

Modelling Distribution of *Onthophagus* Species (Coleoptera: Scarabaeidae) in Sarawak

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ABSTRACT

Dung beetles (Genus: *Onthophagus*) are members of the family Scarabaeidae and the subfamily Scarabaeinae. Despite their small size and unattractive appearance, dung beetles play an important role in the ecosystem, and they are widely recognised as one of the most effective bioindicators of ecosystem health. Although there has been an increase in dung beetle studies in Peninsular Malaysia, there are very few ecological studies of dung beetles conducted in Sarawak, despite being the largest state of Malaysia. Therefore, this study aims to provide recent information on the distributions of dung beetles from the genus *Onthophagus* in Sarawak. A total of 32 occurrences data for eight selected *Onthophagus* species representing 11 localities were successfully recorded. All analyses were performed using the Maximum Entropy Modelling Version 3.4.4 (MaxEnt) and Quantum Geographic Information Systems 3.28.2 (QGIS) software. It is revealed that most dung beetles' distributions are strongly influenced by temperature and precipitation which suggests its capabilities as a bioindicator to identify high biodiversity areas. In conclusion, this study could be beneficial to identify the potential hotspot areas for biodiversity conservation and effective management practices in Sarawak.

Keywords: Coleoptera, distribution, dung beetles, modelling, Sarawak

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INTRODUCTION

Sarawak is known for its mega biodiversity with distinct ecosystems, of which its forests vary from typical hill mixed dipterocarp forest, peat swamp forest, and mangrove forest to heath forest, montane forest, and limestone forest (Hazebroek & Abang Kashim, 2000; Forest Department Sarawak, 2020). This emphasises the diversity and abundance of species-rich organisms, particularly insects. Beetles under the class Insecta, are well-adapted to both terrestrial and freshwater environments. They can survive in a variety of environments due to their diverse range of feeding behaviours (Krinsky, 2002). Even so, some beetles are highly sensitive to disturbance such as the dung beetles (Kakkar & Gupta, 2010).

Dung beetles from the genus *Onthophagus*, classified under the subfamily of Scarabaeinae (Bosuang *et al.*, 2017) are also known as dung chafers and tumblebugs (Gaur *et al.*, 2020).

These scarab beetles can be distinguished through their distinctive antennae that end in three flattened plates that form a club, which are mostly dull black and some are metallic green (Triplehorn & Johnson, 2005; Gaur *et al.*, 2021). According to Howden and Cartwright (1963), over 1400 *Onthophagus* species have been described globally, with approximately 332 species recorded from Asia.

Despite their small size and unattractive appearance, dung beetles play important roles in the ecosystem as the most effective bioindicators of environmental and landscape changes (Davis *et al.*, 2001; Saleh *et al.*, 2014; Goh & Hashim, 2019; Djamel *et al.*, 2021). Their occurrences are assumed to be associated with the presence of other vertebrates through droppings, of which the scarab beetles functioning as decomposers (Kakkar & Gupta, 2010; Goh & Hashim, 2019). In addition, they also play significant roles in other ecological functions from soil aeration and