, August 2019

CHRIS A. M. REID¹, IAN HUTTON² AND SAXXON THOMPSON³

¹ Australian Museum Research Institute,
Australian Museum, 1 William Street, Sydney NSW 2010, Australia

² Lord Howe Museum, Middle Beach Road, Lord Howe Island, NSW, Australia

³ Lord Howe Island Board, Middle Beach Road, Lord Howe Island, NSW, Australia

ABSTRACT. A survey of large beetles, 1 cm or more in length, on Lord Howe Island was conducted by the Australian Museum in August 2019, with the help of citizen scientist volunteers. Twelve areas were sampled and the results are discussed. The survey was in late winter, a generally poor time for beetle activity, but 23 large species were found. The large beetle fauna of Blackburn Island is reviewed.

Introduction

Lord Howe and its offshore islands are listed as a World Heritage Site (Anonymous, 2018), and have a highly diverse and endemic flora and fauna. This fauna includes at least 535 species of Coleoptera, most of which are endemic to the archipelago (Cassis *et al.*, 2003; Reid, pers. obs.). The vast majority of these beetle species are small, less than 6 mm. in length, and have therefore been poorly sampled and poorly treated taxonomically in historical surveys of the beetle fauna, as reported by Olliff (1889) and later authors. On the other hand, beetles 1 cm. or more in length are generally well-collected and well understood taxonomically. From a biodiversity monitoring perspective, this group of beetles is the best for sampling as it has the best historical record. There are approximately 75 species of Coleoptera on Lord Howe with body length at least 1 cm.

A survey of these large beetles was made by a team including citizen scientists in 2018, with interesting and useful results (Reid & Hutton, 2019). This review reports the results of a second similar survey, conducted in 2019 to obtain further baseline data on the distribution of large beetles immediately prior to the eradication of rodents, in late 2019 (Anonymous, 2020). The justification and methodology have been described in our account of the 2018 event (Reid &

Hutton, 2019). In brief, the highly diverse and endemic flora and fauna, is threatened by introduced rodents, particularly black rats (Hutton *et al.*, 2007). The rats have eliminated or severely reduced populations of several large insects from the main island including many beetles (Reid *et al.*, 2018a; Reid & Hutton, 2019) but have failed to invade the small offshore islets. In 2019 an intensive rodent baiting programme was undertaken, from April to October, covering the entire island (Anonymous, 2020).

As in 2018, interested members of the public were recruited for the beetle survey, with our guidance, to provide extra eyes and hands. They were provided with some training in search techniques and some information on identification of some of the commoner species. These surveys of large beetles will provide a baseline for determining the effects of rodent eradication on this large group of organisms, most of which are endemic to Lord Howe.

The 2019 event was similar to that of 2018 in concept and practice, but differed in that it was advertised two months in advance, it took place a month later in mid August, and the second author was largely unable to participate due to illness. Instead, the third author, local islander and keen entomologist Saxxon Thompson, was recruited as a guide, when he was not engaged in rodent baiting. In addition, Ewan Reid provided support for the first author.

Keywords: Lord Howe Island; Blackburn Island; Coleoptera; conservation; citizen science

Corresponding author: Chris A. M. Reid Chris.Reid@Australian.Museum

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Methods

The concepts of the survey were presented through an introductory talk, with demonstration of collecting methods and distribution of laminated handouts illustrating some of the target taxa, as per the 2018 survey (Reid & Hutton, 2019). The collecting events undertaken with the citizen scientists included some of the sites surveyed in 2018 and some new sites.

The following sites or areas were investigated by citizen scientists on Lord Howe in 2019: Blinky Beach (dunes and forest), Boat Harbour (littoral vegetation and forest), Mutton Bird Point (forest), Stevens Reserve (forest) and Valley of Shadows and nearby coast (littoral vegetation and forest). The first author also collected at Blackburn Island (littoral vegetation), Catalina track and Arijilla Resort area (forest), Goat House (forest), Malabar Ridge (stunted forest), Middle Beach (littoral vegetation), North Beach (littoral vegetation and forest) and Old Settlement Beach (littoral vegetation and grassland). Collecting effort with the volunteers at each site varied from 30 minutes to one hour. The survey of Blackburn Island by the first author took about 3 hours. Two night walks, in Stevens Reserve and Valley of Shadows, were included so that volunteers could be shown nocturnal beetle activity.

An identifiable fragment of a dead specimen is just as good as a live specimen for recording the presence of species, especially in a fauna of limited diversity such as on Lord Howe. Participants were therefore encouraged to include fragments in their searching. Large larvae were also identified in situ where possible (larvae of Lucanidae and large Cerambycidae).

Collecting methods included hand-searching, sweep-netting, beating and litter sieving. Everyone took part in examining the sieved forest leaf-litter. All volunteers were given one or more large dry vials and encouraged to present finds as soon as they had captured something, so that they could be briefed on the significance of their specimen.

The weather was initially windy with occasional showers but improved to be fine and sunny during the organized collections with the volunteers. Maximum diurnal temperature ranged from 18 to 22°C.

Results

Approximately 500 specimens of Coleoptera were collected by the authors and the citizen scientists, including at least 120 species. All collected specimens are preserved in the Australian Museum collection. The 23 large species collected or observed, length ≥ 1 cm, are listed below (Table 1). Larvae of some large species are easily identifiable so these observations are also included. No new large species were recorded for Lord Howe.

Family Anthribidae

The Anthribidae or fungus weevils are mostly associated with rotting wood. The fauna of Lord Howe is relatively rich and diverse and mostly undescribed, with at least 15 species (Zimmerman, 1994; pers. obs. CAMR) but most of these are inconspicuous. The species included here is a remarkable exception.

Mecocerinopsis balli (Olliff, 1889)

Fig. 1

Material examined. 1♂ / Clear Place track, 200–300 m from rd, at night [on tree trunk] 31°31.69'S 159°04.62'E, 42 m 15.viii.2019 C. Reid, S. Thompson & volunteers.

Mecocerinopsis balli is a large and spectacular fungus weevil which is endemic to Lord Howe (Olliff, 1889; Zimmerman, 1994; Pullen *et al.*, 2014). Fungus weevil larvae are generally associated with fungoid wood, often

Table 1. Diversity of large beetle species plotted against sites on Lord Howe Island, 2019.

