

## A CHECKLIST OF ORTHOPTERA IN SINGAPORE PARKS

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**ABSTRACT.** — The diversity of Orthoptera of urban parks in Singapore is inventorised. At least 61 species of Orthoptera were recorded from eight parks: Admiralty Park, Ang Mo Kio Town Garden West, Bukit Batok Nature Park, East Coast Park, Kent Ridge Park, Labrador Nature Reserve, Pasir Ris Park, and Sengkang Riverside Park.

**KEYWORDS.** — Orthoptera, inventory, urban parks, Singapore

### INTRODUCTION

This paper reports the inventory of Orthoptera found in some major urban parks of Singapore. Orthopterans are important biotic components of ecosystems, especially grassland (Belovski & Slade, 1993), but study of this taxon in Singapore is limited. In Singapore, historical deforestation (Corlett, 1992) has resulted in the formation of grassland sites that are known to contain orthopteran diversity (Tan, 2010a, 2010b, 2011a). Some of these grassland sites and secondary forest patches were subsequently developed into urban parks. There are more than 50 urban parks managed by the National Parks Board (NParks) that contain grassy as well as replanted habitats. The National Biodiversity Centre (NBC) of the NParks initiated a project to inventorise the orthopteran diversity in eight urban parks from Mar.2011 to Jun.2011. A total of eight parks which contain suitable orthopteran habitats were selected for investigation.

### METHODS

The orthopteran diversity was inventorised in eight urban parks with data collected from surveys conducted from Mar.2011 to Jun.2011. Surveys were carried out by one to three personnel, mostly in the morning (ca. 0700–1200 hours). In some parks, occasional night surveys (ca. 1900–2230 hours) were conducted to supplement data. A survey involved collecting data from a 20–50 m transect within an hour. Counts within 5–10 m of either side of the transect and only up to 2 m height were considered. Two to 4 transects were demarcated per park. Adults and nymphs of orthopteran species were identified by visual census, whenever possible. The numbers of adults and nymphs of each species were also recorded, whenever possible. Each park was surveyed between 2–6 times. The urban parks investigated, listed alphabetically, were (Fig. 1):

- 1) Admiralty Park (Nature Park)
- 2) Ang Mo Kio Town Garden West
- 3) Bukit Batok Nature Park
- 4) East Coast Park
- 5) Kent Ridge Park (Nature/Mountain biking Trail)
- 6) Labrador Nature Reserve
- 7) Pasir Ris Park
- 8) Sengkang Riverside Park

Any specimens collected were either dry-mounted or preserved in alcohol (70% or 90%) and deposited as voucher specimens at the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR), National University of Singapore. The classification of species is based on the Orthoptera Species File Online Version 2.0/4.0 (Eades et al., 2011). The families, subfamilies, and genera are arranged alphabetically for ease of reference.



Fig. 1. The locations of the eight parks surveyed for Orthoptera in Singapore Island.

## RESULTS

In total, 51 day (41) and night (10) surveys were conducted over four months in the eight parks (Fig. 2). Overall, at least 61 species of Orthoptera from 52 genera were recorded, representing nine families (Fig. 3). Family Tettigoniidae is represented by the greatest number of species (at least 19 species), whereas families Chorotypidae, Gryllacrididae, and Rhaphidophoridae are least represented (one species each). The orthopteran diversity in the eight parks differs markedly (Fig. 4). Of the eight parks investigated, Admiralty Park and Pasir Ris Park are richest in term of species diversity (34 and 33 species, respectively) while Kent Ridge Park is the poorest (12 species). The Appendix presents all the species recorded during the study.

## DISCUSSION

The study showed that the eight urban parks provide different habitats for different orthopterans. Grassy plots were surveyed in Sengkang Riverside Park (Fig. 5A, 5B), while forested plots were surveyed in parks such as Ang Mo Kio Town Garden West (Fig. 5C), Bukit Batok Nature Park, and Kent Ridge Park. In Admiralty Park (Fig. 5D), East Coast Park (Fig. 5E), Labrador Nature Reserve, and Pasir Ris Park (Fig. 5F, 5G), both forested and grassy plots were surveyed, whenever possible. Among the forested plots surveyed in different parks, it shall also be mentioned that mangrove forest along Sungei Tampines was surveyed in Pasir Ris Park while coastal forest was surveyed in Labrador Nature Reserve. In Admiralty Park, secondary forest located near to mangrove forest along Sungei Cina was investigated. Each of these parks displayed slightly different forest habitats, resulting in differences in the orthopteran diversity. It is, therefore, not always possible to compare the orthopteran diversity in these parks as the parks differ in habitats, and the numbers of day and night surveys conducted also varied among different parks.

