Zoological Studies **60**:12 (2021)
doi:10.6620/ZS.2021.60-12

Zoological Studies

Open Access

Beetle Diversity Across Micro-habitats on Lizard Island Group (Great Barrier Reef, Australia)

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Received 16 May 2020 / Accepted 31 December 2020 / Published 26 March 2021
Communicated by Jen-Pan Huang

The beetles (Coleoptera) of Lizard Island group, a complex of small granitic islands on the Great Barrier Reef, have never been systematically assessed. In April 2019, we conducted the first survey of the island group across different micro-habitats. We specifically aimed to determine which beetle families are the most diverse, and how beetle diversity varies across the island group. We sampled several sites on seven large collection areas using a variety of methods: pitfall traps, beating sheet, sifting leaf litter, and active night and day collection. Our sampling yielded 108 beetle morphospecies representing at least 21 families. The most diverse families on Lizard Island group were Curculionidae, Carabidae, Scarabaeidae, Tenebrionidae, and Cerambycidae, in general accordance with global patterns in Coleoptera diversity. The families Chrysomelidae, Staphylinidae, and Buprestidae were found to be proportionally less diverse on the island group than on mainland Australia, though Australia as a whole is of limited value as a reference. Beetle diversity varied across both large-scale collection areas and small-scale collection sites on Lizard Island group. As expected, greater habitat complexity and vegetation diversity corresponded with greater beetle diversity, though these patterns might be biased due to the temporal and spatial limits of our sampling. We hope this preliminary survey will facilitate further research on Lizard Island group, taking advantage of the research facilities on the island and the possibility of establishing long-term studies.

Key words: Continental islands, Great Barrier Reef, Micro-habitats, Taxonomic variation.

BACKGROUND

The Great Barrier Reef, located off northeast Australia, contains more than 900 islands in a latitudinal range of 2,300 km. Many of the islands are of post-glacial origin and were disconnected from the continental landmass by sea level rise (Hopley et al. 2007; Lentfer et al. 2013). Lizard Island is a seven km^2 granitic island located 33 km off the coast of Cape Flattery on the mid-shelf of the Great Barrier Reef (Queensland Government 2017a). The smaller South and Palfrey islands are located within a kilometer of Lizard Island, and together with Lizard Island make up the Lizard Island group. The three islands are continental islands and were connected to mainland Australia until sea levels rose 9,000 years ago (Queensland Government 2017a).

Lizard Island group presents a diverse range of habitats in a small area. These include grasslands, dune shrublands, eucalypt and acacia woodlands, mangroves, and paperbark (*Melaleuca* sp.) and pandanus swamps (Queensland Government 2017b). These habitats vary across Lizard Island group with topography and the presence of freshwater. Well-drained hillsides and valleys are dominated by grasses (Queensland Government 2017b), while woodlands grow in more sheltered areas. Seasonal streams are present in a few gulches around Lizard Island, serving as refugia areas for denser vegetation including palms, pandanus, and paperbarks.

The habitat diversity across Lizard Island

Citation: McCormack JJ, Cotoras DD. 2021. Beetle diversity across micro-habitats on Lizard Island group (Great Barrier Reef, Australia). Zool Stud **60**:12. doi:10.6620/ZS.2021.60-12.

group would predict a similar diversity in faunal communities. However, the terrestrial biodiversity of the archipelago is conspicuously understudied. Here, we take a first step in characterizing the diversity of beetles (Order Coleoptera) across the various habitats of Lizard Island group. Coleoptera is the most diverse group of organisms on Earth, constituting about 25% of all described animal species (Zhang et al. 2018). Beetles play important roles in nearly all terrestrial and freshwater ecosystems (Zhang et al. 2018) and are found in a remarkable diversity of habitats. Greater habitat complexity has been correlated with greater species richness for certain beetle families, including the families Staphylinidae and Carabidae (Lassau et al. 2005). On islands, total island area is generally the best predictor of beetle species richness, though habitat variation plays a role on a local scale (Nilsson et al. 1988).

This study is the first survey of Lizard Island group Coleoptera, helping to fill a gap in the knowledge related to the archipelago's terrestrial biodiversity. We conducted a baseline survey of the beetle diversity across various habitats on Lizard Island group in April 2019 and developed a list of beetle families for the archipelago. We specifically aimed to determine which beetle families are the most diverse, and how beetle diversity varies across the island group.

This study was based out of the Lizard Island Research Station on Lizard Island, which has been operated by the Australian Museum since 1973. Because most research at the station has been marine-oriented, our survey contributes to a better understanding of the terrestrial diversity of the island group. We hope this preliminary survey will stimulate and facilitate further research on this location, taking advantage of the research facilities on Lizard Island and the possibility of establishing long-term studies.

MATERIALS AND METHODS

Collection Areas and Sites

We sampled a total of seven "collection areas" on Lizard, South, and Palfrey islands. Pitfall traps were deployed at a total of 33 "collection sites" across the seven collection areas (Fig. 1). The Mangroves collection area had pitfall traps at only one site. Active day collection (beating sheet and/or sifting leaf litter) was performed at 29 collection sites, while night collection was performed at eight collection sites. Opportunistic hand collection occurred at all sites. Table S1 provides collection area place names, collection site locations with their associated coordinates, collection dates per site, a description of the methods applied per collection site, and the general habitat type at each collection site. A brief description of each collection area is given below.

