THE ORTHOPTERA OF SEMAKAU LANDFILL, SINGAPORE:
A PROJECT SEMAKAU CHECKLIST

Ming Kai Tan¹ and Luan Keng Wang²

¹Department of Biological Sciences, National University of Singapore
14 Science Drive 4, Singapore 117543, Republic of Singapore
²Raffles Museum of Biodiversity Research, Department of Biological Sciences, National University of Singapore
6 Science Drive 2, Singapore 117546, Republic of Singapore

(*Corresponding author: tmk1990@hotmail.com)

ABSTRACT. — The list of Orthoptera at the Semakau Landfill was compiled. At least 20 species were recorded from terrestrial surveys conducted during Project Semakau from Nov.2009 to Feb.2012. In Singapore, Gonista cf. bicolor (de Haan) is postulated to be restricted to the Semakau Landfill and appears to be the first published record for Singapore.

KEY WORDS. — Orthoptera, inventory, Semakau Landfill, Project Semakau, Singapore

INTRODUCTION

This paper contains an inventory of Orthoptera (Insecta) at the Semakau Landfill. Located in the Straits of Singapore, the Semakau Landfill is made from the merging of two offshore islands, Pulau [= Island] Semakau and Pulau Sakeng, by land reclamation (Fig. 1). As part of an attempt to assess the biodiversity found on this offshore landfill, Project Semakau was initiated by the Raffles Museum of Biodiversity Research to collect data through scientific surveys with the aid of the community and volunteers.

The landfill consists of cells filled with incinerated waste as well as construction debris that could not be incinerated. After each cell has been filled, 30 cm of top soil will be used to cover the cell. Natural succession will then take place, resulting in open country habitats with tall grasses, shrubs, and some trees, from seeds brought in by the wind or by birds. As the grassland matures, many animals that thrive in such open country habitats colonise the area. Several terrestrial surveys were made in these landfill cells.

Based on the specimens collected during the terrestrial surveys, a preliminary inventory of the orthopteran fauna in the Semakau Landfill is presented. Colour images of some noteworthy species (some of which are yet to be conclusively identified) are also presented for future comparisons. Among the several publications on Semakau’s biodiversity (Tan & Yeo, 2010; Chua, 2011; Teo et al., 2011; Wang & Yeo, 2011), this is the first on the landfill’s insect fauna. It is also the first checklist of Orthoptera from the southern islands of Singapore, adding to a number of publications on the orthopteran fauna of Singapore (Tan, 2010a, 2010b, 2012; Tan et al., 2012).

METHODS

Sweep-netting collections were conducted during terrestrial surveys. Specimens were collected by sweep-nets in the filled cells as well as the secondary forests (Fig. 2). In total, 12 surveys were conducted from Nov.2009 to Feb.2012: 7–8 Nov.2009, 5 Dec.2009, 23–24 Oct.2010, 7–8 May 2011, 18 Jun.2011, 13 Aug.2011, 26–27 Nov.2011, and 18 Feb.2012. As it is not possible to accurately identify nymphs to species level, only adult specimens were included in the inventory. Specimens were collected, pinned, and examined. Photographic images were obtained with a digital SLR with compact-macro lens, and measurements were made using a vernier caliper with precision of 0.05 mm. Specimens were subsequently deposited in the Zoological Reference Collection (ZRC) of the Raffles Museum of Biodiversity Research (RMBR), National University of Singapore, and catalogued under ZRC.ORT.369–398. Classification was based on the Orthoptera Species File Online Version 2.0/4.1 (Eades et al., 2012). The families, subfamilies, and genera are arranged alphabetically for ease of reference. Measurement given in the figures indicates the body length of dry-pinned specimens.
Fig. 1. A satellite image of the Semakau Landfill. (Photograph by: CRISP).

Fig. 2. Different terrestrial habitats on the Semakau Landfill in which sweep-netting was carried out: A, B, grassy plots of filled cells, and C, secondary forest.
RESULTS

Twenty known species from six families were recorded from the Semakau Landfill and examined. More species of the suborder Caelifera (grasshoppers) were recorded compared to that of the suborder Ensifera (crickets and katydids) (12 and eight species, respectively), although both suborders are represented with three families each. The family Acrididae is the largest with eight species, within the Caelifera and overall diversity. This is followed by the family Tettigoniidae with four species.

