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Landscape-scale benefits of protected areas for tropical biodiversity

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The United Nations recently agreed to major expansions of global protected areas (PAs) to slow biodiversity declines[1]. However, although reserves often reduce habitat loss, their efficacy at preserving animal diversity and their influence on biodiversity in surrounding unprotected areas remain unclear[2–5]. Unregulated hunting can empty PAs of large animals[6], illegal tree felling can degrade habitat quality[7], and parks can simply displace disturbances such as logging and hunting to unprotected areas of the landscape[8] (a phenomenon called leakage). Alternatively, well-functioning PAs could enhance animal diversity within reserves as well as in nearby unprotected sites[9] (an effect called spillover). Here we test whether PAs across mega-diverse Southeast Asia contribute to vertebrate conservation inside and outside their boundaries. Reserves increased all facets of bird diversity. Large reserves were also associated with substantially enhanced mammal diversity in the adjacent unprotected landscape. Rather than PAs generating leakage that deteriorated ecological conditions elsewhere, our results are consistent with PAs inducing spillover that benefits biodiversity in surrounding areas. These findings support the United Nations goal of achieving 30% PA coverage by 2030 by demonstrating that PAs are associated with higher vertebrate diversity both inside their boundaries and in the broader landscape.

The establishment of PAs such as national parks and nature reserves is a foundational strategy to slow and reverse the global loss of biodiversity[1,2] - one of humanity's greatest challenges. The recent Conference of Parties to the Convention on Biological Diversity (CBD) in Montreal, Canada, committed nations to protecting 30% of their lands and seas by 2030[1] (the '30 × 30 goal'). But to justify this goal, we need to know that PAs are actually effective at enhancing a range of metrics of biodiversity. Indeed, the conservation outcomes of PAs are highly variable[2,10,11]. Many lack the resources for effective management[4,12] and are considered 'paper parks' (Fig. 1), and whereas others may be successful at maintaining habitat cover[2,13,14] and even alleviating poverty of nearby communities[15], their efficacy at protecting vulnerable elements of biodiversity - such as wildlife - remains uncertain[2,3,16,17].

Prior studies have assessed the efficacy of PAs at enhancing a variety of conservation metrics, often with mixed results. For example, PAs in forested areas tend to experience lower habitat conversion pressures than matched unprotected sites[2], and have been reported to contain higher levels of biodiversity[2,18,19]. But in much of the world, PAs were established in relatively remote areas[20] because these locations had low societal opportunity costs (that is, agriculture, logging and other commercial land uses would have been difficult there). Therefore, any differences in biodiversity levels observed in PAs[18,19,21] or in landscapes with a high proportion of protected area[2] could simply be owing to PAs having been established in inaccessible areas where forest disturbance and extractive pressures were low owing to logistical constraints rather than owing to the protection status itself. In other words, any effects of PAs on biodiversity are statistically confounded with site accessibility

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