Description of Collection Areas

Researcher's Path

Researcher's Path is a sand path through a relatively dense woodland. The Researcher's Path woodland was the largest tract of forest sampled in this study. Key components of the vegetation include Moreton Bay Ash (*Corymbia tessellaris*), eucalyptus trees, *Acacia crassicarpa*, fig (*Ficus* sp.), and *Thryptomene oligandra* in the tree growth form (Colvill et al. 2004). Seven collection sites were sampled along Researcher's Path, in addition to opportunistic collections at the Research Station.

Blue Lagoon

The Blue Lagoon collection area consisted of a sand path leading from a dune shrubland down to the beachfront. The Blue Lagoon 5 collection site was located furthest from the beach in a homogeneous dune shrubland dominated by *Suriana maritima*. Blue Lagoon 1 was located above the tideline on the beach (Mangrove Beach), in an area with sparse *Spartina* grasses and sea purslane (*Sesuvium portulacastrum*). The other Blue Lagoon collection sites were located in patches of relatively low-growing woodland. A total of five collection sites were sampled in the Blue Lagoon collection area.

Watson's Bay Mangroves

The Mangroves collection area was a low-lying area of homogeneous mangrove shrubs on Lizard Island. The area appeared to experience occasional saltwater flooding. One collection site was sampled at the Mangroves.

Cook's Trail

Cook's Trail begins on the Watson's Bay beach and leads to the highest point on Lizard Island (Cook's Look, 359 m). The habitat transitions from relatively tall eucalypt and acacia woodland at lower elevations to grassland with sparse acacia patches at higher elevations. Cook 1 was located at the peak of the trail (Cook's Look) in a patch of woodland surrounded by grassland. Cook 2 was a rocky and grassy area near patches of acacia trees. The other Cook collection sites were located in relatively continuous eucalypt and acacia woodland. A total of five collection sites were sampled along Cook's Trail. Mermaid's Cove was also included as part of the Cook's Trail collection area. Mermaid's Cove consists of a creek running towards a sandy beach. The creek supports abundant vegetation and is enclosed by hills on both sides.

Gulches

The three Gulches, surrounded by grassland, are located on the southeast side of Lizard Island. Each Gulch contains a small freshwater stream descending in elevation towards the beach. The Gulches serve as refugia areas for moisture-dependent species including palm, paperbark, and pandanus trees. A total of five collection sites were sampled at the Gulches: two sites at each of the first two Gulches and one site at the third Gulch. The Gulch 1 collection site was located furthest from the running water in a thicket of shrubs and small trees. Gulch 2 was located in a woodland close to the beach and appeared to be occasionally flooded by saltwater. Gulch 4 was located directly above the flowing stream, on a rocky patch covered in ground-hugging vines.

Palfrey Island

Palfrey Island is located less than a kilometer southwest of Lizard Island and was accessed by boat. Aside from aboriginal rock formations, the only structure on the island is an automated lighthouse. Much of the island consists of grassland interspersed with patches of low-growing woodland. The Palfrey 2 collection site was a grassland located near a patch of woodland and was the only true grassland sampled in this study. Palfrey 6 was located above the tideline on the beach in an area with sparse *Spartina* grasses. The other collection sites were patches of woodland varying in vegetation density and composition. A total of seven collection sites were sampled on Palfrey Island.