Many of the surveyed parks, including Pasir Ris Park and Sengkang Riverside Park, are also adjacent to wasteland vegetation, which may hold interesting biodiversity (Tan et al., 2007; Tan, 2010a). Most of these wasteland sites are awaiting development (Corlett, 1992). Of particular interest is the the grassy vacant plot in presently-defunct Parkland Golf Driving Range within East Coast Park was found to be fairly rich and abundant in Orthoptera.

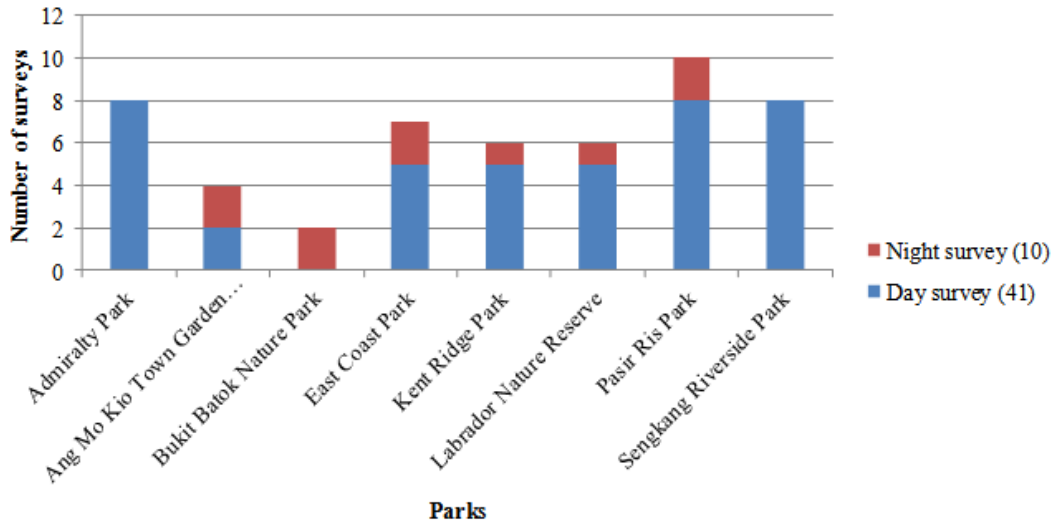


Fig. 2. Numbers of surveys conducted over the study period (Mar.2011 to Jun.2011) in the eight Singapore parks (numbers of surveys conducted in day and night in brackets).

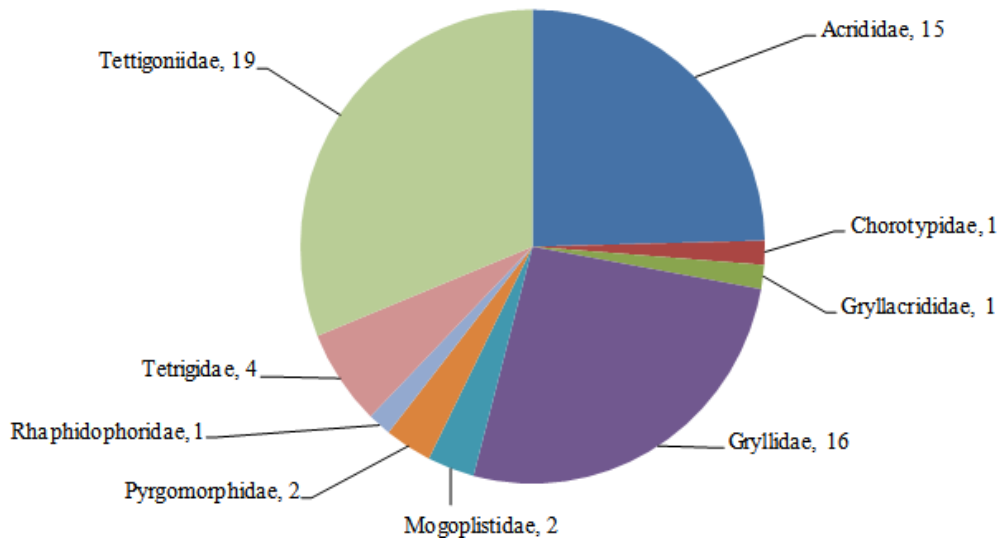


Fig. 3. Species numbers of Orthopteran families from the eight Singapore parks.

