Strengthening the future: advancing biodiversity conservation in Indonesia

Ulfah Mardhiah*[1], Nuruliawati[2] and Irene M.R. Pinondang[3]

It has been over 170 years since the naturalist Alfred Russel Wallace travelled across the Malay archipelago, collecting, describing and commenting on the species he encountered. He was accompanied by a Malay youth from Sarawak named Ali who was initially a personal assistant but became an eminent naturalist himself. Ali had a particular interest in birds, and even adopted the surname Wallace. One of the great discoveries of Alfred Russel Wallace's endeavours in Indonesia was the transitional zone between the fauna of Asia and Australasia, commemorated as the Wallace Line. This runs through the Makassar Strait between Borneo and Sulawesi and the Lombok Strait between Bali and Lombok. Today, Indonesian researchers, with in-depth understanding of the local context, continue to build on the endeavours of Alfred Russel and Ali Wallace, improving our knowledge of biodiversity patterns, species' habitats and interactions, and—most importantly—how best to conserve species and their habitats in the face of multiple challenges.

To celebrate and mark this work, this issue of *Oryx* focuses on conservation in Indonesia. The nine articles examine a broad range of contemporary issues in biodiversity conservation research, from individual species to conservation methods, bird and amphibian diversity, protected area management and research on mammals.

Recognizing the potential threat of coconut farming to biodiversity, Winarni et al. (2024) explore the conservation value of coconut palm plantations relative to forest and mixed farmland in northern Sulawesi. Bird communities in palm plantations and mixed farmland sites were dominated by generalist birds but there was a higher number of endemic species in coconut palm plantations than in mixed farmland, mirroring patterns of biotic homogenization documented elsewhere in the Wallacea centre of endemism (another biogeographical term commemorating the work of Alfred Russel Wallace).

Indonesia is a hotspot of vertebrate decline, and Ardiantono et al. (2024) focus on mammals, reviewing the last 2 decades of research. They identify four key issues: disproportionate attention on a few species, geographical bias towards west Indonesia (although small mammals tend to receive greater attention in central Indonesia, given the interest in the Wallacea region), survey and analytical limitations, and few long-term studies.

The earliest scientific record of amphibians in Sumatra dates from 1799, predating even the studies of the Wallaces in Indonesia, but Arifin (2024) finds that of the 135 species recorded there, 44 have been described since 2000. Although 66% of these 135 species are categorized as Least Concern on the IUCN Red List, this may not represent their actual conservation status as many of the assessments are outdated, and 14% have not yet been evaluated.

Protected areas are strongholds for conservation, and in Indonesia 554 areas protect a total of 27 million ha across the archipelago. Summarizing assessments—some of which were in multiple years—of 422 of these areas with the widely used Management Effectiveness Tracking Tool, Nugraha et al. (2024) identify five main threats: poaching, illegal logging, human settlements, tourism and non-timber cultivation. However, repeated assessment indicates an overall improvement in management and professionalism.

Focusing on individual species in Sumatra, and addressing the bias towards research on charismatic mammals (Ardiantono et al., 2024), Sibarani et al. (2024) model occupancy of the sun bear *Helarctos malayanus* in Bukit Barisan Selatan National Park, Pinondang et al. (2024) model habitat suitability for the Endangered Asian tapir *Tapirus indicus*, and Kuswanda et al. (2024) examine potential conflicts around Asian tapir habitat in Batang Gadis National Park.

The authors in this conservation in Indonesia theme employ a wide range of tools in their research. As elsewhere, camera trapping is being used extensively in Indonesia, including for the sun bear (Sibarani et al., 2024) and Asian tapir (Pinondang et al., 2024). Wirdateti et al. (2024) use DNA analysis of a single hair to examine whether the Javan tiger *Panthera tigris sondaica* could be extant, prompting considerable debate on the accuracy of this type of analysis (Khan et al., 2024; Sui et al., 2024). Nuruliawati et al. (2024) explore the potential of text messaging surveys to investigate songbird ownership and shark consumption across Indonesia, identifying hotspots of both.

These nine studies expand our knowledge of habitats that require protection, identify significant research gaps, and show how the latest analytical tools and methods can be employed for biodiversity and conservation research in Indonesia. The authors are principally Indonesian researchers, and in most cases the lead authors. In this context, Ardiantiono et al. (2024) note the challenges that

*Corresponding author: umardhiah@wcs.org
[1]Wildlife Conservation Society Indonesia Program, Bogor, West Java, Indonesia
[2]University of Warwick, Coventry, UK
[3]Durrell Institute of Conservation and Ecology, School of Anthropology and Conservation, University of Kent, Canterbury, UK

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Indonesian researchers face in publishing their work in international journals and call for continued capacity building to support their contributions to conservation science. Providing support for authors, and developing capacity for conservation more widely (O'Connell & Carter, 2022), particularly for researchers and practitioners in regions with high biodiversity (Sterling et al., 2022), is an integral part of the remit of *Oryx*. This conservation in Indonesia theme is part of this support, allowing national researchers to showcase their research for both national and international audiences.

Another important way to increase conservation capacity is through support from governments and national NGOs, particularly for young researchers. Examples in Indonesia include Tambora Muda Indonesia, a networking group for young Indonesian conservationists, and the Ministry of Environment and Forestry–Wildlife Conservation Society research fellowship for undergraduate students. An additional aspect of capacity development for conservation is the need to respond to gender inequalities (Anthem & Westerman, 2021). We note in this context that the majority of the lead authors of this theme's nine articles are women. Capacity development for female researchers also needs to include skills in complex analytical approaches such as those available in the statistical computing environment *R* (R Core Team, 2024), now widely used in conservation, and in five of the articles presented here. This is promoted through R-Ladies chapters in Indonesia, a community that supports enthusiasts in their use of *R*.

This compilation of articles demonstrates the strength that comes from collaboration, with the authors hailing from national and international universities, research agencies, governments and NGOs—23 organizations in all. The nature of these collaborations has moved on since the partnership of Alfred Russell and Ali Wallace, and this is indeed the time to work together, with the need for research to support conservation endeavours more important than ever. Reflecting on this compilation of knowledge and on the strength derived from collaboration, we have pondered the future of biodiversity conservation research in Indonesia and what we can do collectively to strengthen it. We propose the following five actions, which are intended specifically for conservation research in Indonesia but also apply elsewhere: (1) invest in young conservation researchers through capacity building and by opening up job opportunities, to create a dedicated, knowledgeable generation for biodiversity protection; (2) facilitate the contributions of female researchers by creating a safe environment for them to nurture their potential; (3) increase transparency and openness, facilitating collaborative work amongst conservation stakeholders; (4) encourage healthy scientific discussion to sharpen our approaches and facilitate transformations in conservation research and practice; and (5) promote long-term investment in research funding to address key conservation questions. We believe these proposed actions will help us determine how to continue our explorative work while searching for innovative and effective solutions to contemporary conservation challenges.

This Editorial and the *Oryx* articles cited are available as a virtual issue at cambridge.org/core/journals/oryx/virtual-issues.

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