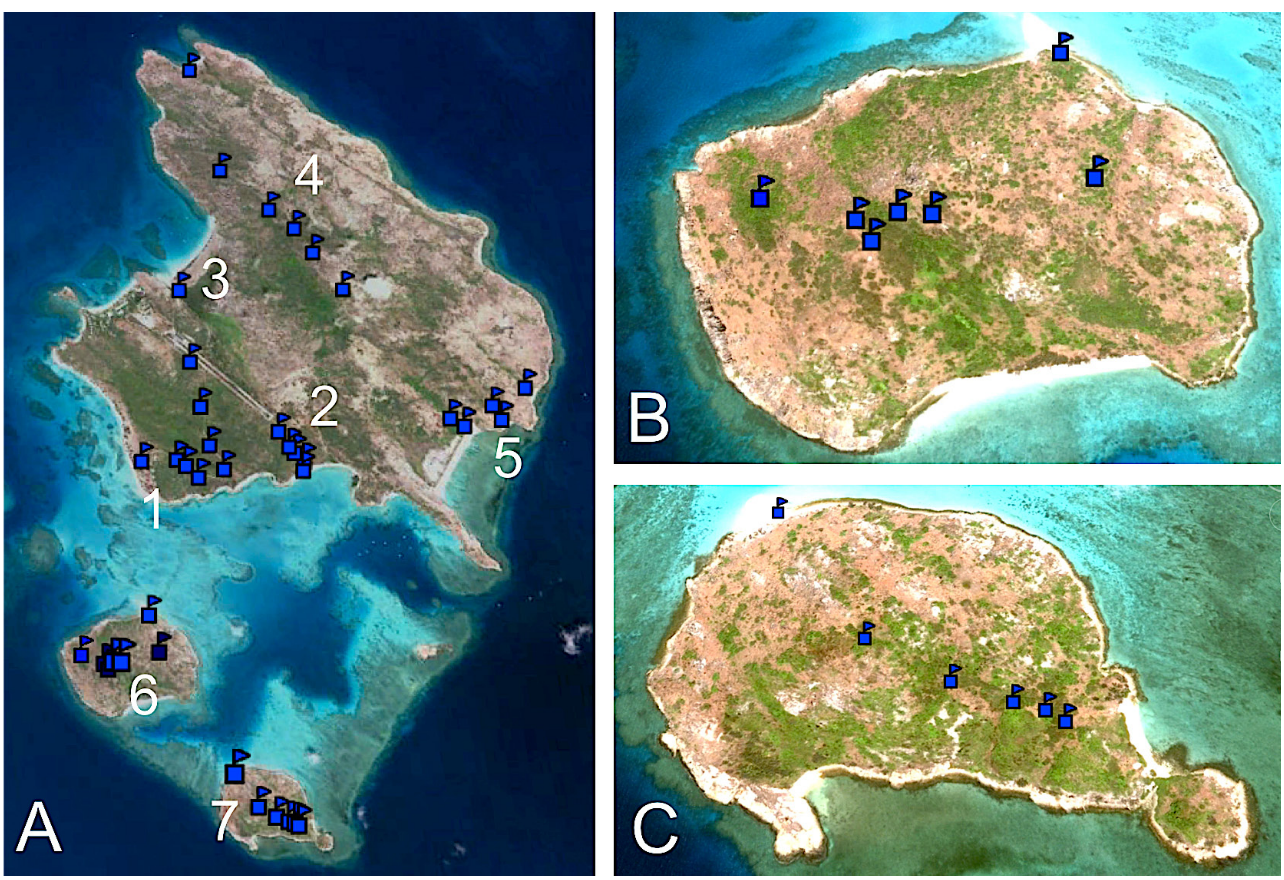

Fig. 1. 38 collection sites sampled across Lizard Island group during April 2019. Multiple collection sites were sampled at each collection area; each flag represents a collection site. (A) Collection Areas. [1] Researcher's Path; [2] Blue Lagoon; [3] Watson's Bay Mangroves; [4] Cook's Trail; [5] Gulches; [6] Palfrey Island; [7] South Island. (B) Palfrey Island and (C) South Island. Table S1 provides additional collection area and collection site details, including the coordinates of each collection site. Maps from Google Earth.

South Island

South Island is located less than a kilometer south of Lizard Island, adjacent to the slightly larger Palfrey Island. South Island was also accessed by boat and contains no structures aside from aboriginal rock formations. Like Palfrey Island, much of South Island consists of grassland interspersed with patches of low-growing woodland. South 1 was located at the base of the island in a homogeneous acacia woodland. South 2 and 3 were areas of dense vegetation overgrown with vine thickets. South 4 was located at the peak of the island in a rocky and grassy area near a patch of low-growing woodland. South 5 was located above the tideline on the beach, in an area with sparse *Spartina* grasses. A total of six collection sites were sampled on South Island.

Sampling Techniques

Pitfall Traps

Three pitfall traps were deployed at each collection site (see Table S1 for exceptions). To create the pitfall traps, 532 mL (18 fl oz) plastic cups were buried and filled with approximately 100 mL of water. Dish soap was added to the water to reduce surface tension. Small sticks were placed over the top of the traps to make them less conspicuous and a large dry leaf was added as a "hanging device" to prevent drowning of any potential bycatch, such as skinks. The three traps at each site were spaced about one meter apart to account for local variation in micro-habitat. Their contents were consolidated to make up a single sample per site. Pitfall trapping took place for one night at all sites except Researcher's Path. Pitfall traps were set for a total of two nights at Researcher's Path. After the first night, they were harvested and re-set for a second night. The contents of the pitfall traps were sorted using a stereoscopic microscope and tweezers.

Active Collection

Active collection was conducted at each collection area. Collection techniques included beating sheet, sifting leaf litter, and opportunistic hand collection. A 71 cm^2 canvas beating sheet (Bioquip Catalog #2840C) was held below selected trees and shrubs while the plants were struck with a PVC pipe. The beetles were collected as they fell off the foliage and onto the beating sheet. Leaf litter was collected beneath selected trees and shrubs, and was sifted over the canvas beating sheet. Opportunistic hand collection involved collecting beetles as encountered – while deploying and removing pitfall traps, and before and after timed searches. Beating sheet and leaf litter sifting were conducted for 15 to 20 minutes at each active collection site (see Table S1 for active collection sites).

Night Collection

Night collection was conducted at select sites for 15 to 30 minutes. Headlamps were used while scanning the litter and vegetation for beetles. In areas with freshwater, the water's surface was scanned for water beetles.

