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A RAPID COMPARISON OF THE ORTHOPTERA COMMUNITIES OF BUKIT BROWN CEMETERY AND LORNIE TRAIL OF THE CENTRAL CATCHMENT NATURE RESERVE, SINGAPORE

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ABSTRACT. — A rapid comparison of the Orthoptera communities in the Bukit Brown Cemetery (BBC) and Lornie Trail (LT) of the Central Catchment Nature Reserve (CCNR) was made by examining the differences in the community indices: abundance, species richness, diversity, and composition. In total, 41 species were recorded from both study areas: 25 species from BBC, and 21 species from LT. In general, few conclusive comparisons may be made using the community indices. For Caelifera, it was found that the abundance, species richness, and diversity are higher in BBC than in LT. In addition, *Microrhebius kopisua* and *Caustogryllacris* species were recorded in BBC, representing the first records of these species outside the Bukit Timah Nature Reserve (BTNR) and CCNR. *Sedulia* cf. *specularia* was recorded in LT, representing the first sighting since 1989 and for the first time outside of the BTNR.

KEY WORDS. — Orthoptera, Bukit Brown Cemetery, Lornie Trail, community, Singapore

INTRODUCTION

The Bukit Brown Cemetery (BBC) is a cemetery located between Lornie Road and Mount Pleasant Road in Singapore. The Lornie Trail (LT) is a forest trail located within the Central Catchment Nature Reserve (CCNR) south of MacRitchie Reservoir. In BBC, plant succession has transformed the vegetation into grassland, scrubland, and young secondary forest (Nature Society (Singapore), 2011). In Sep.2011, the Land Transport Authority (LTA) announced the plan to construct a new road across a part of the BBC to help ease traffic congestion (Urban Redevelopment Authority, 2012). Therefore, the existing biodiversity in BBC is in danger of being impacted by development. Part of the biodiversity that exists in BBC is the Orthoptera, an order of insects comprising grasshoppers (suborder Caelifera), crickets, and katydids (suborder Ensifera). Orthopterans are important components of the terrestrial biodiversity and they play vital roles in the ecosystem, as both predator and prey (Gandar, 1982; Ryszkowski et al., 1993; Tan et al., 2012). Some orthopterans are also useful indicators of environmental quality and impacts of land use change (Samways, 1997; Mahmood et al., 2007).

Despite keen attention provided to other animal groups (Nature Society (Singapore), 2011; Butterfly Circle, 2012), the diversity of orthopterans in BBC is hitherto unknown. This is in contrast to LT where the orthopterans were documented as part of a recently revised inventory of Orthoptera for the Bukit Timah Nature Reserve (BTNR) and CCNR (Tan 2012a, 2012b). In light of the recent development plans for BBC and inadequate information on the orthopterans there, a rapid assessment of the Orthoptera community was carried out between Sep.–Oct.2012. The objective was to understand and compare the differences in the abundance, species richness, diversity, and species composition (specific assemblages of species) of orthopterans in BBC and LT.

MATERIAL AND METHODS

Study area. — In BBC and LT, separated by the Lornie Road, three 50-m line-transects were established for each site (Fig. 1). For each transect, only the side that is closer to Lornie Road for each site was surveyed.

Sampling of Orthoptera. — Night surveys were conducted in LT and BBC, starting at approximately 1945 hours. Each survey was conducted by five persons. For 30 min each, transects were combed for adult and nymph orthopterans for up to 5 m into one side of the trail, and up to 2 m in height. Combing involves searching through the vegetation, ground and fallen trees, raking litter, sweeping vegetation, breaking off branches for access to the interior of the vegetation, searching burrows, and locating individuals via calls. After 30 min, the orthopterans were identified using taxonomic

Fig. 1. Map of the locations of transects surveyed in Bukit Brown Cemetery (BBC) and Lornie Trail (LT) (Google, 2013). The red lines indicate the transect lines surveyed.

keys and references (see Murphy, 1973; Willemse, 2001; Tan, 2012a, 2012b; Tan & Ingrisch, 2013), counted, and released thereafter. Sampling for each site was conducted twice with alternate starting transects to reduce human error owing to sampling fatigue and to account for time differences.

