Tropical Peatland Biodiversity and Conservation in Southeast Asia

FOREWORD

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Tropical peatland is the most biodiverse of peatland environments, yet also amongst the most threatened (Page *et al.* 2006, Yule 2010, Turetsky *et al.* 2015). This is particularly true in Southeast Asia, where large peat deposits (Page *et al.* 2011) have formed beneath rich tropical rainforests. These forests support a wide variety of flora and fauna including numerous globally threatened species (Figures 1, 2). Posa *et al.* (2011) report that 45 % of mammal and 33 % of bird species recorded in tropical peat swamp forests have an IUCN Red List status of near threatened or higher. This includes iconic flagship species such as the orangutan (*Pongo* spp.), gibbon (Hylobatidae), tiger (*Panthera tigris*), clouded leopard (*Neofelis diardi*) and Storm's stork (*Ciconia stormi*), to mention but a few. Tropical peatlands also provide important ecosystem services that benefit both local and international communities, including flood and fire prevention, carbon sequestration and storage, provision of timber and non-timber forest products, and cultural and spiritual wellbeing (Page & Rieley 1998, Page *et al.* 2011, Harrison 2013, MoEF 2018).

Despite this, Southeast Asia's peatlands and their biological communities face a variety of threats including agricultural conversion and logging,

Figure 1. Bornean orangutan (*Pongo pygmaeus wurmbii*). Photo: Andrew Walmsley / BNF.

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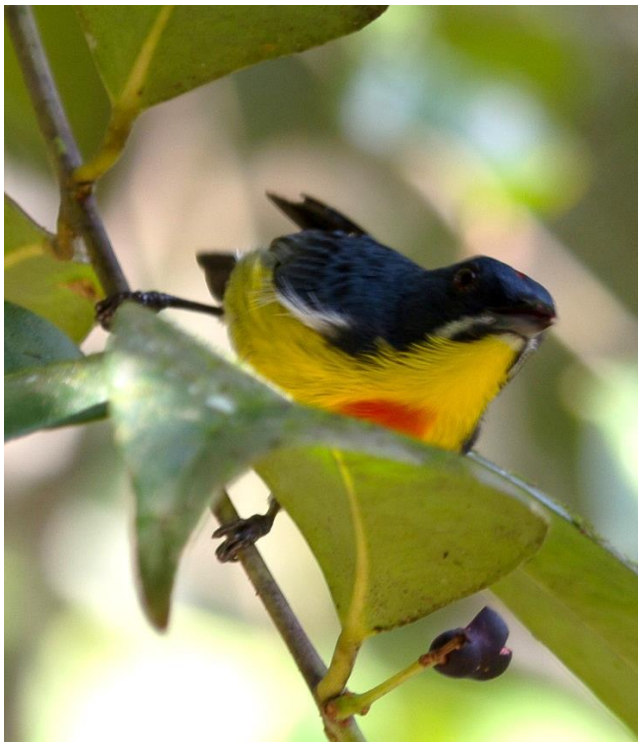
subsequent peat drainage and fire, plus direct wildlife killing and exploitation (Nijman 2005, Meijaard *et al.* 2011, Miettinen *et al.* 2016, Page & Hooijer 2016, Wijedasa & *al.* 2017). These threats are exemplified by the devastating fires that have become increasingly common over the last 20 years (Page *et al.* 2002), burning large areas of peatland (Figure 3) and shrouding the region in toxic haze (Figure 4). During July–November 2015, for example, nearly 98,000 fire hotspots were detected across Peninsular Malaysia, Borneo and Sumatra, 53 % of which were on peatland (Miettinen *et al.* 2017). These fires burned 0.8 Mha of peatland in maritime Southeast Asia during September–October 2015, releasing 227 ± 67 Tg of carbon into the atmosphere (Huijnen *et al.* 2016). Sixty-nine million people were exposed to unhealthy levels of gaseous and particulate pollutants (Crippa *et al.* 2016), with some estimates suggesting that this resulted in up to 100,300 premature mortalities (Koplitz *et al.* 2016). The fires and haze have also been shown to have negative impacts on biodiversity in both Singapore (Lee *et al.* 2017) and Central Kalimantan (Harrison *et al.* 2016).