Collection, Curation, and Taxonomy

All beetles collected were preserved in 100% ethanol. The specimens were identified to the lowest taxonomic level possible using Ślipińksi and Lawrence (2013). Voucher specimens were deposited at the Australian Museum in Sydney, Australia.

RESULTS

We detected 108 morphospecies (representing 21 families; Table 1) in our survey. *Caryotrypes* Decelle, 1968, the only beetle previously documented from Lizard Island, was not found (Reid and Beatson 2013). The best represented families, in relative order, were Curculionidae, Carabidae, Scarabaeidae, Tenebrionidae, and Cerambycidae, which together made up more than 60% of all morphospecies (Fig. 2). The complete list of morphospecies is attached in table S2.

Beetle diversity varied across the different collection areas. 56 morphospecies were detected at Researcher's Path, the most diverse collection area overall (Fig. 3). Only two morphospecies were detected at the Mangroves, the least diverse collection area. Researcher's Path was particularly diverse in Scarabaeidae and Carabidae morphospecies. 10 scarab morphospecies were detected at Researcher's Path, while no more than four scarab morphospecies were detected at any other collection area. 10 carabid morphospecies were detected at Researcher's Path, while no more than five were detected at any other collection area.

Beetle families and morphospecies were differentially distributed across the collection areas. Curculionidae was the only family detected at all collection areas. Carabidae and Tenebrionidae morphospecies were detected at all collection areas except the Mangroves. The single morphospecies in the family Ptiliidae was found only in the Mangroves, while the single species in the family Buprestidae was found

Table 1. List of beetle morphospecies from Lizard Island group. Genera labelled with "spp." contain multiple different morphospecies – see table S2 for more detail

Family Subfamily Genus species	Number of Morphospecies Total per Subfamily
Anthicidae	**2**
Notoxinae	2
Mecynotarsus kreusleri	
Mecynotarsus sp.	
Anthribidae	**1**
No subfamily	1
Araecerus sp.	
Buprestidae	**1**
Chrysochroinae	1
Metataenia sp.	
Carabidae	**15**
Cicindelinae	1
Megacephala sp.	
Harpalinae	3
Chlaenius sp.	
Pseudomorphinae	1
Pterostichinae	1
Nurus sp.?	
Scaritinae	1
Subfamily uncertain	8
Cerambycidae	**9**
Cerambycinae	2
Ceresium sp.	
Strongylurus sp.	
Lamiinae	6
Batocera sp.	
Xylotoles sp.	
Subfamily uncertain	1
Chrysomelidae	**5**
Cassidinae	1
Laccoptera impressa	
Chrysomelinae	1
Paropsis sp.	
Galerucinae	3
Asiophrida sp.	
Halticorcus sp.	
Poneridia sp.	
Coccinellidae	**1**
Curculionidae	**23**
Scolytinae	1
Xyleborus perforans?	
Molytinae	10
Orthorhinus spp.	
Euthyrrhinus sp.	
Entiminae	8
Leptopius spp.	
Myllocerus spp.	
Subfamily uncertain	4

Family Subfamily Genus species	Number of Morphospecies Total per Subfamily
Dermestidae?	**1**
Elateridae	**3**
Agrypninae	2
Agrypnus spp.	
No subfamily	1
Glyphochilus sp.	
Geotrupidae	**2**
Bolboceratinae	2
Hybosoridae	**1**
Lucanidae	**1**
Lucaninae	1
Figulus sp.	
Oedemeridae	**1**
Oedemerinae	1
Copidita sp.	
Passandridae	**1**
No subfamily	1
Passandra sp.?	
Psephenidae	**1**
Ptiliidae	**1**
Scarabaeidae	**11**
Dynastinae	1
Melolonthinae	4
Heteronyx spp.?	
Scarabaeinae	4
Coptodactyla glabricollis	
Onthophagus sp.	
Tesserodon sp.	
Cetoniinae?	2 (larvae)
Silvanidae?	**1**
Staphylinidae	**4**
Pselaphinae?	2
Subfamily uncertain	2
Tenebrionidae	**10**
Alleculinae?	3
Tenebrioninae	2
Gonocephalum sp.	
Subfamily uncertain	5
Unidentified	**13**
Total Number of Families	**21**
Total Number of Morphospecies	**108**

only on South Island (*Metataenia* sp.). Dung beetles (family Scarabaeidae, subfamily Scarabaeinae) were found only at the Blue Lagoon and Researcher's Path. The two species in the family Anthicidae, *Mecynotarsus kreusleri* and *Mecynotarsus* sp., were collected only on sandy beaches.

More than half of all morphospecies were detected in only one of the seven collection areas (69 out of 108 total morphospecies). Most of these singletons were found at Researcher's Path, followed by Palfrey Island and the Gulches (30, 10, and 10, respectively).