Order Orthoptera (20 species)
  Suborder Caelifera (12 species)
    Family Acrididae (8 species)
    Family Pyrgomorphidae (2 species)
    Family Tettigidae (2 species)
  Suborder Ensifera (8 species)
    Family Gryllidae (3 species)
    Family Mogoplistidae (1 species)
    Family Tettigoniidae (4 species)

ORTHOPTERA RECORDED FROM SEMAKAU LANDFILL

SUBORDER CAELIFERA

FAMILY ACRIDIDAE

Subfamily Catantopinae

*Xenocatantops humilis* (Serville)
Material examined. — ZRC.ORT.369, 1 female, forest, 5 Dec.2009.

Subfamily *Cyrtacanthacridinae*

*Valanga nigricornis* (Burmeister) (Fig. 3)
Remark. — Although no adult specimen was collected, an adult was photographed on 13 Aug.2011 (Fig. 3).
Subfamily *Gomphocerinae*

**Gonista cf. bicolor** (de Haan) (Fig. 4)
Material examined. — ZRC.ORT.371, 1 male, landfill, 8 Nov. 2009; ZRC.ORT.372, 1 female, landfill, 8 May 2011; ZRC.ORT.373, 2 females, landfill, 18 Jun. 2011.
Remarks. — This represents the first published record for Singapore (Willemse, 2001; Eades et al., 2012). There was no previous publication on this species in Singapore even though voucher specimens collected from Kent Ridge in 1970 and 1975 by D. H. Murphy were deposited in the ZRC.

![Gonista cf. bicolor](image)

Subfamily *Oedipodinae*

**Aiolopus thalassinus tamulus** (Fabricius)
Material examined. — ZRC.ORT.374, 1 male, landfill, 4 Dec. 2009.

**Gastrimargus marmoratus** (Thunberg) (Fig. 5)
Material examined. — ZRC.ORT.375, 1 male, landfill, 8 Nov. 2009.
Subfamily Oxyinae

**Gesonula mundata** (Walker)

**Oxya hyla intricata** (Stål)
Material examined. — ZRC.ORT.377, 1 male, landfill, 7 Nov.2009.

**Oxya japonica japonica** (Thunberg)
Material examined. — ZRC.ORT.378, 3 males, landfill, 8 Nov.2009; ZRC.ORT.379, 1 male, landfill, 4 Dec.2009.

FAMILY PYRGOMORPHIDAE

Subfamily Pyrgomorphinae

**Atractomorpha** sp.
Material examined. — ZRC.ORT.380, 3 males, landfill, 7 Nov.2009; ZRC.ORT.381, 1 male, landfill, 8 Nov.2009; ZRC.ORT.382, 1 female, landfill, 8 May 2011; ZRC.ORT.383, 2 males, 2 females, landfill, 23/24 Oct.2010.

**Tagasta marginella** (Thunberg)
Material examined. — ZRC.ORT.384, 1 male, forest, 27 Nov.2009.

FAMILY TETRIGIDAE

Subfamily Scelimeninae

**Loxilobus** spp. (Fig. 6)
Material examined. — ZRC.ORT.385, 2 females, 18 Feb.2012.
Remark. — This genus is in need of revision before species can be determined (Kevan, 1966; Tan, 2012; H. Devriese, in litt.).

Subfamily Tetriginae

**Euparatettix** sp. (Fig. 7)
Material examined. — ZRC.ORT.386, 1 female, landfill, 7 Nov.2009.
Fig. 6. *Loxilobus* sp.: ZRC.ORT.385, female, 9.8 mm.

Fig. 7. *Euparatettix* sp.: ZRC.ORT.386, female, 10.5 mm.
Suborder Ensifera

Family Gryllidae

Subfamily Eneopterinae

*Lebinthus* sp. (Fig. 8)

Material examined. — ZRC.ORT.387, 1 female, forest, 5 Dec. 2009; ZRC.ORT.388, 1 male, forest, 27 Nov. 2011; ZRC.ORT.389, 1 female, 18 Feb. 2012.

Remark. — Examination of the male genitalia indicates that this species is *not Lebinthus bitaeniatus* Stål, and it may be an undescribed species.