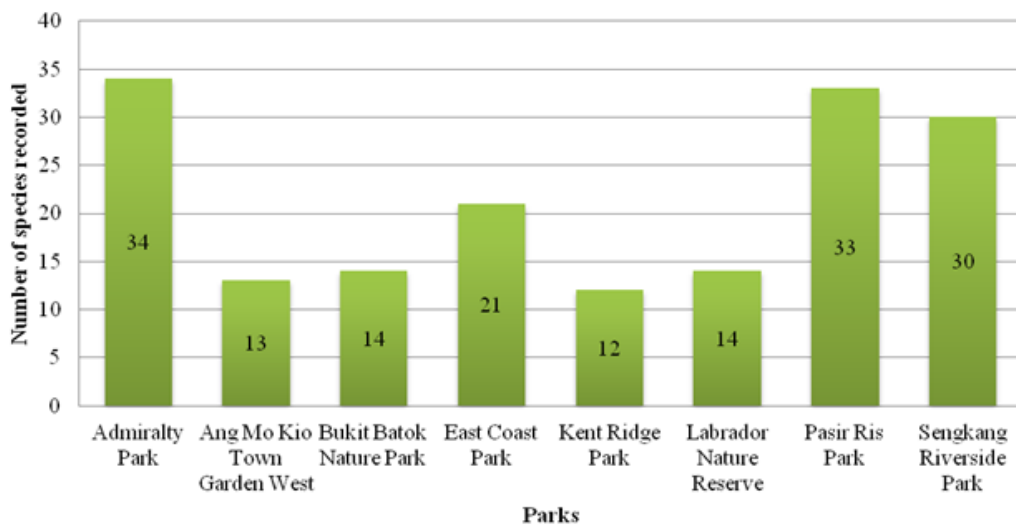


Fig. 4. Orthopteran species richness in the eight Singapore parks.





Fig. 5. Some of the orthopteran habitats found in Sengkang Riverside Park (A, B), Ang Mo Kio Town Garden West (C), Admiralty Park (Nature Park) along part of Sungei Cina (D), presently-defunct Parkland Golf Driving Range within East Coast Park (E) and Pasir Ris Park near car parks B and C (F, G).



Fifteen species out of the 21 species recorded in East Coast Park were found within the grassy areas and about 190 individuals (adults and nymphs) could be recorded per survey hour. In particular, *Acrida willemsei* Dirsh, which was previously only recorded in Pulau Ubin (Tan, 2010b), was observed in the grassy areas. These observations further corroborate the fact that interesting and rich biodiversity may be found in wasteland sites. While there has been no study of the ability of different orthopteran species to migrate across urbanised habitats in Singapore, it shall not be ruled out that the habitats in these urban parks may serve as residential sites for orthopteran populations from the wasteland sites after their clearance for development.

Although the inventory provides some insight into the orthoptera in the surveyed parks, the study of Orthoptera in urban parks in Singapore does not stop here. Owing to time and manpower constraints, only preliminary surveys were conducted in the eight parks. Long-term surveys, along with collections and deposition of specimens, will provide future research material. Similar studies in other parks around Singapore will also be necessary to provide a more comprehensive understanding of the Orthoptera in Singapore's parks. Moreover, it shall be mentioned that several species of genera or subfamilies of Orthoptera in the checklist are subject to taxonomic revision and changes in nomenclature. These also include the description of new species but this is beyond the scope of this paper. It is therefore evident that orthopteran research in Singapore is still far from exhaustive.