A few collection sites were notably poor in diversity. South 1 was the only collection site where both pitfall traps and active collection were conducted

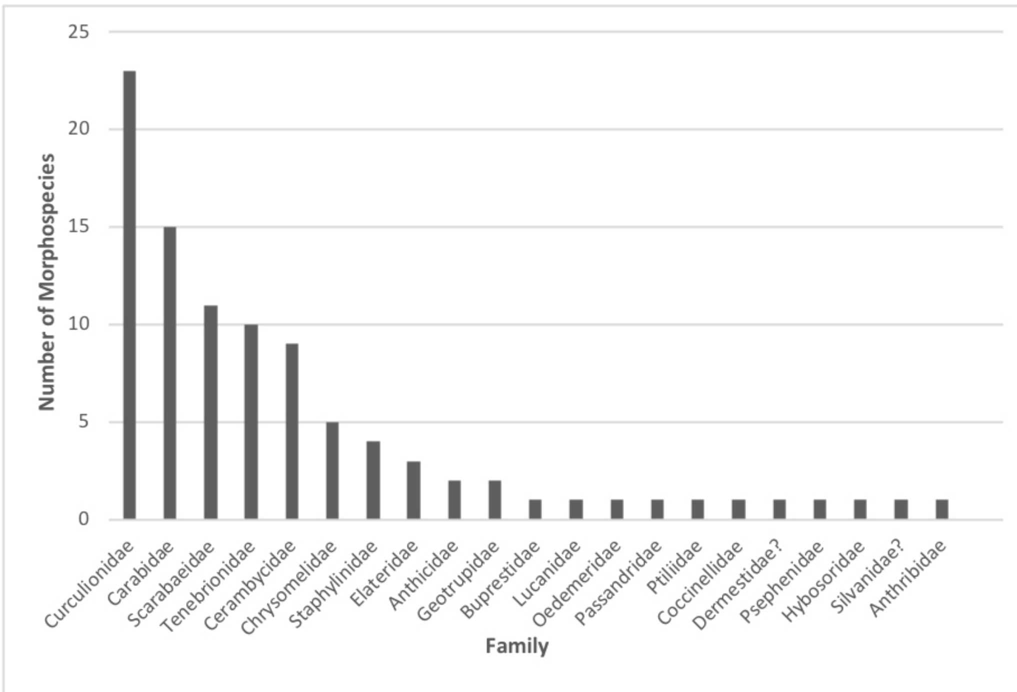

Fig. 2. Number of morphospecies per family.

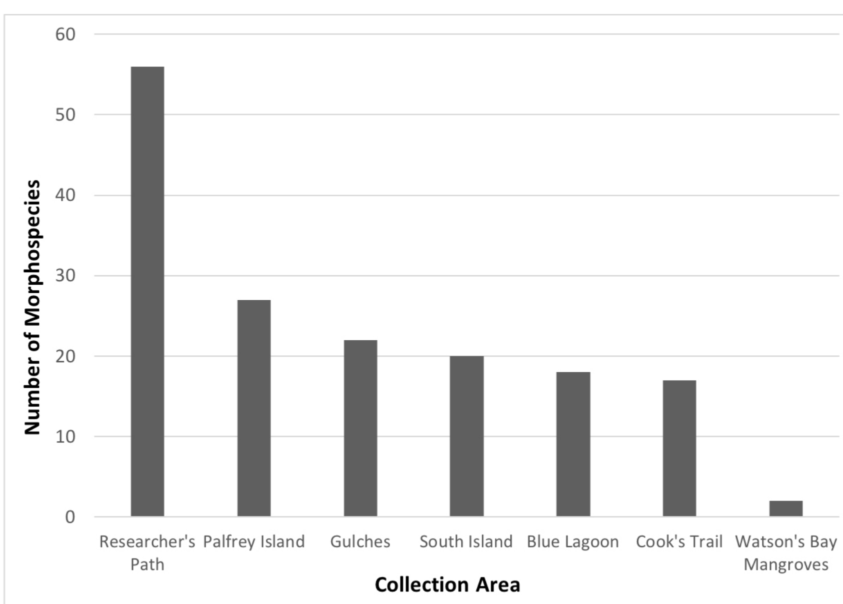

Fig. 3. Number of morphospecies by collection area.

yet not a single beetle was found.

Figure 4 depicts a species accumulation curve reflective of our sampling effort. The curve presents a linear increase, implying that further collection would uncover additional new morphospecies.

DISCUSSION

Our study represents the first beetle diversity survey on Lizard Island group. Here, we determined which beetle families are the most diverse, and how beetle diversity varies across the island group.

The most diverse families recorded in this study (Curculionidae, Carabidae, Scarabaeidae, and Tenebrionidae) are among the most diverse families on mainland Australia (CSIRO Division of Entomology 1991). However, the families Chrysomelidae, Staphylinidae, and Buprestidae were found to be proportionally less diverse on Lizard Island group than on the mainland. It is important to note that mainland Australia as a whole is not the most appropriate reference for Lizard Island beetle fauna, given the diversity and size of the continent. The dry hills of the Cape York Peninsula would provide a better comparison, but survey data from this location does not yet exist.

A survey of Coleoptera on the Capricornia Cay islands in the south of the Great Barrier Reef yielded similar results as the ones presented here (Burwell et al. 2010). Only a single buprestid morphospecies was detected in the 15 Capricornia Cay islands surveyed, and chrysomelids made up less than three percent of all morphospecies recorded.

