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Cryptic mammals caught on camera: Assessing the utility of range wide camera trap data for conserving the endangered Asian tapir

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ABSTRACT

The loss and fragmentation of substantial areas of forest habitat, in combination with rampant hunting, has pushed many of Southeast Asia's megafauna species to the verge of extinction. However, the extent of these declines is rarely quantified, thereby weakening lessons learned and species-based management. This need not be the case as a proliferation of camera trap surveys for large-bodied mammals across Southeast Asia, which use a standardized sampling technique, presents a rich yet under-utilized wildlife data set. Furthermore, advances in statistical techniques for assessing species distribution provide new opportunities for conducting comparative regional analyses. Here, we focus on one of Southeast Asia's least known species of megafauna, the Endangered Asian tapir (*Tapirus indicus*), to investigate the performance of a camera trap-based spatial modeling approach in conducting a range-wide species assessment. Detection data were collectively collated from 52,904 trap days and 1,128 camera traps located across 19 study areas drawn from the Asian tapir's entire range. Considerable variation in tapir occurrence was found between study areas in: Malaysia (0.52–0.77); Sumatra, Indonesia (0.12–0.90); Thailand (0.00–0.65); and, Myanmar (0.00–0.26), with generally good levels of estimate precision. Although tapirs were widespread (recorded in 17 of the 19 study areas), their occurrence was significantly and negatively correlated with human disturbance. Thus, this study extends the previously known applicability of camera traps to include a threatened and cryptic species by identifying where and how tapirs persist (including new records of occurrence), where future surveys should be conducted and providing a benchmark for measuring future conservation management efforts.

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1. Introduction

Large-bodied mammals are threatened throughout Southeast Asia. Over 10% of their forest habitat has been lost and fragmented since 2000 thereby increasing access for hunters of wildlife (Miettinen et al., 2011). In combination, deforestation and poaching have had a devastating effect on the region's megafauna (Clements et al., 2010; Corlett, 2007). For example, the Javan rhino (*Rhinoceros sondaicus*) was extirpated across most of its range from India to China to Java, due to the loss of its lowland habitats and intensive illegal hunting for its prized horn. In 2011, the species was declared extinct from Vietnam, leaving behind the last remaining population in Ujung Kulon National Park in Java (Brook et al., 2011). Likewise, Sumatran rhino (*Dicerorhinus sumatrensis*) populations have been decimated across mainland Southeast Asia, including from a former stronghold, the 13,300 km^2 UNESCO World Heritage Site of Kerinci Seblat National Park in Indonesia (Zafir et al., 2011). Furthermore, weak to non-existent law enforcement has strongly contributed to the loss of guilds of other large-bodied mammal species from several Southeast Asian countries, such as Cambodia and Vietnam (Bennett, 2011).

The ability of Southeast Asia's megafauna to recover from unrelenting hunting pressures is complicated by their generally slow reproductive rates and heightened sensitivities to human disturbances, such as forest habitat conversion (Kinnaird et al., 2003). Also, the rapid clearance and accompanying fragmentation of forest habitats across Southeast Asia, especially for oil palm cultivation (Fitzherbert et al., 2008), has had a disproportionate impact on those species with large home range requirements, such as the tiger (Wibisono et al., 2011). This situation is exacerbated as wildlife comes into closer contact and ultimately greater conflict with people. For example, the Sumatran elephant (*Elephas maximus sumatranus*) was recently placed on the IUCN Red List as Critically Endangered due to the severity of its habitat loss, hunting and retaliatory killings arising from crop-raiding (IUCN, 2012).

A fundamental requirement for protecting increasingly threatened megafauna species and populations in tropical landscapes is robust law enforcement (Leader-Williams and Milner-Gulland, 1993). Integral to this, is a clear understanding of the response of different species to this and other types of management intervention (Clements et al., 2010). Surprisingly few studies have explored the effect of physical and anthropogenic threat covariates or their proxies, such as roads, on Southeast Asia's megafauna (Rood et al., 2010; Linkie et al., 2006). As important, range-wide assessments are typically limited by a lack of comparable data sets that are confounded by different approaches to data collection and/or the shy and secretive nature of the focal species that makes it difficult to survey in the first place. However, this is changing due to the proliferation of camera trapping and recent advances in occupancy modeling techniques.

The now widespread use of camera traps for monitoring large-bodied mammals in Southeast Asia has, for the majority of recent work, been conducted according to a standardized monitoring protocol that was originally developed for estimating tiger abundance (Karanth and Nichols, 1998). Here, camera traps are placed along trails that are typically favoured by tigers, such as ridges and undistributed dirt tracks, to increase species detection probabilities. These trails are also favoured by many other large-bodied mammals that would otherwise have difficulties moving through the understory, especially in the dense humid evergreen forests of Southeast Asia. Thus, a rich yet under-utilized wildlife data set exists on many of the region's poorly studied species, which are not a primary target within the respective camera trapping projects and therefore whose data are unlikely to be analysed.

Next, through use of the robust capture-mark-recapture sampling framework, the statistical advances in distribution analyses now enable imperfect species detection to be explicitly accounted for (MacKenzie et al., 2005). In turn, this has progressed wildlife population studies beyond using a presence/absence approach, which assumes detection probability to be perfect. Thus, new opportunities exist for using camera trap data to assess the status of cryptic, threatened and/or data deficient species that were previously difficult to detect. This has been conducted for species, such as sun bears *Helarctos malayanus*, within a single landscape and holds much promise (Linkie, 2008; Wong et al., 2013). However, how this spatially explicit modeling approach performs for conducting a regional assessment remains untested, but is highly relevant for reliably assessing the conservation status of many of Southeast Asia's megafauna species.

In this study, we focus on one of Southeast Asia's least studied megafauna species, the Asian tapir, to assess the potential of camera trapping as a method that can significantly advance the science and practice of conserving cryptic and poorly studied wildlife. The Asian tapir makes an ideal case study because previous assessments have relied heavily upon expert knowledge or have pooled different types of survey data for which it was not possible to control for varying detection probabilities (Clements et al., 2012; Lynam et al., 2012; Medici et al., 2003; Shwe and Lynam, 2012)

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