### CONCLUSIONS

Foundational work on the Orthoptera in Singapore was carried out by D. H. Murphy in the 1960s to 1980s (Chan, 1991). Since then, orthopteran-specific surveys were conducted in wasteland sites on mainland Singapore, parts of Pulau Ubin, Bukit Timah Nature Reserve, and Central Catchment Nature Reserve by TMK and collaborators for the past two years (Tan, 2010a, 2010b, 2011a, 2011b). This report adds to the understanding of the Orthoptera in Singapore, in particular in the parks of Singapore. Even in a highly urbanised Singapore, new records, rediscoveries, and even undescribed species are still being discovered from the small pockets of nature areas (Gorochov & Tan, 2011; Robillard, 2011; Tan, 2011b; Ingrisich & Tan, 2012; Tan, 2012). These show that there is a dearth in the knowledge of Orthoptera and signify the importance of conservation of natural habitats, without which many species would be lost without being discovered.

### ACKNOWLEDGEMENTS

TMK would like to express his gratitude to Chan J. Y. Jerelyn for her assistance in field. He is also grateful to the staff at the National Biodiversity Centre, National Parks Board for their support and guidance in the project. The authors thank Lim Li-Feng Rachel (National Biodiversity Centre) for the map of Singapore (Fig. 1). Collaborators mentioned refer to Jerelyn Chan, Leong Tzi Ming, and Henrietta P. M. Woo.

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## APPENDIX

Localities of orthopteran species at the eight urban parks surveyed in Singapore. Zoological Reference Collection (ZRC) catalogue numbers are provided for reference to the species identified to genus or higher levels, whenever possible. Legend: 1 = Admiralty Park (Nature Park); 2 = Ang Mo Kio Town Garden West; 3 = Bukit Batok Nature Park; 4 = East Coast Park; 5 = Kent Ridge Park; 6 = Labrador Nature Reserve; 7 = Pasir Ris Park; 8 = Sengkang Riverside Park; + = adult encountered; N = only nymph was encountered.