***Data analysis*.** — The abundance (number of individuals of each species recorded) and species richness (number of species recorded) were determined. Species composition was illustrated by listing the species recorded in BBC and LT (Table 1). The diversity, which accounts for both species richness and evenness, was quantified using the Shannon-Weiner Index (H'), using this formula (where p_i is the relative abundance of the i^{th} species within R):

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

RESULTS AND DISCUSSION

In total, 41 species were recorded from both study areas. Cumulatively, 25 species from four infraorders of Orthoptera were recorded in BBC, whereas 21 species from five infraorders were recorded in LT (Table 2). In BBC, the orthopteran composition is dominated by species from the infraorders Acrididea, Grylloidea, and Tettigonioidea, whereas in LT, the orthopteran composition is dominated by species from only Grylloidea and Tettigonioidea. All species recorded during the rapid assessment are listed in Table 1.

The preliminary assessment of the orthopteran community in BBC and LT could not yield many conclusions from the community indices. In general, the differences in the orthopteran communities are diluted between the two study areas. Although it is evident that the orthopteran abundance is higher in BBC than in LT, no conclusion on the species richness and diversity between BBC and LT can be made (Fig. 2). At the suborder level, some differences may be observed. For Caelifera, the abundance, species richness, and diversity are higher in BBC than in LT (Fig. 3A). For Ensifera, it only appears that abundance is higher in BBC than in LT (Fig. 3B).It seems reasonable to suggest that BBC supports a greater abundance of Orthoptera than LT, and the suborder Caelifera in particular. Hence, a thorough study on the community indices may better clarify the orthopteran community in BBC and LT.

Table 1. Cumulative inventory of Orthoptera in Bukit Brown Cemetery (BBC) and Lornie Trail (LT).

Suborder	Infraorder	Species	BBC	LT
Caelifera	Acrididea	*Sedulia* cf. *specularia*		+
		Traulia azureipennis	+	+
		Xenocatantops humilis	+	
		Phlaeoba sp.	+	
		Oxya spp.	+	
		Pseudoxya diminuta	+	
		Valanga nigricornis	+	
		Erianthus sp.	+	
		Tetrigidae sp.	+	
		Euparatettix sp.	+	
Ensifera	Grylloidea	*Nisitrus vittatus*	+	+
		Cardiodactylus singapura		+
		Svistella (?) sp. (black-headed)	+	
		Svistella (?) sp. 2	+	
		Homeoxipha lycoides	+	
		Amusurgus sp.	+	
		Euscyrtus concinnus	+	
		Aphonoides sp.		+
		Cricket sp.		+
		Duolandrevus sp.		+
		Varitrella or *Idiotrella* sp.		+
		Apterornebius sp.		+
		Ornebius pullus		+
		Ornebius rufonigrus	+	
		Cycloptiloides cf. *timah*		+
		Micrornebius kopisua	+	+
	Tettigonioidea	*Peracca subulicerca*		+
		Conocephalus melaenus	+	
		Hexacentrus unicolor	+	
		Alloteratura sp.		+
		Xiphidiopsis sp.	+	+
		Mecopoda elongata	+	
		Lipotactes maculatus		+
		Mortoniellus karnyi		+
		Elimaea sp.	+	
		Holochlora obtusa	+	
		Phaneropterinae sp.	+	+
		Cesasundana sp.		+
	Stenopelmatoidea	*Larnaca nigrata*		+
		Caustogryllacris sp.	+	
	Rhaphidophoroidea	*Rhaphidophora* sp.		+

Table 2. Cumulative species richness of the different infraorders of Orthoptera between Bukit Brown Cemetery (BBC) and Lornie Trail (LT).

