

Developing strategies to improve METT scores and overall management effectiveness in selected Malaysian Protected Areas

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SUPPLEMENTARY ONLINE MATERIAL 1: DETAILED STUDY AREA

Peninsular Malaysia

The project involved ten PAs in Peninsular Malaysia including national parks, wildlife reserves and a Ramsar site. These PAs consist primarily of lowland dipterocarp forests that encompass unique ecosystems and are home to a variety of flora and fauna species. Tengku Hassanal Wildlife Reserve, Tioman Island Wildlife Reserve, Sungkai Wildlife Reserve and Sungai Dusun Wildlife Reserve are designated as Category I (Strict Nature Reserves/Wilderness Area). These sites are managed with minimal human disturbance and encompasses pristine tracts of forests. Several PAs in Peninsular Malaysia included in this project were designated as Category II (National Parks) including the Pahang National Park, Terengganu National Park, Kelantan National Park and Penang National Park. The Pahang National Park, Terengganu National Park and Kelantan National Park, which are collectively known as the Taman Negara National Park, have some of the oldest expanse of tropical rainforest found in the world. On the other hand, Penang National Park boasts of a unique feature, the meromictic lake, which is found within the park (Abas *et al.*, 2016). This lake has layers of water that do not mix due to differences in densities, and therefore able to feature a distinct separation of the water layers (Abas *et al.*, 2016; Hong & Chan, 2010). There were also two Category V PAs included in this project from Peninsular Malaysia, namely, the Tasek Bera Ramsar Site and Tanjung Tuan Wildlife Reserve. The former encompasses the largest freshwater lake found in Malaysia and was designated as Malaysia's first Ramsar site in 1994 (Mokbolhassan, 2014), while the latter has been designated as an Important Bird Area (BirdLife International, 2024) and is the sole coastal forest on the west coast of Peninsular Malaysia that has been gazetted as a wildlife reserve (Bernama, 2020).

Sabah

Initially, the workshop conducted in Sabah involved five PA management agencies and the METT assessment was initiated for eight sites in Sabah. However, the assessments were not completed for seven sites by the end of the workshop due to time limitations and only one site in Sabah, the Sugud Island Marine Conservation Area (SIMCA), was able to complete the METT assessment. Therefore, only this site's assessment score has been considered in this paper. SIMCA which is a Category II PA, encompasses three islands, namely, Lankayan, Billean and Tegaipil and is currently co-managed by the Sabah Wildlife Department and Reef Guardian, a non-profit company in Sabah, Malaysia (Teh *et al.*, 2008). This site is well-known for its marine biodiversity including marine fishes, seagrass bed and coral reef (Gan *et al.*,

2021; Teh *et al.*, 2008; Chung *et al.*, 2017; Chung & Komilus, 2012) and is part of the Coral Triangle region.

Sarawak

The project involved five sites in Sarawak, namely, Bako National Park, Kuching Wetlands National Park, Mulu National Park, Niah National Park and Santubong National Park, all of which are categorised under IUCN Management Category II (National Park).

Bako National Park is characterised by heath, beach and mangrove forests (Mohamad Bukhori *et al.*, 2022) and is home to over 200 species of fauna (Zahidin *et al.*, 2016). Niah National Park showcases a network of caves that is of important archaeological significance (Reynolds *et al.*, 2013) and includes limestone and peat swamp forest (Anwarali Khan *et al.*, 2008). Similarly, the Mulu National Park is also known for some of the more extensive cave networks in Southeast Asia (Gillieson & Clark, 2010). It is also characterised by mixed dipterocarp, heath and limestone forests (Proctor *et al.*, 1983). Additionally, Kuching Wetlands National Park consists of mangrove and heath forest which is the habitat for over 70 flora species including protected species (Noorhana *et al.*, 2016). This site has also been designated as a Ramsar site in 2005. The Santubong National Park consists mainly of beach and mangrove forests and has some areas of heath forest (Mohamad Bukhori *et al.*, 2022; Mohd Azlan *et al.*, 2019).