	<i>Agrianome spinicollis</i>	<i>Ceresium flavipes</i>	<i>Porithodes triangulifera</i>	<i>Rhytiphora</i> sp2	<i>Stellenopsis</i> sp	<i>Xyloteles segrex</i>	<i>Notagonum marginellum</i>	<i>Prosopogmus suspectus</i>	<i>Mecocerinopsis balli</i>	<i>Dematochroma picea</i>	<i>Talaya brevipilis</i>	<i>Orthorhinus cylindrirostris</i>	<i>Euryrhinus mediatubundus</i>	<i>Celibe exulans</i>	<i>Hydissus vulgaris</i>	<i>Metisopus curtulus</i>	<i>Prionesthis sterrha</i>	<i>Heteronychus arator</i>	<i>Cryptodus tasmanianus</i>	<i>Pimelopus noctis</i>	<i>Pimelopus fischeri</i>	<i>Lamprima insularis</i>	<i>Figulus nitens</i>	total species per site	
Blinky Beach Dunes	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	■	—	—	—	1	
Blinky Beach Forest	■	—	—	—	—	—	—	—	—	—	—	—	—	■	—	—	—	—	—	—	—	■	■	4	
Boat Harbour	—	—	—	—	—	—	—	—	—	■	—	—	—	—	■	■	—	—	—	—	—	■	■	5	
Blackburn Island	■	■	—	■	—	—	—	■	—	—	—	■	—	■	■	■	■	—	■	—	—	■	—	—	11
Catalina walk ... ^a	■	—	■	—	—	—	—	■	—	■	—	—	—	—	—	■	—	—	—	—	—	■	■	7	
Clear Place track	■	—	—	—	■	■	—	■	■	■	—	—	—	■	■	—	—	—	—	—	—	■	■	10	
Intermediate Hill ... ^b	■	—	—	—	—	—	—	—	—	—	—	—	■	■	■	■	—	—	—	—	—	■	—	—	6
North Beach	—	—	—	—	—	—	—	—	—	—	—	■	—	—	—	—	—	—	—	■	—	—	—	—	2
North Beach Forest	■	—	—	—	—	—	—	—	—	—	—	—	—	■	■	■	—	—	—	—	—	■	■	—	6
Old Settlement Beach	—	—	—	—	—	—	■	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Stevens Reserve	■	—	■	—	—	—	—	—	—	—	—	—	—	■	■	■	—	■	—	—	—	■	—	—	7
Smoking Tree Ridge	—	—	—	—	—	—	—	—	—	—	—	■	—	—	—	—	—	—	—	—	—	—	—	—	1

^a Catalina walk to Somerset Apartments area

^b Intermediate Hill, north and east slopes

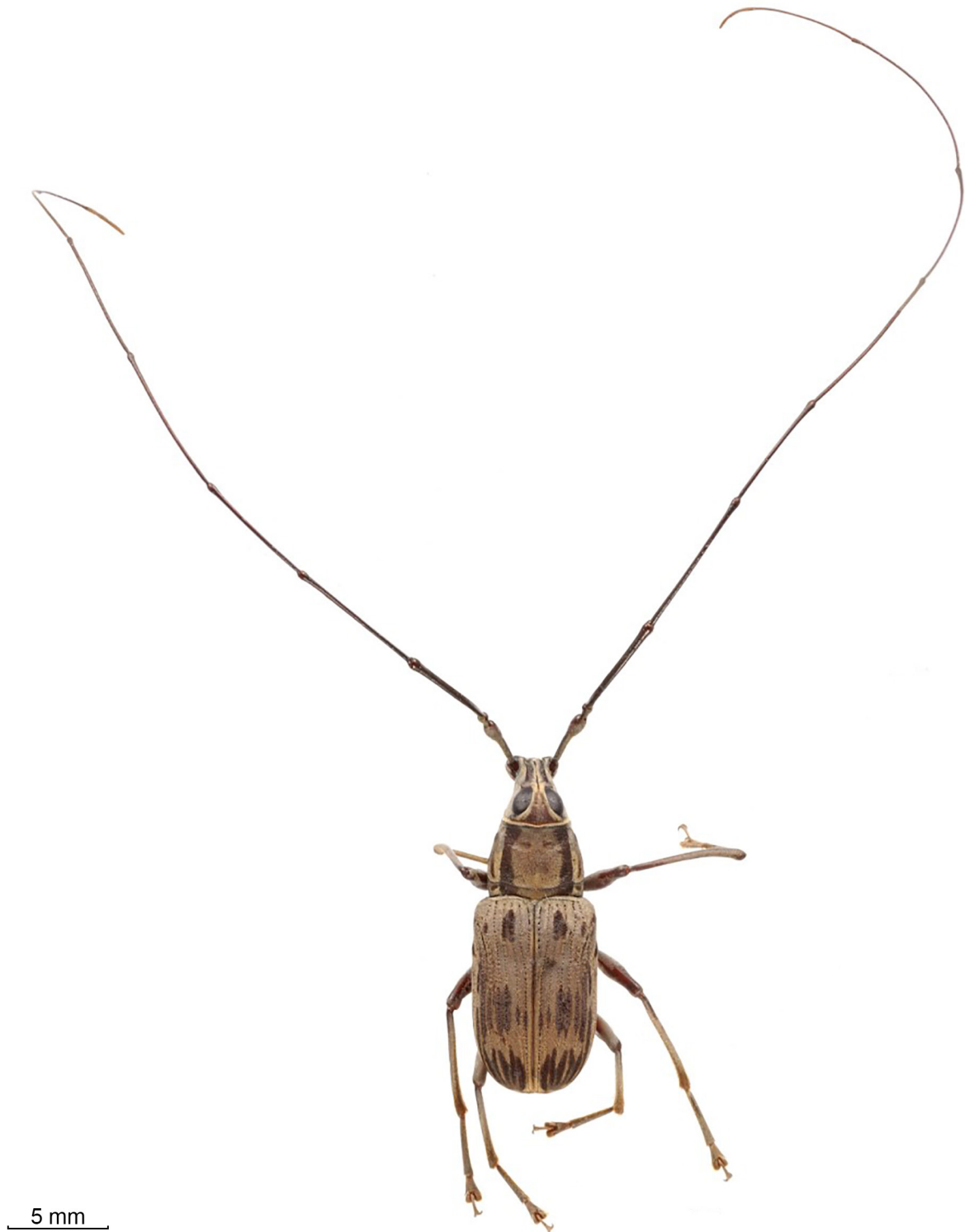


Figure 1. *Mecocerinopsis balli* (Olliff, 1889), male.

with a narrow host range (Holloway, 1982). This species appears to be confined to lowland forest and is rarely seen. Specimens in the Australian Museum are only from the Stevens Reserve area and Soldiers Creek, but *M. balli* is probably under-recorded because it is nocturnal. Label data

indicate it is collected sweeping at night or at lights and this particular specimen was spotted walking on a tree trunk at night. Males may be commoner or more active than females (there are 7 males to 2 females in the Australian Museum). Length 13–20 mm.

***Prosopogmus suspectus* Chaudoir, 1878**

Fig. 2

Figure 2. *Prosopogmus suspectus* Chaudoir, 1878.**Family Carabidae**

This family is generally known as the ground beetles and almost all the species known from Lord Howe are terrestrial predators, as adults and larvae. At least 32 species have been collected on Lord Howe (Moore, 1992; pers. obs. CAMR).

