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Short communication

Asia's economic growth and its impact on Indonesia's tigers

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ABSTRACT

Illegal wildlife trade represents a major threat to biodiversity. Recent wildlife consumption trends across Asia have shown shifts in preference towards new species, such as Sunda pangolin, and increased volumes of consumption for longer-traded species, such as tiger. These trends are widely thought to be a result of the higher levels of wealth generated from the impressive economic growth experienced across Asia. This raises important questions regarding the role that economic growth plays as a driver of poaching on source populations of highly-prized species. As a first step to answering these, we investigate trade dynamics related to the poaching of tigers and their principal prey using a long-term biological and economic data set. The fluctuating poaching patterns recorded for tiger prey, which are locally consumed for their meat, showed no association with rising domestic beef prices, the most likely substitutable protein source. However for tiger, annual poaching rates were positively and significantly correlated with changes in local tiger skin prices that, in turn, were closely correlated with annual GDP changes in the key consumer countries. Our preliminary analysis raises further questions around the causal pathways through which rising affluence and extinction risk are linked; a question that should be posed for a wide set of species. Thus, the strong regional leadership that has enabled high economic growth across Asia and lifted hundreds of millions of people out of poverty should now be urgently directed to tackling illegal wildlife trade and, as a priority, to closing domestic and international trafficking routes.

1. Introduction

The illegal wildlife trade is valued at US$7–23 billion/year (Nellemann et al., 2016). It is run by well-organized and sophisticated criminal networks that are skilled in circumventing detection by border agencies, which in themselves are insufficiently resourced to counter wildlife trafficking (Dutton et al., 2013). The trade is now occurring on an unprecedented scale, as shown by the unsustainable volumes and huge diversity of species involved (UNODC, 2013). Changing consumer trends have pushed many species, such as helmeted hornbill (*Rhinoplax vigil*) and Sunda pangolin (*Manis javanica*), which had hitherto not been particularly threatened, to the brink of extinction in less than a decade (BirdLife International, 2016; Challender et al., 2014). As a result, the United Nations now lists illegal wildlife trade as a 'serious crime', placing it alongside trafficking of weapons, drugs and humans.

The illegal use of wildlife in products such as tiger bone wine, rhino horn medicine or elephant ivory carvings fits better known consumption patterns for luxury goods, such as those for Harley Davidson motorbikes, Cuban cigars or designer handbags (Bär, 2016). Over the past decade, Asia has dominated the luxury goods market, including for exotic species (May, 2017). This demand has been largely driven by the high economic growth experienced across most Asian countries, with national gross domestic product (GDP) typically achieving 6–7% over many consecutive years. Consequently, this has created a burgeoning middleclass and a larger number of high net worth individuals, with both groups having amassed greater amounts of disposable income to spend on luxury goods, including wildlife. Despite being a global problem, several Asian countries stand out as the major demand countries for wildlife consumption and therefore have a disproportionate influence on poaching rates in source countries, which includes Indonesia (UNODC, 2013).

Indonesia has an incredibly rich biodiversity. It is an archipelago of over 17,000 islands that spans an area equivalent to mainland United States, but has porous borders that are difficult to protect from

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smuggling. Consequently, Indonesia has become one of the largest suppliers of illegal wildlife products in Asia (UNODC, 2013). This is acutely and commonly illustrated by high profile cases, such as the 6.6 kg of Javan rhino horn seized by Hong Kong customs and five tonnes of frozen pangolins seized by the Indonesian police in North Sumatra, single shipments each worth US$1.5–2.0 million dollars (Hong Kong Customs, 2017; WCS, 2015).

To explore the supply and demand of the illegal wildlife trade and whether economic forecasts could be used to provide insights on future poaching trends, we perform a longitudinal analysis using a 12 year data set on one of Indonesia's most highly prized and in demand species, the Critically Endangered Sumatran tiger (*Panthera tigris sumatrae*). Our aim was to test whether annual changes in the GDP of the main consumer countries are associated with landscape level market prices for tiger body parts and in turn tiger poaching rates. We also felt it important to consider consumption patterns of tiger prey as this can have a direct effect on tiger population status (Karanth et al., 2004). Thus, we investigate the poaching patterns of the principal prey by testing whether domestic meat market prices can accurately predict the poaching of wild deer, which are locally consumed.

2. Methods

The Kerinci Seblat law enforcement program was initiated in 2000 with the creation of two anti-poaching units. The number of units increased to five in 2005, with a sixth unit in 2013. The years 2005 to 2016 are selected for this study because they represent the fullest amount of comparable data. Annual data on the number of patrols and removal of tiger and prey snare traps were calculated based on Risdianto et al. (2016), with the addition of data collected from patrols conducted in 2015 and 2016. The targeted deer species are sambar (*Rusa unicolor*) and red muntjac (*Muntiacus muntjac*).

The Kerinci Seblat law enforcement program manages a highly successful local informant network that continually monitors wildlife trafficking. These units also conduct independent wildlife market surveys and sting operations on traders of tiger body parts (Linkie et al., 2015). A typical case involves a specially trained member of the tiger team posing as a fake buyer to verify the skin, or other body parts, which involves negotiating a pre-sale price before a sting operation is conducted.

