

Infectious Diseases and Their Outbreaks in Asia-Pacific: Biodiversity and Its Regulation Loss Matter

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Abstract

Despite increasing control measures, numerous parasitic and infectious diseases are emerging, re-emerging or causing recurrent outbreaks particularly in Asia and the Pacific region, a hot spot of both infectious disease emergence and biodiversity at risk. We investigate how biodiversity affects the distribution of infectious diseases and their outbreaks in this region, taking into account socio-economics (population size, GDP, public health expenditure), geography (latitude and nation size), climate (precipitation, temperature) and biodiversity (bird and mammal species richness, forest cover, mammal and bird species at threat). We show, among countries, that the overall richness of infectious diseases is positively correlated with the richness of birds and mammals, but the number of zoonotic disease outbreaks is positively correlated with the number of threatened mammal and bird species and the number of vector-borne disease outbreaks is negatively correlated with forest cover. These results suggest that, among countries, biodiversity is a source of pathogens, but also that the loss of biodiversity or its regulation, as measured by forest cover or threatened species, seems to be associated with an increase in zoonotic and vector-borne disease outbreaks.

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Introduction

The Asia-Pacific region, and particularly Southeast Asia, is recognized as a hotspot for biodiversity [1], but is suffering from rapid and extensive erosion of that diversity [2–3]. As exemplified by Schipper et al. [4], this region is a major hotspot of mammal diversity at threat, which urges rapid identification of both the drivers of species loss and its consequences for human well-being and health [5–6]. Asia-Pacific is also a hotspot for emerging infectious diseases [7–8] as illustrated by emergence of Nipah virus, new cholera and dengue variants among others [8]. As biodiversity loss is thought to be a major explanatory factor of the increase in emergence of infectious diseases [7,9], Asia-Pacific appears a key region where to investigate the links between biodiversity, and its loss, on the patterns of infectious diseases.

Infectious disease (ID) incidence has clearly increased during recent decades [7,10]. This same time frame has also seen an increase in emergence of infectious diseases (EID) [7]. While some of this increase is undoubtedly due to improvements in disease reporting and surveillance, studies have found that the trends persist even after correction for changes in sampling effort over time [7,10]. It is emphasized that biodiversity changes through

fragmentation and degradation of natural habitats (particularly forested areas) increase the proximity of wildlife to humans, and their domestic animals, and result in increased health risks through increased transmission of zoonotic diseases [11–14]. Increasing encroachment of farms on wildlife habitats has increased the overlap between livestock and wild animals, with the consequence that the vast majority of emerging diseases of livestock have been acquired from wild animals [15]. Indeed, escalating human activities as a result of economic development lead to several regional environmental changes, which include altered land use and distributions of domestic animals and wildlife as well as increased international trade. Increased urbanization and agricultural intensification change land use as well as the changes in behaviour and population size or density of humans, and the hosts and vectors, may affect the spread of infectious diseases.

The increased interactions between humans and wildlife resulting from habitat fragmentation are also affected by changes in wildlife species richness and community composition. At the local level, a reduction in biodiversity may lead to an increase in the prevalence and transmission rates of certain vector-borne diseases as reviewed by Keesing *et al.* [9]. Several studies have