***Notagonum marginellum* (Erichson, 1842)**

Material examined. 5 / Old Settlement Beach, 31°31.154'S 159°03.460'E, 3 m, under grass at edge of creek, 16.viii.2019, C. Reid.

Notagonum marginellum is a widespread riparian species in southeast Australia, from southern Queensland to Tasmania. It was first collected on Lord Howe in 1966 (Moore, 1992) and is also known from Norfolk Island. There is an old New Zealand record from the 1860s but it is not established there (Larochelle & Larivière, 2001). The relatively late first collection date for Lord Howe suggests that it is adventive on Lord Howe as well as New Zealand. Moore recorded *N. marginellum* from the Erskine Valley and “Old Settlement area” and we can confirm that it remains common on the banks of the Old Settlement Creek. Length 9.5–10.5 mm.

Material examined. 1 / forest E Arajilla Resort, vic. 31.5201°S 159.0595°E, 20 m, on and under logs at night, 13.viii.2019, C. Reid; 1[elytron] / Blackburn Id, S side 31°32.092'S 159°03.510'E, 16 m, soil / debris under *Melaleuca* bushes above cliff, 15.viii.2019 C. Reid; 5 / Clear Place track, 1st 100 m from rd, at night [on track] 31°31.66'S 159°04.50'E, 42 m 15.viii.2019 C. Reid, S. Thompson & volunteers.

Prosopogmus suspectus is flightless and endemic to Lord Howe where it is fairly common. Moore (1992) recorded it from Roach Island and Lorhiti Lodge (south of Neds Beach). The Australian Museum collection includes specimens from Stevens Reserve, Valley of Shadows and the summit of Mount Gower on the main island, and also the offshore islands of Balls Pyramid, Blackburn Island and Roach Island. Our records confirm its presence on both the main island and Blackburn Island. Length 8–10 mm.

Family Cerambycidae

The longhorn beetle family Cerambycidae includes many large and conspicuous species but adults are usually only active at night. The larvae feed in plant stems, usually in hard woody tissue. The cerambycid fauna of Lord Howe is diverse, with at least 22 species (Ślipiński & Escalona, 2013, 2016; Reid *et al.*, 2018a).

***Agrianome spinicollis* (Macleay, 1826)**

Material examined. Large larvae seen, not collected: lower slope North Beach, 31.5191°S 159.0418°E, 5 m, 13.viii.2019, C. Reid; mid slope North Beach, 31.5200°S 159.0406°E, 50 m, 13.viii.2019, C. Reid; north slope Intermediate Hill, 31.5434°S 159.0808°E, 52 m, 14.viii.2019, C. Reid & volunteers; Mutton Bird Point t'off, 31.5470°S 159.0906°E, 91 m, 14.viii.2019, C. Reid & volunteers; Mutton Bird Point to Rocky Road path, 31.5528°S 159.0933°E, 67 m, 14.viii.2019, C. Reid & volunteers; Boat Harbour, vic. 31.5596°S 159.0982°E, 5–20 m, 14.viii.2018, C. Reid & volunteers; lower Valley of Shadows, 31.5270°S 159.0793°E, 21 m, 15.viii.2019, C. Reid & volunteers; upper Valley of Shadows, 31.5279°S 159.0779°E, 40 m, 15.viii.2019, C. Reid & volunteers; first 100 m of Clear Place track, 31.5277°S 159.0748°E, 28 m, 15.viii.2019, C. Reid & volunteers.

These records confirm the abundance and wide lowland distribution of this large beetle species, at least in larval form (Reid *et al.*, 2018a; Reid & Hutton, 2019). The adults are most often encountered flying to light in summer. Length (of adult): 35–50 mm.

***Ceresium flavipes* (Fabricius, 1792)**

Material examined. 1 / Blackburn Id, S side 31.5350°S 159.0594°E, 32 m, beating *Lagunaria* foliage, low bush, 15.viii.2019, C. Reid.

Ceresium flavipes is a widespread exotic species in Australia, originally from southern Africa (Ślipiński & Escalona, 2016) and first recorded from Lord Howe by Olliff (1889, as “*Ceresium* species”). The species is also known from Norfolk Island and New Zealand (McKeown, 1947). Although well established on Lord Howe it is rarely collected and there are only 4 other specimens in the AM collection, from forest at the north and south ends of Settlement Beach and from Stevens Reserve. This is the first record for Blackburn Island. Length: 12–19 mm.

***Porithodes parenthetica* (Lea, 1929)**

Material examined. 1 [leg] / forest E [of] Arajilla Resort, vic. 31.5201°S 159.0595°E, 20 m, on and under logs at night, 13.viii.2019, C. Reid; 3 / Stevens Res. 31.5241°S 159.0655°E, 15 m, vic. fallen tree, night searching, 13.viii.2019, C. Reid, S. Thompson & volunteers.

This distinctively marked graceful cerambycine is endemic to Lord Howe and was first described from material collected in 1916 (Lea, 1929). It is widespread in the lowland forests of the centre of the island. On the mainland of Australia, a different species of *Porithodes* has been reared from *Cryptocarya* (Ślipiński & Escalona, 2016), a tree genus which is widespread on the island. Length 10–18 mm.

***Rhytiphora* species**

Material examined. 1 [partly eclosed adult, found dead] / Blackburn Id, S side 31.5350°S 159.0594°E, 32 m, soil / debris under *Lagunaria*, low bush, 15.viii.2019, C. Reid.

This shrivelled specimen seems to have died before fully eclosing, so that the appendages are poorly developed, particularly the elytra, and surface sculpture may not be in its final state. It is therefore difficult to identify. The head, pronotum and antennae are of similar size and sculpture to a species identified as *Rhytiphora* “species 1” which was noted from Balls Pyramid (Reid *et al.*, 2018a). There is one other specimen of what is probably this species in the Australian Museum collection, from Transit Hill, collected in 2001. Whether it is endemic to Lord Howe or an introduced species is impossible to determine at present as the genus has hundreds of named species without a diagnostic key (Ślipiński & Escalona, 2013). Length 12–15 mm.

***Stenellipsis* sp 1**

Material examined. 3 / Clear Place track, 200–300 m from rd, at night 31.5281°S 159.0770°E, 42 m 15.viii.2019 C. Reid, S. Thompson & volunteers.

This possibly endemic species of *Stenellipsis* was first noted from Lord Howe in 2018 (Reid *et al.*, 2018a). It is a frequently collected species on the island and is widespread in the lowland forests. Length 7–12 mm.

***Xylotoles segrex* Olliff, 1889**

Material examined. 1 / Clear Place track, 1st 100 m from rd, at night 31°31.66'S 159°04.50'E, 42 m 15.viii.2019 C. Reid, S. Thompson & volunteers.