On Lizard Island group, the proportionally low diversity of chrysomelids detected might be related to habitat. Chrysomelids are herbivorous beetles and their diversity has been shown to increase in areas of herbaceous vegetation cover (Gok and Sen 2014). However, Lizard Island consists of about 60% grassland (Queensland Government 2017b) - insufficient habitat for most chrysomelids.

The low diversity we recorded in some families might also be explained by sampling bias. Our field collection occurred at the beginning of the dry season (April), when many beetle species have completed their adult activity. We may have detected a relatively low diversity of chrysomelids because most species in this family are buried in the soil as larvae during this time. Flowering of vegetation has also generally ended by April. As such, we recorded low diversity in families that are known to associate with flowers (*e.g.*, Buprestidae). In addition, Christmas beetles (family Scarabaeidae, genus *Anoplognathus*) have been observed by the directors of the Research Station in the past, but adults only emerge in November and December (Carne et al. 1974). Thus, they were not detected in our survey.

The low staphylinid diversity recorded in our survey is likely related to our failure to capture and identify many small beetle morphospecies (3 mm or less). Some small beetle species might not have wandering habits, so a passive collection method such as pitfall traps might not capture them efficiently. In addition, small beetle species are often difficult to recognize with the naked eye while sifting litter.

Geographic Variation in Beetle Diversity

Beetle diversity was found to be differentially

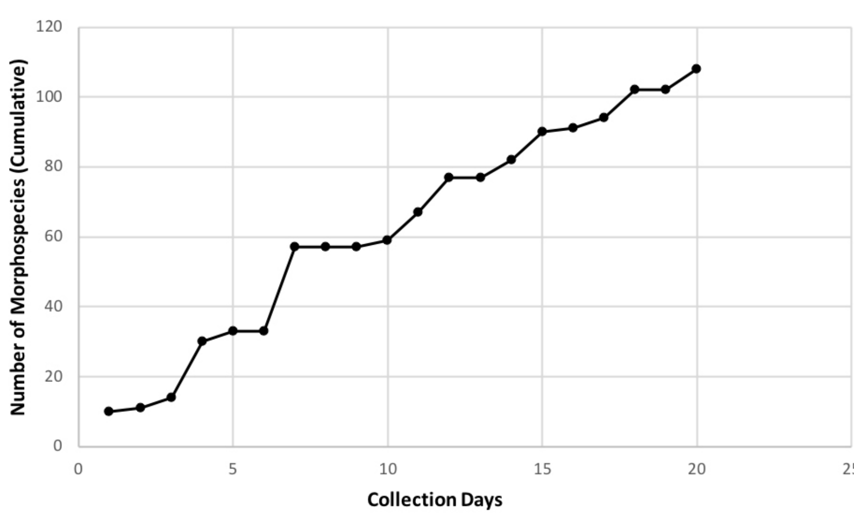

Fig. 4. Species accumulation curve.

distributed across the island group. Researcher's Path was the collection area with the highest diversity (56 morphospecies). This may be the result of the habitat complexity and vegetation diversity in the woodland surrounding the path. The Researcher's Path woodland consisted of an assortment of fig, eucalypt, and acacia trees, providing the highest canopy on the island. Certain beetle families are indeed known to increase in species richness in more complex habitats (Lassau et al. 2005). Researcher's Path also yielded the most carabid and scarab morphospecies of any collection area (10 and 10, respectively). This may be attributed to the diverse and abundant leaf litter present, which, along with other soil parameters, has been shown to be a determinant of carabid beetle diversity and abundance (Magura et al. 2000). Due to its large area, Researcher's Path was subject to a greater sampling intensity than other collection areas, which might be a confounding factor.

The Watson's Bay Mangroves was the collection area with the lowest beetle diversity, with only two morphospecies detected. A study of mangrove herbivory in Townsville, north Queensland, also found a notably low diversity of beetles in mangrove habitats (six species) (Burrows 2003). The low diversity recorded in our survey may be attributed to the homogeneous vegetation composition of the Mangroves collection area. Moreover, little to no leaf litter was present in the Mangroves, making it inhospitable for ground-dwelling beetles (including the families Carabidae, Tenebrionidae, and Staphylinidae). It is important to note that the Mangroves collection area was subject to a lower sampling intensity than the other collection areas, which most likely contributed to the low beetle diversity recorded.

The Gulches collection area yielded the highest chrysomelid diversity, with three of the five chrysomelid morphospecies recorded in this study detected at the Gulches. The small streams in the Gulches support denser vegetation than the surrounding grassland habitat (*i.e.*, shrub and tree layers), which might contribute to the chrysomelid diversity in this area (Gok and Sen 2014). No other collection area yielded more than a single chrysomelid morphospecies.

On a more local scale, beetle diversity varied across the numerous collection sites at each collection area. Despite their close proximity to each other, certain collection sites represented distinct micro-habitats. For example, the Palfrey 2 site was the only grassland sampled in this study. Pitfall trapping at this site yielded six morphospecies, while each of the woodland pitfall sites on Palfrey Island yielded no more than two morphospecies. Such variation in beetle communities between micro-habitats has been well documented in other ecosystems (Wardhaugh et al. 2012).