	Species richness	
Infraorders	**BBC**	**LT**
Acrididea	9	2
Grylloidea	8	10
Tettigonioidea	7	7
Stenopelmatoidea	1	1
Rhaphidophoroidea	0	1
Total	**25**	**21**

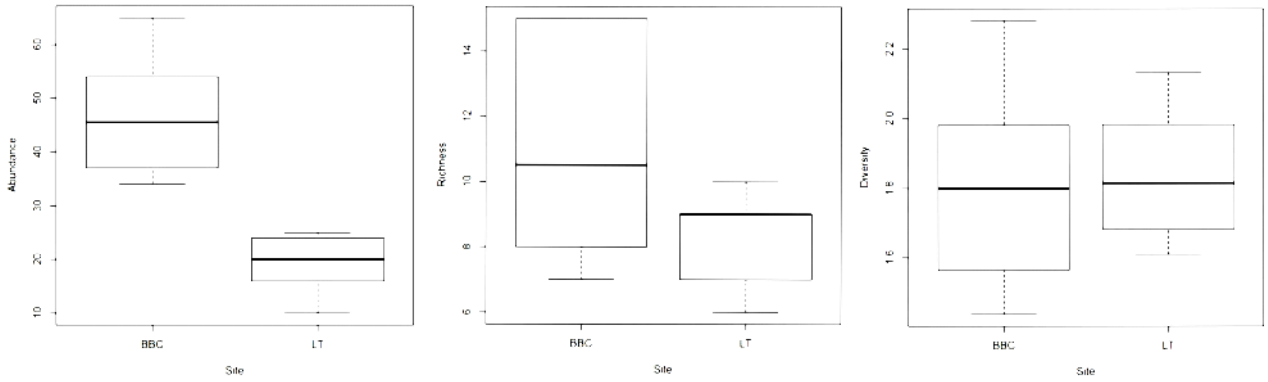

Fig. 2. Boxplots with whiskers from minimum to maximum comparing the abundance, species richness, and diversity of orthopterans in Bukit Brown Cemetery (BBC) and Lornie Trail (LT). The bold line within the box represents the median.