Xylotoles segrex is one of several flightless species of *Xylotoles* on Lord Howe, all of which are endemic. This is the most frequently collected species of the genus, from Erskine Valley north to Stevens Reserve (Australian Museum specimens). The genus is diverse in New Zealand, but there are also two species on Norfolk Island and a single species in northern Queensland. Length 7–11 mm.

Family Chrysomelidae

Leaf beetles primarily feed on leaves as adults, although the larvae are often stem or root feeding (Reid, 2017). There are at least 28 species on the island, including a few synanthropic species.

***Dematochroma picea* (Baly, 1864)**

Material examined. 1[elytron] / Boat Harbour, vic. 31.5596°S 159.0982°E, 5–20 m, sieved litter, 14.viii.2019,

C. Reid & volunteers; 1 / Clear Place track, 1st 100 m from rd, at night 31.5277°S 159.0748°E, 28 m 15.viii.2019 C. Reid, S. Thompson & volunteers; 1[elytron] / Clear Place track, 200–300 m from rd, at night 31.5281°S 159.0770°E, 42 m 15.viii.2019 C. Reid, S. Thompson & volunteers; 1[photograph of adult] / Somerset Apartments 31.5213°S 159.0639°E, 15 m, in room, 15.viii.2019, C. E. Foelz.

In our previous report (Reid & Hutton, 2019) we noted the absence of live adults of this endemic species in July and its relative abundance in summer. Our survey in 2019 showed that a few newly emerged adults are active by mid August. The larvae are likely to inhabit soil, feeding on tree roots. Length 8–12 mm.

Family Curculionidae

The true weevils are the most diverse group of beetles on Lord Howe, with more than 100 species. All are plant feeding as adults and larvae, but the larvae of all Lord Howe species are cryptic, feeding inside plant tissue or in soil. Most species are very small.

***Eutyrrhinus meditabundus* (Fabricius, 1775)**

Material examined. 2[fragments] / path to Muttonbird Pt from airfield at 31°32.604'S 159°04.850'E, 52 m dead wood / leaf litter dry forest 14.viii.2019 C. Reid & volunteers.

This widespread weevil species is well-established on the island, where it is restricted to lowland forest (Olliff, 1889; Reid & Hutton, 2019). Length 8–12 mm.

***Orthorhinus cylindrirostris* (Fabricius, 1775)**

Material examined. 1 / Smoking Tree Ridge, 200–300 m from x-rds, 31°33.36'S 159°05.18'E, 135 m beating bushes & vines 16.viii.2019 C. Reid.

Orthorhinus vagus was described from Lord Howe and was erroneously considered endemic to that island in our previous report (Olliff, 1889; Reid & Hutton, 2019). However we overlooked its synonymy with the widespread mainland Australian species *O. cylindrirostris* (Fabricius, 1775) (Pullen *et al.*, 2014), although these authors acknowledged that *O. cylindrirostris* “may be a complex of closely similar species” (loc. cit. p. 469). This 2019 record extends the known distribution on Lord Howe to the southern foothills. There may be two other species of *Orthorhinus* on Lord Howe, differing mainly by pattern and elevation of scales on the elytra (material in Australian Museum). Length 7–12 mm (on Lord Howe).

Family Lucanidae

Lucanidae are known as stag beetles, because some species have males with elaborately enlarged mandibles. The larvae are generally found in rotting wood and the adults drink sap or nectar. Lord Howe has three species, all with only modestly sized mandibles. One species is endemic and one has only recently arrived and may not be established (Reid *et al.*, 2018a).

***Figulus nitens* Waterhouse, 1874.**

Material examined. 1 adult / Blinky Beach, 31.5378°S 159.0806°E, 4–6 m, dead wood etc under stunted forest on dunes, 12.viii.2019, C. Reid & volunteers; 1 adult [fragment] / Boat Harbour, vic. 31.5596°S 159.0982°E, 5–20 m, swept / rotten wood, 14.viii.2019, C. Reid & volunteers; 2 adults /

S end North Beach, 31.5191°S 159.0418°E, 5 m, under / in *Araucaria* / palm, 13.viii.2019, C. Reid; 1 adult / North End ridge above S end North Beach, 31.5203°S 159.0396°E, 95 m, in scalybark log, 13.viii.2019, C. Reid; larval or adult records (seen, not collected): Clear Place track, 100–200 m from rd, 31.5291°S 159.0764°E, 62 m 15.viii.2019 C. Reid, S. Thompson & volunteers; mid slope North Beach, 31.5200°S 159.0406°E, 50 m, 13.viii.2019, C. Reid.

These records confirm the widespread distribution of *Figulus nitens* in the lowlands of the island. The larva is easily distinguished from that of *L. insularis* by the presence of distinct claws at the apices of the legs. Length of adult 10–13 mm.

Lamprima insularis Macleay, 1885

Material examined. 1 [elytron] / Clear Place track, 200–300 m from rd at night 31.5281°S 159.0770°E, 42 m 15.viii.2019 C. Reid, S. Thompson & volunteers; larval or adult records (seen, not collected): Clear Place track, 100–200 m from rd, 31.5291°S 159.0764°E, 62 m 15.viii.2019 C. Reid, S. Thompson & volunteers; north slope Intermediate Hill, 31.5434°S 159.0808°E, 52 m, 14.viii.2019, C. Reid & volunteers; Mutton Bird Point t'off, 31.5470°S 159.0906°E, 91 m, 14.viii.2019, C. Reid & volunteers; Mutton Bird Point to Rocky Road path, 31.5528°S 159.0933°E, 67 m, 14.viii.2019, C. Reid & volunteers; lower slope North Beach, 31.5191°S 159.0418°E, 5 m, 13.viii.2019, C. Reid; mid slope North Beach, 31.5200°S 159.0406°E, 50 m, 13.viii.2019, C. Reid; North End ridge above S end North Beach, 31.5203°S 159.0396°E, 95 m, 13.viii.2019, C. Reid; Stevens Res, 31.5241°S 159.0655°E, 15 m, vic. fallen tree, night searching, 13.viii.2019, Reid, Thompson & volunteers.

Lamprima insularis is endemic to the main island of Lord Howe. Its status, biology and distribution within the island were recently reviewed (Reid *et al.*, 2018b). The larva is easily distinguished from that of *F. nitens* by the absence of distinct claws at the apices of the legs. Here we confirm that the species is widespread in the lowlands, occurring up to the northern edge of the island at 95 m elevation. Length of adult 16–33 mm.

Family Melandryidae

Melandryids are mostly small brown beetles with short lived adults and larvae that bore into hardwoods. There are two species on Lord Howe (Lea, 1929).