A few collection sites were notably poor in beetle diversity (*e.g.*, Blue Lagoon 5 and Cook 5), possibly due to a lack of vegetation and/or harsh environmental conditions. The South 1 collection site on the South Island collection area warrants special attention, as it was the only collection site where both pitfall traps and active collection were conducted yet not a single beetle was found. The South 1 site was a homogeneous acacia woodland that contained little to no understory growth. Such low habitat complexity and vegetation diversity most likely have a negative effect on beetle diversity. Some species of acacia are also known to be allelopathic, producing phytotoxic compounds in their leaves that inhibit the growth of neighboring plants (Chou et al. 1998). These chemical compounds may have an effect on ground-dwelling beetle communities. As our collection methods were limited in time and scale, we are not suggesting that there are no beetles in this micro-habitat, but that they are relatively rare.

Natural History Notes

The two morphospecies in the family Anthicidae, *Mecynotarsus kreusleri* and *Mecynotarsus* sp., were found only on sandy beaches with sparse *Spartina* grasses (Fig. 5A). Some anthicids are known to associate with decaying vegetation along beaches (Olabarria et al. 2007), and *Mecynotarsus* species have been observed using their pronotal horns to dig through sand (Hashimoto and Hayashi 2012). The previously mentioned Capricornia Cay survey also noted a preference of *Mecynotarsus* for beachside habitat (Burwell et al. 2010).

The carabid *Megacephala* sp. was detected only at the Blue Lagoon collection area (Fig. 5B). Though only one specimen was collected, this morphospecies was observed several times while passing through the Blue Lagoon at night. Some *Megacephala* species are known to favor salt marsh habitats (Sekeroglu and Aydin 2002), which may explain their presence at the coastal Blue Lagoon.

Dung beetles (family Scarabaeidae, subfamily Scarabaeinae) were found only at the Blue Lagoon and Researcher's Path, the only two sandy paths sampled in our survey (Fig. 5C). Certain dung beetle species are indeed known to prefer sandy areas (Lobo et al. 2001). The two common morphospecies in our study were generally found together when congregating around dung. Unfortunately, we could not identify the animal source of the dung used by the beetles, which could provide information related to the beetles' identification and ecology.

The carabid in the subfamily Scaritinae was also found only at the Blue Lagoon and Researcher's Path (Fig. 5D). This morphospecies appeared to be the most abundant beetle present at Researcher's Path, yet was absent from most other collection areas.

The weevils (Curculionidae) appeared to vary in abundance in different collection areas. Most notably, *Orthorhinus* sp. (Fig. 5E) and a specimen in the subfamily Entiminae appeared to be the most abundant weevils on Palfrey Island, while the Entiminae morphospecies alone appeared to be the most abundant weevil on South Island (Fig. 5F). No specimens of *Orthorhinus* sp. were collected on South Island. This apparent variation in abundance might be related to vegetation differences between the two islands. Adults of the species *Orthorhinus cylindrirostris* deposit their eggs in plant tissue, and are known to show a preference for specific host plant species (Murdoch et al. 2014). Therefore, it is possible that a suitable plant was abundant on Palfrey Island, but absent on South Island. This hypothesis remains to be tested.

Further Research

Our study offers several pathways for further research on the Coleoptera of Lizard Island group. As shown in the species accumulation curve (Fig. 4), our sampling effort was far from complete and subsequent surveys would yield more species. Further identification of smaller specimens would similarly yield new species, as would sampling during the wet season.

In addition, sampling of the mainland hills nearest to Lizard Island (*i.e.*, the dry hills of the Cape York Peninsula) would provide a mainland counterpart to assess the effect of post-glacial sea level rise on Lizard Island beetle fauna. Like Lizard Island, these mainland hills are also affected by maritime conditions (*e.g.*,