| SPECIES   | PARKS |   |   |   |   |   |   |   |
|---|-------|---|---|---|---|---|---|---|
|   | 1     | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| <b>FAMILY ACRIDIDAE</b>                                 |       |   |   |   |   |   |   |   |
| <b>Subfamily Acridinae</b>                              |       |   |   |   |   |   |   |   |
| <i>Acrida willemsei</i> Dirsh                           |       |   |   | N |   |   |   |   |
| <i>Phlaeoba antennata</i> Brunner von Wattenwyl         |       |   |   |   | + |   | + |   |
| <i>Phlaeoba infumata</i> Brunner von Wattenwyl          |       |   |   |   | N |   |   |   |
| <b>Subfamily Catantopinae</b>                           |       |   |   |   |   |   |   |   |
| <i>Apalacris varicornis</i> Walker                      | +     |   |   |   |   |   | + | + |
| <i>Traulia azureipennis</i> (Serville)                  | +     | + |   |   | + | + |   |   |
| <i>Xenocatantops humilis</i> (Serville)                 | +     |   | + | + | + | N | + | + |
| <b>Subfamily Coptacridinae</b>                          |       |   |   |   |   |   |   |   |
| <i>Epistaurus aberrans</i> Brunner von Wattenwyl        | +     |   |   |   |   |   | + | + |
| <b>Subfamily Cyrtacanthacridinae</b>                    |       |   |   |   |   |   |   |   |
| <i>Valanga nigricornis</i> (Burmeister)                 |       |   |   | N |   | N | N | N |
| <b>Subfamily Oedipodinae</b>                            |       |   |   |   |   |   |   |   |
| <i>Aiolopus thalassinus tamulus</i> (Fabricius)         |       |   |   |   |   |   |   | + |
| <i>Trilophidia annulata</i> (Thunberg)                  | +     | + | N |   |   |   |   | + |
| <b>Subfamily Oxyinae</b>                                |       |   |   |   |   |   |   |   |
| <i>Gesonula mundata</i> (Walker)                        | +     |   |   |   |   |   |   |   |
| <i>Oxya hyla intricata</i> (Stål)                       | +     | + |   | + |   | + | + | + |
| <i>Oxya japonica japonica</i> (Thunberg)                | +     | + |   | + |   | + | + | + |
| <i>Pseudoxya diminuta</i> (Walker)                      | +     | + | + | + | + | + | + | + |
| <b>Subfamily Spathosterninae</b>                        |       |   |   |   |   |   |   |   |
| <i>Spathosternum prasiniferum</i> (Walker)              | N     |   |   | + |   |   | + | + |
| <b>FAMILY CHOROTYPIDAE</b>                              |       |   |   |   |   |   |   |   |
| <b>Subfamily Erianthinae</b>                            |       |   |   |   |   |   |   |   |
| <i>Erianthus</i> species (ZRC.ORT.209)                  | +     | + | N |   |   |   |   |   |
| <b>FAMILY GRYLLACRIDIDAE</b>                            |       |   |   |   |   |   |   |   |
| <b>Subfamily Gryllacridinae</b>                         |       |   |   |   |   |   |   |   |
| <i>Gryllacris</i> species (ZRC.ORT.122)                 |       |   |   | N |   |   | N |   |
| <b>FAMILY GRYLLIDAE</b>                                 |       |   |   |   |   |   |   |   |
| <b>Subfamily Eneopterinae</b>                           |       |   |   |   |   |   |   |   |
| <i>Cardiodactylus singapura</i> Robillard               | N     |   | N |   |   |   |   |   |
| <i>Lebinthus</i> species (ZRC.ORT.294)                  |       |   |   |   |   | + |   |   |
| <i>Nisitrus vittatus</i> (de Haan)                      | +     | + | N |   | + | + |   | + |
| <b>Subfamily Euscyratinae</b>                           |       |   |   |   |   |   |   |   |
| <i>Euscyrtus concinnus</i> (de Haan)                    | +     |   |   | + |   | + | + | + |
| <i>Patiscus</i> species (ZRC.ORT.48, 336)               |       |   |   |   |   |   |   | + |
| <b>Subfamily Gryllinae</b>                              |       |   |   |   |   |   |   |   |
| <i>Gymnogryllus</i> species (ZRC.ORT.156)               |       |   | + |   | + |   |   |   |
| <i>Gryllus bimaculatus</i> De Geer                      |       | + |   |   |   |   |   |   |
| <i>Velarifictorus aspersus</i> (Walker)                 |       | + | + |   | + | N | N | N |
| <b>Subfamily Nemobiinae</b>                             |       |   |   |   |   |   |   |   |
| <i>Pteronemobius</i> species (ZRC.ORT.310)              | +     |   |   | + |   |   | + | + |
| <b>Subfamily Oecanthinae</b>                            |       |   |   |   |   |   |   |   |
| <i>Oecanthus</i> species (ZRC.ORT.98, 325)              |       |   |   | + |   |   |   | + |
| <b>Subfamily Trigonidiinae</b>                          |       |   |   |   |   |   |   |   |
| <i>Amusurgus</i> species (ZRC.ORT.218)                  |       | + | + |   |   |   |   |   |
| <i>Anaxipha</i> (American genus?) species (ZRC.ORT.261) | +     |   |   |   |   |   | N |   |
| <i>Homoeoxipha lycoides</i> (Walker)                    | N     |   |   |   |   |   | + |   |
| <i>Metioche pallipes</i> (Stål)                         |       |   |   | + |   |   |   | + |