Fig. 8. *Lebinthus* sp.: A, ZRC.ORT.387, female, 15.2 mm; B, ZRC.ORT.388, male, 15.5 mm.
Subfamily *Oecanthinae*

**Oecanthus** sp. (Fig. 9)

![Fig. 9. Oecanthus sp.: ZRC.ORT.392, male, 13.4 mm.](image)

Subfamily *Trigonidiinae*

**Metioche pallipes** (Stål)
Material examined. — ZRC.ORT.393, 1 male, landfill, 7 Nov. 2009.

**FAMILY MOGOPLISTIDAE**

Subfamily *Mogoplistinae*

**Ornebius** sp. (Fig. 10)
Material examined. — ZRC.ORT.394, 2 females, 18 Feb. 2012.

![Fig. 10. Ornebius sp.: ZRC.ORT.394, female, 10.8 mm.](image)
FAMILY TETTIGONIIDAE

Subfamily Conocephalinae

Conocephalus maculatus (Le Guillou)
Material examined. — ZRC.ORT.395, 1 female, landfill, 7 Nov. 2009; ZRC.ORT.395, 1 male, landfill, 7 May 2011.

Subfamily Mecopodinae

Mecopoda elongata (Linnaeus)
Material examined. — ZRC.ORT.396, 1 male, forest, 27 Nov. 2011.

Subfamily Phaneropterinae

Ducetia japonica (Thunberg)
Material examined. — ZRC.ORT.397, 1 male, landfill, 7 Nov. 2009.

Phaneroptera brevis (Serville)
Material examined. — ZRC.ORT.398, 1 male, 1 female, landfill, 7 Nov. 2009

DISCUSSION

Of the orthopteran species recorded, most are fairly common and also occur on Singapore Island. The record of Gonista cf. bicolor, however, is an exception. Last collected from Kent Ridge in 1970 and 1975, there was no sighting during recent orthopteran studies by Tan and others on Singapore Island, including Kent Ridge Park, and offshore islands such as Pulau Ubin since 2009 (Tan 2010a, 2010b, 2012; Tan et al., 2012; M. K. Tan, per. obs.). Without further investigation, it is not possible to establish if this is a result of local extinction on Singapore Island or that of poor sampling. Thus far, it may only be postulated that Gonista cf. bicolor may hitherto be restricted to the Semakau Landfill, even though the documentation of its existence in Singapore is still positive.

Based on the material acquired, it appears that more species of Orthoptera were recorded from the grassy plots of the landfill cells as compared to the coastal forest (14 and four, respectively, and two species unknown). The species appear to be restricted to the respective habitats they were collected from. This, however, does not necessarily represent the overall orthopteran diversity in the two different terrestrial habitats on Pulau Semakau. This is because nocturnal surveys were not conducted and many forest-dwelling orthopterans tend to be nocturnal. As most katydids and crickets are more active at night, this could explain the greater diversity of grasshoppers obtained on the surveys. There are species of Orthoptera which were sighted but not collected. These include a slime cricket (Gryllidae: Euscyrtinae: cf. Beybienkoana species) photographed on 7 May 2011 (Fig. 11). It is therefore evident that the inventory of Orthoptera

Fig. 11. Beybienkoana sp., taken on 7 May 2011. (Photograph by: Ahmad Syalabi Adi Sunaryo).
from the Semakau Landfill presented here is not exhaustive, and more species are still waiting to be discovered. Given the limited material collected, it is also not possible to comment on the relative abundance of the different orthopteran species. To have a comprehensive understanding of the Orthoptera from the Semakau Landfill, continuous monitoring of the fauna may be necessary.

ACKNOWLEDGEMENTS

The authors thank sponsorship from the Hongkong and Shanghai Banking Corporation Limited (HSBC) which made Project Semakau possible; the National Environment Agency (NEA) for granting access to the landfill for surveys and for assistance with the transport logistics at Semakau Landfill; the Project Semakau volunteers who helped in the surveys and assisted in pinning the specimens; the Centre for Remote Imaging, Sensing and Process (CRISP) for the satellite image of the Semakau Landfill (Fig. 1); Lua Hui Kheng for granting access to examine the orthopteran specimens from Project Semakau under her care at the Zoological Reference Collection, Raffles Museum of Biodiversity Research; and Martina Chia and Ahmad Syalabi Adi Sunaryo for permitting the use of their photographs.

LITERATURE CITED