The importance of tropical peatlands for biodiversity conservation and the threats that this biodiversity faces are becoming increasingly understood (e.g., Yule 2010, Posa *et al.* 2011). However, there is much we still do not know about the biodiversity of these ecosystems, which is a hindrance to their effective conservation. There have been few intensive studies of the biodiversity of tropical peatland sites in Southeast Asia. Even fewer have been published in accessible media, and there is a heavy bias towards studies of flagship taxa such as orangutans and felids. For example, in the Sebangau peat swamp forest of Central Kalimantan, Indonesia, where we have a long history of research, much has been learned and published about the orangutan population (e.g., Morrogh-Bernard *et al.* 2003, Harrison *et al.* 2010, Morrogh-Bernard *et al.* 2014) but we know next to nothing about most of the site's other species apart from the fact that they are there. Recent interest in tropical peat swamp forests for Reduced Emissions from Deforestation and Degradation (REDD+) projects has resulted in compilation of species list records and population estimates for many previously un(der)studied sites (e.g., Katingan, Central Kalimantan; PT. RMU 2015), but most of these studies have not been published in peer reviewed literature. Hardly any information on biodiversity is available for most Southeast Asian peatlands, particularly outside of Indonesia, Malaysia and Brunei (e.g., the island of Papua remains highly under-represented).

Consequently, knowledge of key biodiversity-related issues in Southeast Asian tropical peatlands



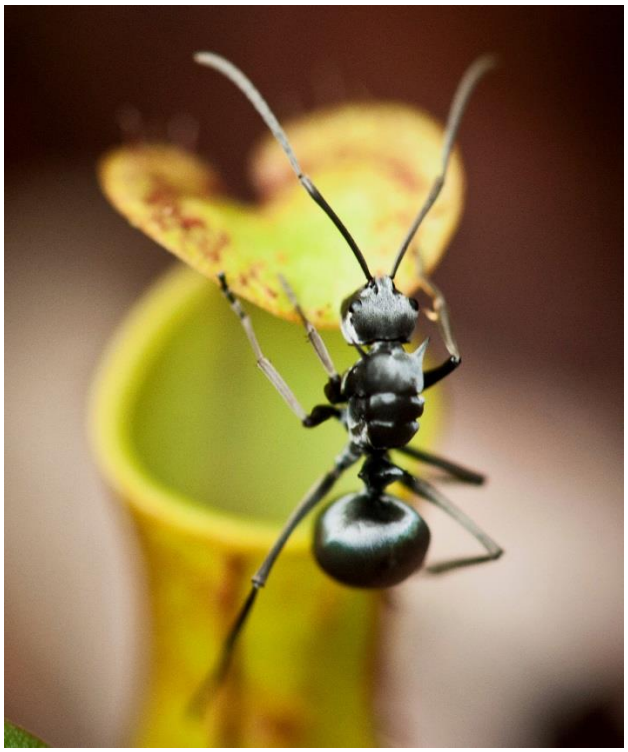


Figure 2. Left: the crimson-breasted flowerpecker (*Prionochilus percussus*); photo Eric Perlett / BNF. Right: spiny ant *Polyrhachis* (*Myrma*) sp.; photo Christopher Owen / BNF.

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remains fragmentary, from both topical and geographical perspectives. This relates to questions such as where different species are found at different spatial scales and their dependence on peatland (but see, e.g., Wilting *et al.* 2016 and others in the same volume for felids and Utami-Atmoko *et al.* 2017 for orangutans); how biodiversity and local human communities in tropical peatlands interact with and influence each other (but see, e.g., Graham 2013, Law *et al.* 2015); and how biodiversity responds to human disturbance (but see, e.g., Felton *et al.* 2003, Yule 2010, Houlihan *et al.* 2013, Husson *et al.* 2015) and conservation management interventions (but see, e.g., Page *et al.* 2009, Blackham *et al.* 2014).