These combined sources of information were used to compile annual data on tiger skin prices from traders operating in the four provinces surrounding Kerinci Seblat National Park (Jambi, Bengkulu, West Sumatra and South Sumatra). Tiger skins originating from the national park are most likely to be sold in these provinces before being exported. Ideally, we would have tested for consumption patterns associated with Sumatran tiger canines, as the demand across Asia for this body part is strong (Stoner and Pervushina, 2013). However, we had too few (< 10) data to test these patterns over the study period and this therefore remains an important area for future research. Next, for the four study provinces, data on domestic beef market prices were compiled from national government statistics from 2007, when comparable records began, to 2016 (Indonesian Central Bureau of Statistics, 2016).

Our study focussed on Indonesia because there is a strong domestic market for tiger body parts that might also influence motivation to poach (Shepherd and Magnus, 2004; Wildlife Crimes Unit, 2014, 2015). Information on annual GDP for the study years were compiled for Indonesia using data obtained from the World Bank (2017). Next, our study focussed on the strong Asia-Asia wildlife trafficking. Within this regional network, Indonesia is one of the main source countries, particularly wildlife originating from Sumatra, which includes species such as tiger, Sunda pangolin and helmeted hornbill (UNODC, 2013). Many wildlife body parts travel from Indonesia via mainland Southeast Asia to their destination country within this region or the East Asia region. For example, over our study period, there were reports of Sumatran tiger products, including skins, destined for China being exported from the Indonesian province of Riau via Singapore (TRAFFIC, 2007). So, instead of trying to prize a part the influence of individual countries, we decided to treat the Southeast/East Asian region as a whole and compiled the corresponding regional annual GDP data from the World Bank (2017). Market price data were adjusted for inflation using a GDP deflator for Indonesia to set tiger skin prices (2005–2016) and then domestic meat market prices (2007–2016) at constant 2011 prices. To account for the influence of currency movements of Indonesia with the Southeast/East Asian region, nominal GDP per capita figures in local currency were converted into Indonesian rupiah using historic annual exchange rates. These figures were then also converted to constant 2011 prices using the Indonesian GDP deflator.

Pearson's coefficient tests were performed to investigate temporal associations between: domestic meat prices-deer poaching; domestic meat prices-Indonesia's GDP; tiger skin length-skin prices and annual variation in skin lengths seized; tiger poaching-tiger skin prices; tiger skin prices-GDP of focal consumer countries; and, tiger poaching-GDP of focal countries.

3. Results

Annual deer poaching rates in the Kerinci Seblat landscape fluctuated, and often widely, whereas domestic meat prices in provincial markets had much smaller fluctuations (Fig. 1). For the 2574 deer snare traps that were dismantled from 2007 to 2016, there was no significant correlation between deer poaching rates and domestic meat prices ($df = 8$, $r = -0.294$, $P = .410$) or between meat prices and national GDP ($df = 8$, $r = 0.618$, $P = .057$).

From 2005 to 2016, 362 tiger snare traps were dismantled and 91 tiger skins seized through law enforcement operations. Larger tiger skins were found to be worth more than smaller ones across years ($r_s = 0.409$, $P < .001$), but the lengths of tiger skin seized did not significantly differ between years (Kruskal-Wallis, $X^2 = 9.726$, $df = 11$, $P = .555$). Annual tiger poaching over the study years was positively correlated with the tiger skin prices recorded ($df = 10$, $r = 0.674$, $P = .016$). In the years 2013–2015, a spike in demand (as indicated by skin price increases) and tiger poaching was recorded. However, with a subsequent GDP drop in 2016, the poaching of tigers underwent a corresponding decline (Fig. 2). Poaching rates and skin prices were significantly correlated with GDP in Indonesia (poaching: $r = 0.624$, $P = .030$; and, skins: $r = 0.765$, $P = .003$) and Southeast/East Asian region (poaching: $r = 0.546$, $P = .023$; and, skins: $r = 0.881$, $P < .001$). There were significant and positive correlations between GDP per capita, at historical exchange rates (constant 2011 Indonesian rupiah), for Indonesia-Southeast/East Asia ($r = 0.983$, $P < .001$) meaning that it was not possible to prise apart the influence on tiger poaching of one country over the other.

4. Discussion

Our results provide important insights into how the strong economic growth in Asian countries that are primary consumers of illegally traded wildlife are closely associated with local tiger poaching patterns. Our study is the first of its kind for Indonesia and highlights the need for more in-depth research to analyse the extent of the role of macro-economic trends and their impact on other highly threatened species. From the Kerinci Seblat landscape, the substantial number of snare traps removed and tiger traders arrested (Risdianto et al., 2016; Linkie et al., 2015) underscores the importance of employing anti-poaching forest patrols (as a preventive approach) and sting operations (as a repressive approach), but highlights a notable absence of a persuasive approach, such as demand reduction strategies, to change consumer behaviour (Smith et al., 2010; Schneider, 2008). Furthermore, while the Asian consumer countries may not be predicted to continue the high levels of growth experienced over the past decade, even at a 3–5% annual growth rate the impact of a growing middle class in China would, for

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