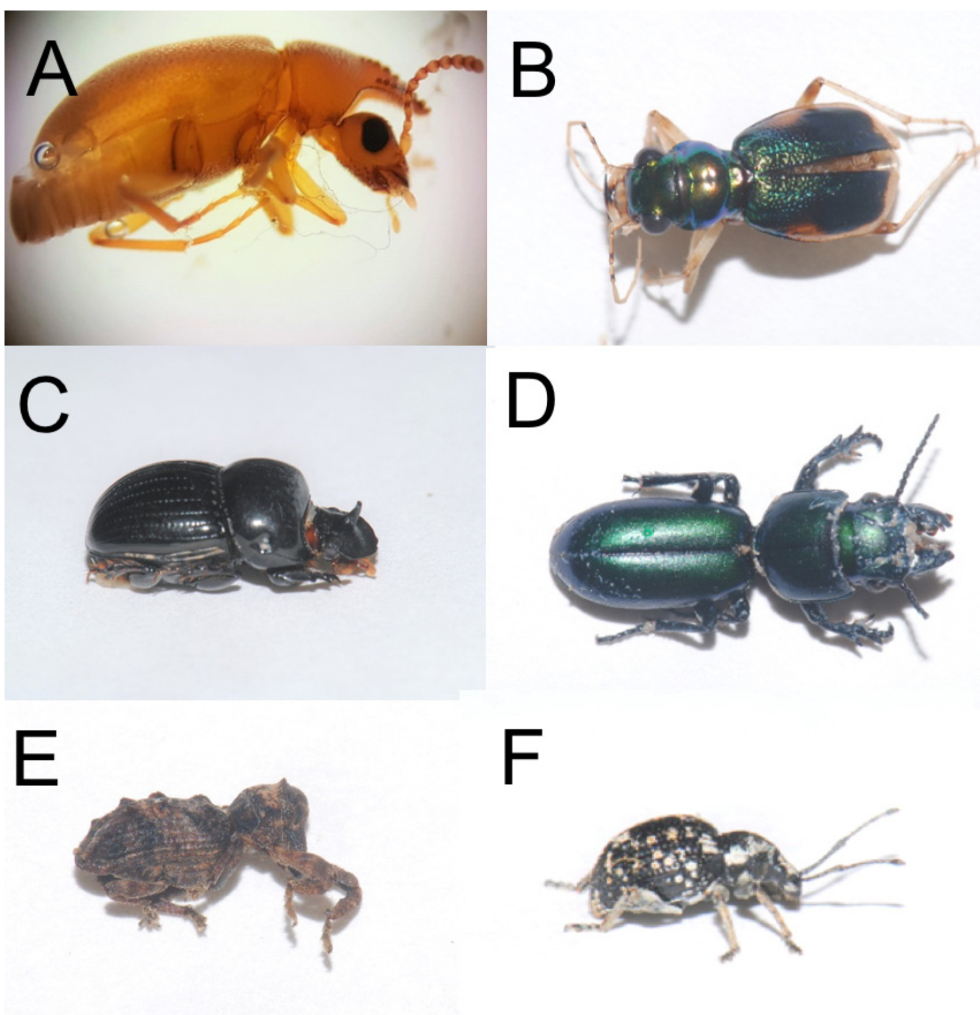

Fig. 5. Examples of beetles from Lizard Island group: (A) *Mecynotarsus* sp. (Anthicidae), (B) *Megacephala* sp. (Carabidae), (C) Scarabaeinae (Scarabaeidae), (D) Scaritinae (Carabidae), (E) *Orthorhinus* sp. (Curculionidae), and (F) Entiminae (Curculionidae).

cyclones), and are isolated within flat plains.

CONCLUSIONS

Our survey of the Coleoptera from Lizard Island group provides the first species list for the archipelago and reveals several insights to better understand the diversity of these islands. First, the family Curculionidae was identified as the most diverse family on the island group, in accordance with global patterns in beetle diversity. Second, the families Chrysomelidae and Buprestidae were proportionally less diverse on Lizard Island group than on mainland Australia, a trend also noted in a previous survey of the Capricornia Cay islands on the southern Great Barrier Reef. Finally, beetle diversity varied across both large-scale collection areas and small-scale collection sites on Lizard Island group. Beetle diversity appeared highest in the most complex habitats, and lowest in sites with homogeneous assemblages of vegetation, though these patterns might be explained by the temporal and spatial limits of our sampling.

This study represents only a first step in understanding the beetle fauna of Lizard Island group and provides a baseline for future work. Establishing diversity baselines is more important than ever under the current scenario of Climate Change, especially in vulnerable areas such as the low elevation islands of the Great Barrier Reef.

Acknowledgments: This study was funded by the 2019 Lizard Island Postdoctoral Fellowship granted to DDC. We thank Chris A.M. Reid and Graham Goodyear of the Australian Museum for their help with identification. We also thank Chris A.M. Reid and an anonymous reviewer for their comments on earlier versions of the manuscript, and Chris McCormack for reviewing the pre-print. We thank Lyle Vail and Anne Hoggett, the directors of Lizard Island Research Station, and John Williamson and Marianne Dwyer, Lizard Island Research Station staff, for their assistance during our stay at Lizard Island. We also thank Tony Cummings and the School for International Training for helping orchestrate this project and providing necessary materials. Collections were done under the permit number PTU19-001732 granted by the Department of Environment and Science of the Queensland Government, Australia.

Authors' contributions: John J. McCormack: Contributed to the study design, performed field collection, species identification, sample curation and data analysis, and wrote the manuscript. Darko D. Cotoras: Conceived and designed the study, performed field collection, advised on species identification and data analysis, and wrote the manuscript.

Competing interests: The authors declare that they have no competing interests.

Availability of data and materials: The raw data is available in the supplementary materials and the specimens deposited at the Australian Museum.

Consent for publication: We agree on having our work published by Zoological Studies.

Ethics approval consent to participate: Not applicable.

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Supplementary materials

Table S1. Description of collection areas and sites. Provides collection area place names, collection site locations with their associated coordinates, collection dates per site, a description of the methods applied per collection site, and the general habitat type at each collection site. (download)

Table S2. Specimen list. Provides identification and collection information regarding the specimens deposited at the Australian Museum. (download)