In light of this, we convened a special session of presentations on Southeast Asian tropical peatland biodiversity and conservation at the 2016 International Peat Congress in Kuching (Sarawak, Malaysia), which laid the foundation for this special volume of *Mires and Peat* on the same topic. The special volume includes five articles describing aspects of the biodiversity of the region's peatlands, together with two articles that adopt more applied ecological approaches and thus provide information of high relevance for informing conservation management strategies in the region.

In what is, to our knowledge, the most comprehensive across-taxa species list published for any peatland in the region, **Husson *et al.*** (2018) present records of all the tree flora and macro-fauna found in the Sebangau peat swamp forest since research began there in 1993. They report the presence of more than 1,100 potential species (615 confirmed so far), including 46 that are globally threatened and 59 that are protected by law in Indonesia. Despite imperfect sampling in a relatively restricted area, this study highlights clearly the high biodiversity of the region's peat swamp forests and the consequent importance of their protection for biodiversity conservation.

Lo *et al.* describe a recently discovered mangrove peat ecosystem in Botum Sakor National Park, Cambodia; a country in which peatlands and their biodiversity have received very scant research attention. They confirm a total 4,768 ha of relatively shallow (maximum depth 135 cm) mangrove peat in this area, and record the presence of 26 plant species. Such information from new sites in under-studied parts of Southeast Asia is essential for developing scientifically-based local conservation management plans and for advancing our wider understanding of peatland biodiversity in the region.

Figure 3. Peat swamp forest on fire. Photo: Alex Allsop / BNF.

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Peatlands in the Philippines are similarly under-studied, with reportedly only one site on Mindanao Island still containing a substantial area of peat swamp forest, thus making its study particularly important. **Aribal & Fernando** present data on plant species diversity and vegetation structure, and their relationship with peat depth and other characteristics, to describe four forest zones and two additional plant communities at this site.

Tropical peatland macro-invertebrates have been the focus of relatively little scientific inquiry (compared to vertebrates and particularly flagship felid and ape species) despite their richness, ecological importance and high potential as ecological indicators. Thus, the description of the macro-invertebrate community of Maludam National Park in Sarawak by **Dosi *et al.*** provides timely information about this under-studied component of the tropical peatland ecosystem.

Moving up to regional scale, **Giesen *et al.*** compile records for 1,441 higher plants found in Southeast Asia's swamps to assess habitat specificity and species overlap. They find that more than 80 % of the angiosperm species found in lowland swamps are common to a range of habitats and only 3.4 % are truly restricted to lowland peat swamp forest habitat.

Recognising the importance of fishing for local communities in the region's peatlands, **Thornton *et al.*** provide a detailed assessment over 15 months of fish populations in the river and forest of Sebangau. They find higher fish diversity in the river than in the forest, and explore the environmental variables associated with fish capture rates. Importantly, they also show that river acidity increased and fish captures decreased following the 2015 fires, which may have negative implications for fish-dependent local communities.

With continuing expansion of degraded peatland in the region, the importance of peatland reforestation and restoration is likely to increase. A reduced seed bank in degraded forests is one potential barrier to restoration. This was studied across five peat swamp forest zones of varying degradation in Sebangau by **Graham & Page**. These authors found that both seed and seedling densities were lower than in other forest types in the region and, on this basis, suggest that seed banks are of relatively low importance for tropical peat swamp forest regeneration.

While the studies reported here provide much new information in the quest to understand and effectively conserve tropical peatland ecosystems in Southeast Asia, many important questions remain unanswered. In particular, we need data on species presence and physical ecosystem characteristics across the many peatland ecosystems in the region that are still un(der)studied, in order to better understand species

Figure 4. Burned peatland shrouded in haze during the major 2015 fire season in southern Borneo. Some standing forest is still visible in the background. Note the fire-fighters' hose pipe running across the middle of the picture. Photo: Suzanne Turnock / BNF.

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distributions and their determinants; to document the (long-term) impacts of, and recovery of biodiversity from, events such as peatland drainage and fire; to understand how this affects the delivery of ecosystem services, particularly to local communities; and how outcomes may be influenced and modified by (changes in) human behaviour in combination with local community and government policies. Therefore, we look forward to watching this story develop through future research that we hope the articles presented here will help to inspire.

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