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| SPECIES   | PARKS |   |   |   |   |   |   |   |
|---|-------|---|---|---|---|---|---|---|
|   | 1     | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| <i>Sivistella</i> species (ZRC.ORT.352)                       |       |   |   |   |   |   |   | + |
| Trigonidiinae species (unidentified)                          | +     |   |   |   |   |   |   |   |
| <b>FAMILY MOGOPLISTIDAE</b>                                   |       |   |   |   |   |   |   |   |
| <b>Subfamily Mogoplistinae</b>                                |       |   |   |   |   |   |   |   |
| <i>Ornebius</i> species (ZRC.ORT.46)                          | +     |   |   | + |   | + |   |   |
| <i>Ornebius</i> species (ZRC.ORT.357)                         |       |   |   |   |   |   |   | + |
| <b>FAMILY PYRGOMORPHIDAE</b>                                  |       |   |   |   |   |   |   |   |
| <b>Subfamily Pyrgomorphinae</b>                               |       |   |   |   |   |   |   |   |
| <i>Atractomorpha psittacina psittacina</i> (de Haan)          | +     |   |   | + |   |   | + | + |
| <i>Tagasta marginella</i> (Thunberg)                          | +     |   |   |   |   |   | N | + |
| <b>FAMILY RHAPHIDOPHORIDAE</b>                                |       |   |   |   |   |   |   |   |
| <b>Subfamily Rhaphidophorinae</b>                             |       |   |   |   |   |   |   |   |
| <i>Rhaphidophora</i> species (ZRC.ORT.114)                    |       |   |   |   |   | N |   |   |
| <b>FAMILY TETRIGIDAE</b>                                      |       |   |   |   |   |   |   |   |
| <b>Subfamily Scelimeninae</b>                                 |       |   |   |   |   |   |   |   |
| <i>Thoradonta</i> species (ZRC.ORT.36)                        |       |   |   |   |   | + |   |   |
| Scelimeninae species (unidentified)                           |       | N | N |   |   | + |   | + |
| <b>Subfamily Tetrigidae</b>                                   |       |   |   |   |   |   |   |   |
| <i>Coptotettix</i> species (unidentified)                     | +     | + | + |   |   | + |   | + |
| Tetriginae species (unidentified)                             | +     |   | N |   |   |   |   |   |
| <b>FAMILY TETTIGONIIDAE</b>                                   |       |   |   |   |   |   |   |   |
| <b>Subfamily Conocephalinae</b>                               |       |   |   |   |   |   |   |   |
| <i>Conocephalus borneensis</i> (Redtenbacher)                 |       |   |   |   |   |   |   | + |
| <i>Conocephalus cognatus</i> (Redtenbacher)                   |       |   |   |   |   |   |   | + |
| <i>Conocephalus longipennis</i> (de Haan)                     | +     |   |   |   |   |   |   | + |
| <i>Conocephalus maculatus</i> (Le Guillou)                    | +     |   |   | + |   |   | + | + |
| <i>Conocephalus melaenus</i> (de Haan)                        | +     |   |   |   |   |   |   | + |
| Copiphorini species (ZRC.ORT.64, 09, 59, 01)                  |       |   |   |   |   |   |   | N |
| <i>Euconocephalus pallidus</i> (Redtenbacher)                 |       |   |   |   | + |   |   |   |
| <b>Subfamily Listroscelidinae</b>                             |       |   |   |   |   |   |   |   |
| <i>Hexacentrus unicolor</i> Serville                          | +     |   | + | + |   |   |   | N |
| <b>Subfamily Meconematinae</b>                                |       |   |   |   |   |   |   |   |
| Meconematini c.f. <i>Alloteratura</i> species (ZRC.ORT.179)   | +     |   |   |   |   |   |   |   |
| Meconematini c.f. <i>Alloteratura</i> species 2 (ZRC.ORT.256) |       |   | + |   |   |   |   |   |
| <b>Subfamily Mecopodinae</b>                                  |       |   |   |   |   |   |   |   |
| <i>Mecopoda elongata</i> (Linnaeus)                           | N     | + |   | + |   |   |   | + |
| <b>Subfamily Phaneropterinae</b>                              |       |   |   |   |   |   |   |   |
| <i>Ducetia japonica</i> (Thunberg)                            | +     |   |   | N |   |   |   | + |
| <i>Elimaea subcarinata</i> (Stål)                             | N     |   |   |   |   |   |   | + |
| <i>Phaneroptera brevis</i> (Serville)                         | +     |   |   | N |   |   |   | + |
| Phaneropterinae species 1 (unidentified)                      | N     |   |   | N |   | N |   | N |
| Phaneropterinae species 2 from mangrove (unidentified)        |       |   |   |   |   |   |   | N |
| Phaneropterinae species 3 from mangrove (unidentified)        |       |   |   |   |   |   |   | N |
| <i>Arnobia</i> species (ZRC.ORT.171)                          | N     |   |   |   |   |   |   |   |
| <b>Subfamily Pseudophyllinae</b>                              |       |   |   |   |   |   |   |   |
| Pseudophyllinae species (unidentified)                        |       |   |   |   |   |   | N |   |