Talayra brevipilis Lea, 1929

Material examined. 1 fragment [elytron] / S end North Beach, 31.5191°S 159.0418°E, 5 m, under / in *Araucaria* / palm, 13.viii.2019, C. Reid.

This large melandryid is endemic to Lord Howe and was first described from specimens collected in 1916 (Lea, 1929). The elytron noted here is the first record of the species from the northern end of the island. Length 11–14 mm.

Family Scarabaeidae

The family Scarabaeidae includes the familiar lawn scarabs, dung beetles and chafers. All have C-shaped “curl grubs” with well-developed legs and head capsule, feeding on rotting vegetation (including herbivore dung) or plant roots. Lord Howe has at least 14 species, but that includes several from the mainland that have been accidentally introduced in garden material, or deliberately introduced for cow dung burial.

Cryptodus tasmanianus Westwood, 1841

Material examined. 2[fragments] / Blackburn Id, S side 31.5350°S 159.0594°E, 32 m, soil / debris under *Lagunaria*, low bush, 15.viii.2019, C. Reid.

This widespread species in southeast Australia was recently recorded from Blackburn Island (Reid & Hutton, 2019) where it may have been overlooked through lack of intensive collecting. Length 17–22 mm.

Heteronychus arator (Fabricius, 1775)

Material examined. 1 / Stevens Reserve 31.5241°S 159.0655°E, 15 m, vic. fallen tree, night searching 13.viii.2019 C. Reid, S. Thompson & volunteers.

Although only recently first recorded for Lord Howe (Reid *et al.*, 2018a), this exotic pasture and lawn pest is evidently well-established in the cultivated parts of the island. Length 10–12 mm.

Pimelopus fischeri (Montrouzier, 1860)

Material examined. 1[fragments] / Blackburn Id, S side 31.5348°S 159.0585°E, 16 m, soil / debris under *Melaleuca* bushes above cliff, 15.viii.2019 C. Reid; 1[fragments] / Blackburn Id, S side 31.5351°S 159.0592°E, 26 m, soil / debris under old *Melaleuca* bushes above cliff, 15.viii.2019, C. Reid; 1[elytron] / Blackburn Id, S side 31.5351°S 159.0598°E, 20 m, soil / debris under *Melaleuca* bushes above cliff, 15.viii.2019, C. Reid; 1 [fragments] / Boat Harbour, vic. 31.5596°S 159.0982°E, 5–20 m, sieved litter, 14.viii.2019, C. Reid & volunteers.

Pimelopus fischeri is widespread in lowland forest on Lord Howe (Reid & Hutton, 2019). This is the first record of this species on Blackburn Island, but there are specimens from there in the Australian Museum collected in 1979. Length 16–20 mm.

Pimelopus noctis (Olliff, 1889)

Material examined. 1[elytron] / Blinky Beach, 31.5384°S 159.0769°E, 3 m, under spinifex / *Cakile* / herbs vn dunes, 12.viii.2019, C. Reid & volunteers; 1[dead] / S end North Beach 31.5191°S 159.0418°E, 5 m under / in *Araucaria* / palm logs 13.viii.2019 C. Reid.

Pimelopus noctis is endemic to Lord Howe where hitherto it has been recorded from the sand dunes of Blinky Beach, Neds Beach and the south end of Lagoon Beach (Reid *et al.*, 2018a; Reid & Hutton, 2019). There are also specimens in the Australian Museum collected at light from Middle Beach, the Public Jetty and the Research Station, by Tim Kingston in 1979. On this 2019 trip, *Pimelopus noctis* was searched for, but not found, at Middle Beach and Old Settlement Beach. Our new records extend its distribution to include North Beach. Length 15–20 mm.

Family Tenebrionidae

The family Tenebrionidae (darkling beetles) mainly consists of rather dull black or brown crepuscular species, 12 of which have been collected on Lord Howe. Many of these species are flightless and endemic. Tenebrionids are generally associated with rotting vegetation, plant roots and fungi. Most species emit an offensively smelly chemical when handled, which may protect them from predators such as rats.

Celibe exulans (Pascoe, 1866)

Fig. 3

Material examined. 1[elytron] / Blackburn Id, S side 31.5348°S 159.0585°E, 16 m, soil / debris under *Melaleuca* bushes above cliff, 15.viii.2019 C. Reid; 1[fragment] / Blackburn Id, S side 31.5351°S 159.0592°E, 26 m, soil / debris under old *Melaleuca* bushes above cliff, 15.viii.2019, C. Reid; 1[fragment] / Blackburn Id, S side 31.5350°S 159.0594°E, 32 m, soil / debris under *Lagunaria*, low bush, 15.viii.2019, C. Reid; 1[fragment] / Blackburn Id, S side 31.5351°S 159.0598°E, 20 m, soil / debris under *Melaleuca* bushes above cliff, 15.viii.2019, C. Reid; 1 / Blinky Beach, 31.5378°S 159.0806°E, 4–6 m, dead wood etc under stunted forest on dunes, 12.viii.2019, C. Reid & volunteers; 1[fragment] / Boat Harbour, vic. 31.5596°S 159.0982°E, 5–20 m, swept / rotten wood, 14.viii.2019, C. Reid & volunteers; 2 / Clear Place track, 1st 100 m from rd, 31.5276°S 159.0750°E, 42 m at night, 15.viii.2019, C. Reid, S. Thompson & volunteers; 1 / Mutton Bird Pt t'off, 31.5470°S 159.0906°E, 91 m, 14.viii.2019, C. Reid



Figure 3. *Celibe exulans* (Pascoe, 1866).

& volunteers; 1[fragment] / Valley of Shadows, 31.5276°S 159.0785°E, 30 m, leaf litter / logs, 15.viii.2019, C. Reid & volunteers; 2 / West [sic] Gulch, from North Beach 31.5163°S 159.0407°E, 20 m dead wood / beating 13.viii.2019 C. Reid; other material (adults observed, not collected): Clear Place track 200–300 m from rd at night 31°31.69'S 159°04.62'E, 42 m 15.viii.2019 C. Reid, S. Thompson & volunteers; S end North Beach 31.5191°S 159.0418°E, 5 m under / in *Araucaria* / palm logs 13.viii.2019 C. Reid; Stevens Reserve 31.5241°S 159.0655°E, 15 m, vic. fallen tree, night searching 13.viii.2019 C. Reid, S. Thompson & volunteers; Valley of Shadows, 31.5279°S 159.0779°E, 40 m, rotting wood, 15.viii.2019, C. Reid & volunteers.

Celibe exulans is an abundant flightless species, endemic to Lord Howe, found throughout the lowlands and also on Balls Pyramid and Blackburn Island (Reid *et al.*, 2018a; Reid & Hutton, 2019). The larvae of this heleine tenebrionid genus may inhabit soil (Matthews & Bouchard, 2008). Length 7–17 mm.