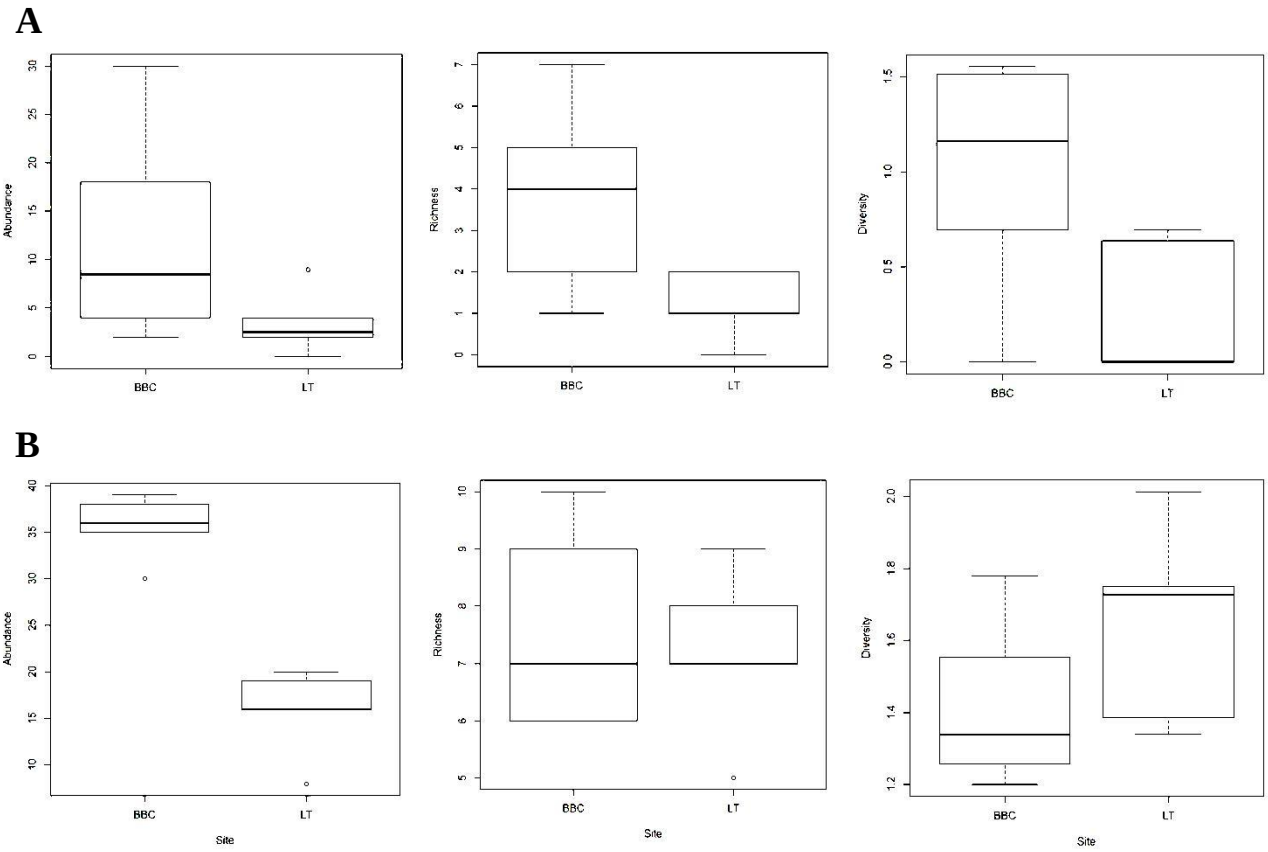

Fig. 3. Boxplots with whiskers from minimum to maximum comparing the abundance, species richness, and diversity of the orthopteran suborders in Bukit Brown Cemetery (BBC) and Lornie Trail (LT): A, Caelifera; B, Ensifera. The bold line within the box represents the median.

Additionally, some interesting observations were made during the surveys. Although many species recorded in BBC can be found in other sites in Singapore, some of which are common, two species previously known only from the BTNR and CCNR were recorded in BBC: *Micrornebius* species (Ensifera: Mogoplistidae: Mogoplistinae) (Fig. 4) and *Caustogryllacris* species (Ensifera: Gryllacrididae: Gryllacridinae) (Fig. 5). Although *Micrornebius kopisua* was sighted in both BBC and LT, it occurs more abundantly in BBC. It was previously recorded in BTNR and CCNR in which it was tentatively identified as *Micrornebius kopisua* (Tan, 2012b). Only recently, it was found that this scaly cricket is undescribed and appears to be endemic to Singapore. Interestingly, it was named after Bukit Brown Cemetery, also known as Kopi Sua (Coffee Hill in Hokkien dialect) (Tan & Ingrisch, 2013). Next, *Caustogryllacris* species is a relatively uncommon species recorded from Nee Soon Swamp Forest and other parts of the CCNR by Tan (2012b) but was not previously sighted in MacRitchie Reservoir or other sites in Singapore (M. K. Tan, pers. obs.). The sighting in BBC may suggest that *Caustogryllacris* species is more widely distributed than previously known. But this may also indicate that the BBC provides suitable forested habitats for species previously known only from mature secondary and primary forests. Such claims are nonetheless suggestive until further studies on this species and BBC are conducted.

Fig. 4. *Microrornebius kopisua* male nymph (BL = ca. 6 mm) from Lornie Trail (LT). (Photograph by: Tan Ming Kai).

Fig. 5. *Caustogryllacris* species female adult (BL = ca. 26 mm) from Bukit Brown Cemetery (BBC). (Photograph by: Yeo Huiqing).

There were also interesting findings from LT. Nymphs of a peculiar species were recorded during the surveys. When photographs of these nymphs were compared with specimens from the Zoological Reference Collection (ZRC), Raffles Museum of Biodiversity Research, National University of Singapore, the characteristic black colouration with a red margin on the ventro-external surface of hind femora suggests that this may be the species *Sedulia specularia* (Caelifera: Acrididae: Catantopinae) (Fig. 6). Moreover, the nymphs were found on leaf litter, similar to the specimens deposited in the ZRC. Interestingly, this species was last recorded in 1989 from BTNR, with no sighting from the recent checklist by Tan (2012a). This may also indicate that the sighting during the survey in LT may represent the first record of this species outside of the BTNR. However, it shall be mentioned that the record requires further confirmation from collection and examination of adult specimens.