Hydissus vulgaris (Olliff, 1889)

Fig. 4

Material examined. 1 / Blackburn Id, S side 31.5351°S 159.0592°E, 26 m, soil / debris under old *Melaleuca* bushes above cliff, 15.viii.2019, C. Reid; 1 / north slope Intermediate Hill, 31.5434°S 159.0808°E, 52 m, dead wood / leaf litter,



Figure 4. *Hydissus vulgaris* (Olliff, 1889).

dry forest, 14.viii.2019, C. Reid & volunteers; 1 / Mutton Bird Point to Rocky Road [sic] path, 31.5528°S 159.0933°E, 65 m, steep slope, 14.viii.2019, C. Reid & volunteers; 1 / S end North Beach 31.5191°S 159.0418°E, 5 m under / in *Araucaria* / palm logs 13.viii.2019 C. Reid; 1 / Stevens Reserve 31.5241°S 159.0655°E, 15 m, vic. fallen tree, night searching 13.viii.2019 C. Reid, S. Thompson & volunteers; 1 / Valley of Shadows, 31.5268°S 159.0793°E, 15 m, dead wood, forest margin, 15.viii.2019, C. Reid & volunteers; other material (adults seen, not collected): Boat Harbour, vic. 31.5596°S 159.0982°E, 5–20 m, swept / rotten wood, 14.viii.2019, C. Reid & volunteers.

Hydissus vulgaris is a flightless species, endemic to Lord Howe and common in the forested lowlands, but also occurring on Balls Pyramid and Blackburn Island (Reid *et al.*, 2018a; Reid & Hutton, 2019). Larvae develop in rotting wood (Matthews & Bouchard, 2008). Length 8–13 mm.

Metisopus curtulus (Olliff, 1889)

Fig. 5

Material examined. 2 / Blackburn Id, S side 31.5351°S 159.0592°E, 26 m, soil / debris under old *Melaleuca* bushes above cliff, 15.viii.2019, C. Reid; 1 / Blackburn Id, S side 31.5350°S 159.0594°E, 32 m, soil / debris under *Lagunaria*, low bush, 15.viii.2019, C. Reid; 1[fragment] / Blackburn Id, S side 31.5351°S 159.0598°E, 20 m, soil / debris under



Figure 5. *Metisopus curtulus* (Olliff, 1889).

Melaleuca bushes above cliff, 15.viii.2019, C. Reid; 1 / Boat Harbour, vic. 31.5596°S 159.0982°E, 5–20 m, swept / rotten wood, 14.viii.2019, C. Reid & volunteers; 1 / north slope Intermediate Hill, 31.5434°S 159.0808°E, 52 m, dead wood / leaf litter, dry forest, 14.viii.2019, C. Reid & volunteers; 1[elytron] / S end North Beach 31.5191°S 159.0418°E, 5 m under / in *Araucaria* / palm logs 13.viii.2019 C. Reid; other material (adults seen, not collected): forest E [of] Arajilla Resort, vic. 31.5201°S 159.0595°E, 20 m, on and under logs at night, 13.viii.2019, C. Reid; Stevens Reserve 31.5241°S 159.0655°E, 15 m, vic. fallen tree, night searching 13.viii.2019 C. Reid, S. Thompson & volunteers.

Metisopus curtulus is flightless and endemic to Lord Howe, where it is widespread in the forested lowlands, but also occurs on Balls Pyramid and Blackburn Island (Reid *et al.*, 2018a; Reid & Hutton, 2019). Larvae develop in rotting wood (Bouchard & Yeates, 2001; Bouchard & Steiner, 2004). Length 7–11 mm.

Promethis sterrha (Olliff, 1889)

Material examined. 2[fragments] / Blackburn Id, S side 31.5351°S 159.0592°E, 26 m, soil / debris under old *Melaleuca* bushes above cliff, 15.viii.2019, C. Reid; other material (observed, not collected): 1[fragments]: Blackburn Id, S side 31.5350°S 159.0594°E, 32 m, soil / debris under *Lagunaria*, low bush, 15.viii.2019, C. Reid.

Promethis sterrha is flightless and endemic to Lord Howe but since the introduction of rats in 1918 it has only been collected on Blackburn Island (Reid *et al.*, 2018a; Reid & Hutton, 2019). Larvae develop in rotting wood (Bouchard & Steiner, 2004). Length 20–25 mm.

Discussion

Citizen science activities

The 12 citizen scientists who participated were enthusiastic volunteers. Every site provided something of interest to the volunteers, including specimens displayed to the group, or discussed with individuals, or retained for research. Volunteers were generally adept at developing a search image for both live and fragmentary large beetles. The presence of *Pimelopus noctis*, a large endemic scarab associated with grassed dunes, was quickly confirmed at Blinky Beach by the search activities of the volunteers, as occurred in our previous survey (Reid & Hutton, 2019). In 2019 two night walks were undertaken, with smaller groups of participants than in 2019, which allowed greater input from the authors. As in 2019, there was considerable nocturnal activity by large invertebrates, including beetles, so there was plenty for people to see.

Feedback was positive. Most participants took part in the introductory talk and in both day and night searches. There was much discussion about insects and conservation during these sessions. A well-attended talk was provided at the end of the week summarizing the results, so that the participants had a sense of the significance of their activities.

Significance of the beetle records

There is now a relatively clear picture of the distribution and habitat of the common larger beetles in the lowlands of Lord Howe Island (Reid *et al.*, 2018a; Reid & Hutton, 2019; this work). Despite the presence of rats, three flightless tenebrionids, *C. exulans*, *H. vulgaris* and *M. curtulus* (Figs 3–5) are widespread and numerous throughout the lowland



Figure 6. Blackburn Island photographed December 2019 during drought. The island is orientated West-East. Note the fringe of small *Melaleuca* bushes above the exposed cliffs on the south side and the stunted *Lagunaria* at top of the slope above the middle gully. Previously surveyed areas include the central clump of *Araucaria* trees and the large sprawling *Ficus* at the eastern end. Photo: Ian Hutton.

westerlies. These trees, about 12 individuals altogether, include a large *Ficus macrophylla* ssp. *columnaris*, *Howea forsteriana* sheltered by the *Ficus*, several *Lagunaria patersonia* and three exotic *Araucaria heterophylla* (Fig. 6). Blackburn Island has been formally surveyed for vertebrates (Carlile & Priddell, 2013) and the endemic cockroach *Panesthia lata* (Carlile *et al.*, 2018), but these authors made no mention of any other significant invertebrate species. As far as we are aware, the first entomological survey of Blackburn Island was by Tim Kingston in 1979 and 1980 (unpublished, material in Australian Museum), and the island was also sampled as part of an extensive study of different habitats on Lord Howe by the Australian Museum in 2000–2001 (Cassis *et al.*, 2003). Recently the beetles of Blackburn Island have been surveyed annually (Reid *et al.*, 2018a; Reid & Hutton, 2019; this report) (Table 2). Blackburn Island has at least three large beetles no longer found on the main island of Lord Howe, *Cormodes darwini*, *Cryptodus tasmanianus* and *Promethis sterrha* (Reid & Hutton, 2019) (Table 3).

Based on all of these collections there are or have been at least 13 large (1 cm or more) species of beetle on Blackburn Island (Table 2): **Carabidae:** *Notoplatynus hilaris*, *Prosopogmus suspectus*; **Cerambycidae:** *Agrianome spinicollis*, *Ceresium flavipes*, *Rhytiphora* sp 1; **Cleridae:** *Cormodes darwini*; **Curculionidae:** *Orthorhinus cylindrirostris*; **Scarabaeidae:** *Cryptodus tasmanianus*, *Pimelopus fischeri*; **Tenebrionidae:** *Celibe exulans*,

Hydissus vulgaris, *Metisopus curtulus*, *Prionesthis sterrha*.

Two of these species, *C. darwini* and *P. sterrha*, are Lord Howe endemics which have not been collected on the main island since 1916, before black rats arrived (Table 3). In 2003 the two species were assessed under IUCN criteria as “presumably extinct” (*C. darwini*) or “threatened vulnerable” (*P. sterrha*) (Cassis *et al.*, 2003). These species have not been collected on the other offshore islands that have been surveyed by the Australian Museum (Balls Pyramid and Roach Island; Cassis *et al.*, 2003, Reid *et al.*, 2018a), and are not likely to be, as they are dependent on the presence of rotting wood. These other islands lack trees. Before the 2019 survey, the two beetle species had only been collected from the debris under the trees on the northeastern slope of Blackburn Island (Reid & Hutton, 2019). Therefore, in 2019 four sites on the steep and rocky southern edge of Blackburn Island were surveyed to see if either species was in the dead wood debris produced by a stunted *Lagunaria patersonia* and about 45 *Melaleuca howeana* bushes present there (Figs 6–9). *Prionesthis sterrha* was found at two such localities (only about 40 m apart) and is possibly present wherever there is dead wood on Blackburn Island (total population area < 1 ha). *Cormodes darwini* was not found under any of the southern bushes and is probably much more restricted in distribution, to the few large trees on the northeastern part of Blackburn Island (total population area < 0.5 ha). Both *C. darwini* and *P. sterrha* should be regarded as critically endangered (IUCN, 2019) as they occur at a single site (Blackburn Island) that is



Figure 7. One of the authors (CAMR) crawling under *Melaleuca* bushes, top of cliff on southwestern side of Blackburn Island. Photo: Ewan Reid.



Figure 8. Vegetation including *Melaleuca* bushes, top of cliff on southwestern side of Blackburn Island. Photo: Ewan Reid.



Figure 9. One of the authors (CAMR) standing in a stunted *Lagunaria* bush, southern slope of Blackburn Island. Photo: Ewan Reid.

much less than 10 km² in area. They are certainly much more restricted in distribution than the endemic cockroach, *P. lata*, which is already listed as an endangered species under NSW legislation (Anonymous, 2015).

Of the other large species recorded on Blackburn Island, the two carabids and three other tenebrionids are all flightless and endemic to the Lord Howe group. However all are also common species on the main island and cannot be regarded as threatened. The carabids are predators, as adults and larvae, of small invertebrates. Both species are also on Roach Island (material in Australian Museum) and Balls Pyramid (Reid *et al.*, 2018a). Two of the three tenebrionids, *Hydissus* and *Metisopus*, have larvae associated with rotten wood which may be important potential prey for *Cormodes darwini* and their populations on Blackburn Island should therefore be monitored. These species are also widespread throughout lowland Lord Howe Main Island and offshore islands. The species of Cerambycidae and Curculionidae, which have woodboring larvae and are also non-endemic, may also be important prey for maintenance of the *Cormodes* population. These woodboring species are also widespread on the Main Island.

The two remaining large beetle species on Blackburn Island are both Scarabaeidae, in the subfamily Dynastinae, characterized by root or wood feeding larvae (Weir *et al.*, 2019). *Pimelopus fischeri* is undoubtedly a native species and is widespread in the lowlands of Lord Howe, also occurring on Roach Island (material in Australian Museum). Larvae of *Cryptodus* are supposedly associated with termites or ants (Weir *et al.*, 2019) but the biology of *C. tasmanianus* is undescribed. This is almost certainly an accidentally introduced species to Lord Howe, before the arrival of rats, which now only survives on Balls Pyramid and Blackburn Island (Reid *et al.*, 2018a; Reid & Hutton, 2019).

Several species which are currently absent may colonize Blackburn Island in the near future through the afforestation programme for the Lord Howe phasmid. Neither of the endemic lucanid species occurs on the island, reflecting the restricted availability of dead wood and perhaps also the species of trees present (Reid *et al.*, 2018b). The flightless endemic cantharid, *Chauliognathus apterus*, is also unrecorded although this formerly widespread species on Lord Howe is perhaps locally extinct in the lowlands in response to recent droughts (Reid *et al.*, 2018a). Recently arrived grassland species on Lord Howe, such as *Heteronychus arator* (Scarabaeidae), *Sericesthis geminata* (Scarabaeidae) and *Conoderus striatus* (Elateridae), are as yet unrecorded from Blackburn Island. If these colonize the island they may be beneficial, by suppressing the abundant exotic grass *Chloris gayana*. Three large actively volant species associated with carcasses, *Creophilus erythrocephalus* and *Hesperus pacificus*, maggot predators, and *Ptomaphila perlata*, a burying beetle (Reid *et al.*, 2018a), are likely to occur on Blackburn Island as there is a seasonal colony of shearwaters (Carlile & Priddell, 2013), but carrion baited traps have not been used there.

Given the presence of two critically endangered endemic beetles on Blackburn Island we strongly urge careful quarantine practices in transferring materials from the Main Island for re-afforestation. We also recommend further surveys of Blackburn Island.