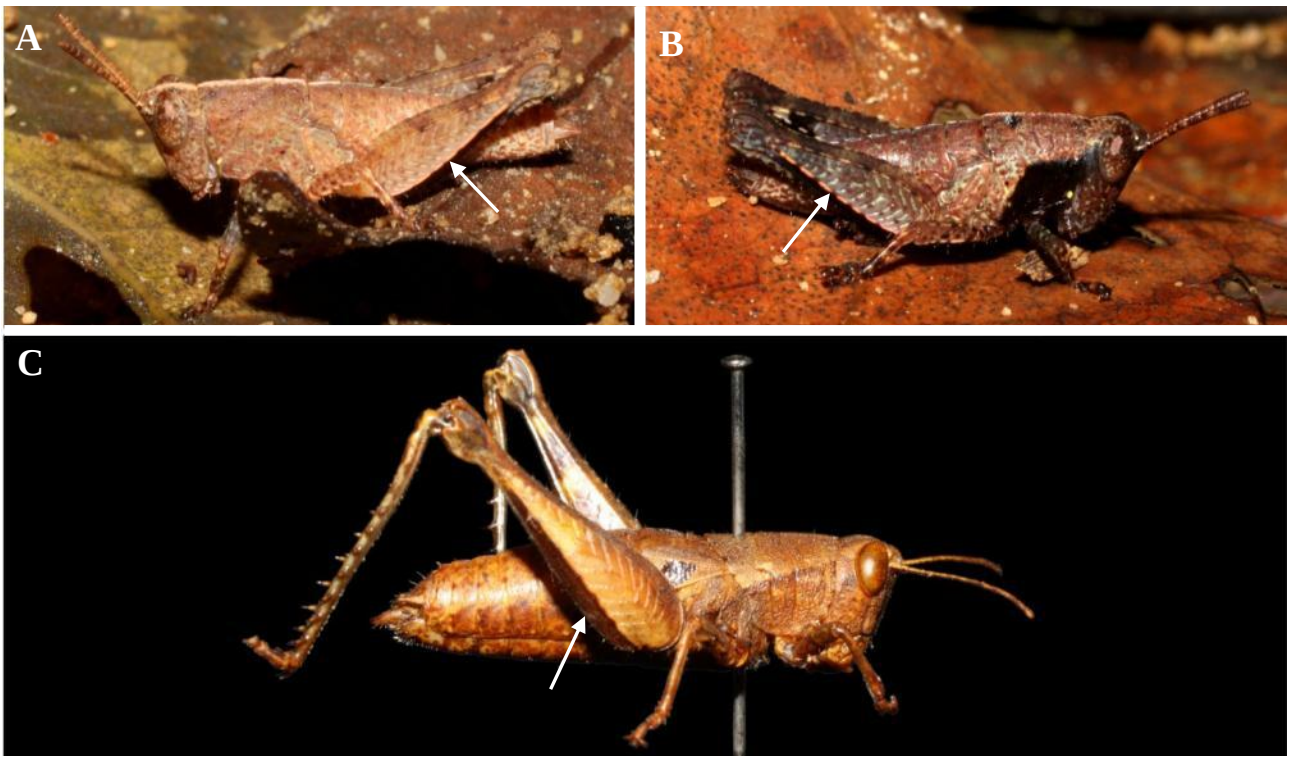

Fig. 6. *Sedulia* cf. *specularia*: A, B, nymphs (BL = ca. 12 mm) from Lornie Trail (LT); C, dry-pinned female adult (BTNR leaf litter, coll. D. H. Murphy, BL = 27.9 mm). The arrows indicate the characteristic black colouration with red margin on the ventro-external surface of the hind femora, observed in both the nymphs and the ZRC specimen. (Photographs by: Tan Ming Kai).

CONCLUSIONS

Owing to the limited time and resources, results on the community indices are inconclusive. Despite the lack in quantitative data, there is a good reason to suggest that BBC provides suitable habitats for orthopterans to thrive, perhaps more so than LT. Observational findings may illustrate that a healthy biodiversity exists in the vacant vegetation of BBC, as well as suggest that more orthopteran species are waiting to be discovered from both BBC and LT. Although the evidence is more indicative than convincing, given the rate of habitat loss in Singapore, such a baseline comparison between the vacant BBC and the legally protected LT allows a quick assessment of the conservation value of a specific site.

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