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References

- Anonymous. 2015. Lord Howe Island wood-feeding cockroach (*Panesthia lata*). [Accessed March 2020].
<https://www.environment.nsw.gov.au/savingourspeciesapp/project.aspx?ProfileID=10887>
- Anonymous. 2018. Lord Howe Island Group. [Accessed March 2020].
<https://whc.unesco.org/en/list/186>
- Anonymous. 2020. Lord Howe Island Board. Rodent eradication. [Accessed March 2020].
<https://www.lhib.nsw.gov.au/environment/environmental-programs/rodent-eradication>
- Bouchard, P., and W. E. Steiner. 2004. First descriptions of Coelometopini pupae (Coleoptera: Tenebrionidae) from Australia, southeast Asia and the Pacific region, with comments on phylogenetic relationships and antipredator adaptations. *Systematic Entomology* 29: 101–114.
<https://doi.org/10.1111/j.1365-3113.2004.00230.x>
- Bouchard, P., and D. K. Yeates. 2001. Phylogenetic relationships of the Australian Coelometopini (Coleoptera: Tenebrionidae): a quantitative cladistic analysis with a review of biology. *Organisms, Diversity and Evolution* 1: 17–43.
<https://doi.org/10.1078/1439-6092-00003>
- Brown, W.V., J. T. Doyen, B. P. Moore, and J. F. Lawrence. 1992. Chemical composition and taxonomic significance of defensive secretions of some Australian Tenebrionidae (Coleoptera). *Journal of the Australian entomological Society* 31: 79–89.
<https://doi.org/10.1111/j.1440-6055.1992.tb00461.x>
- Carlile, N., and D. Priddell. 2013. Seabird islands. No. 262. Blackburn Island, Lord Howe Group, New South Wales. *Corella* 37(4): 97–99.
- Carlile, N., D. Priddell, and T. O'Dwyer. 2018. Preliminary surveys of the endangered cockroach *Panesthia lata* (Blattodea: Blaberidae) on two islands within the Lord Howe Group, Australia. *Austral Entomology* 57(2): 207–213.
<https://doi.org/10.1111/aen.12281>
- Cassis, G., L. Meades, C. Reid, R. Harris, G. Carter, and E. Jefferys. 2003. *Lord Howe Island: Terrestrial Invertebrate Biodiversity and Conservation*. A report prepared by the Australian Museum Centre for Biodiversity Conservation and Research for NSW National Parks and Wildlife Service. Sydney: Australian Museum.
- Holloway, B. A. 1982. Anthribidae (Insecta: Coleoptera). *Fauna of New Zealand* 3: 1–269.
- Hutton, I., J. P. Parkes, and A. R. E. Sinclair. 2007. Reassembling island ecosystems: the case of Lord Howe Island. *Animal Conservation* 10(1): 22–29.
<https://doi.org/10.1111/j.1469-1795.2006.00077.x>
- IUCN (International Union for Conservation of Nature). 2012. *IUCN Red List Categories and Criteria: Version 3.1. Second edition*. Gland, Switzerland and Cambridge, UK: IUCN, iv+32 pp.
<https://portals.iucn.org/library/sites/library/files/documents/RL-2001-001-2nd.pdf>
- Larochelle, A., and M.-C. Larivière. 2001. Carabidae (Insecta: Coleoptera): catalogue. *Fauna of New Zealand* 43: 1–285.
- Lea, A. M. 1929. Notes on some miscellaneous Coleoptera, with descriptions of new species. Part VII. *Transactions and Proceedings of the Royal Society of South Australia* 49: 213–253.
- Lo, Nathan, K. Jun Tong, Harley A. Rose, Simon Y. W. Ho, Tiziana Beninati, David L. T. Low, Tadao Matsumoto, and Kiyoto Maekawa. 2016. Multiple evolutionary origins of Australian soil-burrowing cockroaches driven by climate change in the Neogene. *Proceedings of the Royal Society B: Biological Sciences* 283(1825): e20152869.
<https://doi.org/10.1098/rspb.2015.2869>

- Matthews, E. G., and P. Bouchard. 2008. *Tenebrionid Beetles of Australia. Descriptions of Tribes, Keys to Genera, Catalogue of Species*. Canberra: ABRS, viii+398 pp.
- McKeown, K. C. 1947. Catalogue of the Cerambycidae (Coleoptera) of Australia. *Australian Museum Memoir* 10: 1–190.
<https://doi.org/10.3853/j.0067-1967.10.1947.477>
- Moore, B. P. 1992. *The Carabidae of Lord Howe Island (Coleoptera: Carabidae)*. In *The Biogeography of Ground Beetles of Mountains and Islands*. ed. G. R. Noonan, G. E. Ball, and N. E. Stork, pp. 159–173. *Andover*: Intercept.
- Olliff, A. S. 1889. The insect fauna of Lord Howe Island. *Australian Museum Memoir* 2: 77–98, plate vi, and errata.
<https://doi.org/10.3853/j.0067-1967.2.1889.482>
- Pullen, K. R., D. Jennings, and R. G. Oberprieler. 2014. Annotated catalogue of Australian weevils (Coleoptera: Curculionoidea). *Zootaxa* 3896: 3–481.
<https://doi.org/10.11646/zootaxa.3896.1.1>
- Reid, C. A. M. 2017. Australopapuan leaf beetle diversity: the contributions of hosts plants and geography. *Austral Entomology* 56(2): 123–137.
<https://doi.org/10.1111/aen.12251>
- Reid, C. A. M., and I. Hutton. 2019. Citizen science and the art of discovery: new records of large Coleoptera from Lord Howe Island, July 2018. *Technical Reports of the Australian Museum, Online* 28: 1–16.
<https://doi.org/10.3853/j.1835-4211.28.2019.1717>
- Reid, Chris A. M., Josh Jenkins Shaw, and Arn R. Jensen. 2018a. The Australian Museum Lord Howe Island Expedition 2017—Coleoptera. *Technical Reports of the Australian Museum, Online* 26: 53–67.
<https://doi.org/10.3853/j.1835-4211.26.2018.1706>
- Reid, C. A. M., K. Smith, and M. Beatson. 2018b. Revision of the genus *Lamprima* Latreille, 1804 (Coleoptera: Lucanidae). *Zootaxa* 4446(2): 151–202.
<https://doi.org/10.11646/zootaxa.4446.2.1>
- Ślipiński, S. A., and H. E. Escalona. 2013. *Australian Longhorn Beetles (Coleoptera: Cerambycidae). Volume 1. Introduction and Subfamily Lamiinae*. Clayton: CSIRO Publishing, xviii+484 pp.
<https://doi.org/10.1071/9781486300044>
- Ślipiński, S. A., and H. E. Escalona. 2016. *Australian Longhorn Beetles (Coleoptera: Cerambycidae). Volume 2. Subfamily Cerambycinae*. Clayton: CSIRO Publishing, xxvi+613 pp.
<https://doi.org/10.1071/9781486304592>
- Weir, T. A., J. F. Lawrence, C. Lemann, and N. L. Gunter. 2019. 33. Scarabaeidae: Dynastinae Macleay, 1919 [sic]. In *Australian Beetles Volume 2. Archostemata, Myxophaga, Adepahaga, Polyphaga (part)*, ed. S. A. Ślipiński, and J. F. Lawrence, pp. 516–530. Clayton: CSIRO Publishing.
- Zimmerman, E. 1994. *Australian weevils. Volume 1. Anthribidae to Attelabidae*. Melbourne: CSIRO Publishing, xxxii+741 pp.