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RESEARCH

Effect of CITES Appendix I listing on illegal pangolin trade as gauged from seizure reports in Indonesia

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Abstract

Pangolins, one of the most heavily trafficked animals, have become the poster child for the illegal wildlife trade. Pangolins are protected throughout their range and their international trade has been regulated through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Assessing the effectiveness of trade regulations, such as the listing of all pangolins on CITES Appendix I in 2016 precluding all international trade, can be done by analysis of seizure reports. I report 81 large seizures within Indonesia over the last 12 years, the equivalent of 18,024 pangolins representing a value of USD9.42 million. In Indonesia, the number of seizures remained stable at around seven a year. There was a significant decrease in the number of seized pangolin equivalents, from 3000 to 4000 in 2011 and 2012 to 400 to 600 in 2021 and 2022. A break point analysis showed that any changes in this trend did not coincide with changes in international trade regulations. Seizures were made in 17/22 provinces where pangolins occur. At the provincial level seizures or the number of confiscated pangolins was not linked to minimum wage, area, human population, or international connectiveness. Despite the international nature of the pangolin trade, where reported, suspects that were arrested were Indonesian nationals. Over time the proportion of seizures comprising solely of scales has increased from ~ 5 to 100%. These observations of seizures of large amounts of pangolin scales, in the absence of bodies, carcasses, or meat, suggest there is a hidden trade in these parts, in Indonesia and/or elsewhere. There is no clear support that the CITES Appendix I listing had a direct effect on the pangolin trade within Indonesia.

Keywords China · CITES · Illegal wildlife trade · Indonesia · *Manis javanica* · Media reports

Introduction

The trade in wildlife resources is one of the key threats to global biodiversity loss (Hughes et al. 2023; Morton et al. 2021; Symes et al. 2018), and part of this trade is regulated through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES is one of the most important global initiatives to monitor and regulate international trade of plants and animals. Credible biological and trade data are core to informing decisions and garnering political will and consensus among CITES parties (Phelps et al. 2010) and this includes retrospective analyses of the effects of CITES listings (e.g., Foster et al. 2019; Kuo and Vincent 2018; Shepherd et al. 2020). Assessing the effectiveness of trade regulations can be done by analysis of seizure reports.

Due to its clandestine nature, there are several methodological difficulties in accurately monitoring the illegal wildlife trade, and data on the illegal wildlife trade are inherently incomplete (Rosen and Smith 2010). Seizure records for high-profile species are a relevant source of information on the trade of several wildlife and plant species, but they rarely do contain information on seizures made within countries (e.g., the CITES trade database contains no data on seizures). Alternative monitoring methods are increasingly utilized to fill data gaps (Phelps and Webb 2015). This includes the use of publicly available media reports, especially if these reports are written in languages other than English (Cheng et al. 2017; Indraswari et al. 2020; Nijman 2015; Paudel et al. 2022; Siriwat and Nijman 2018).

Pangolins are a group of eight species of mammals (four in Asia, four in Africa) that are heavily traded for their meat

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and scales; most of this demand is in East Asia, and in particular China, and pangolins are trafficked illegally from throughout Africa and Asia (Challender et al. 2019; Nijman et al. 2016; Shepherd 2009; Semiadi et al. 2009; Xu et al. 2016; Zhang et al. 2017). Pangolins are protected throughout their range and in recent years have become the poster child for the illegal wildlife trade (Burton 2019; Harrington et al. 2018). Global international trade in pangolins has been regulated through CITES and in 2000 it established a zero export quota for wild-caught Asian pangolins, de facto banning all their international trade. As a CITES Appendix II species, any permitted trade would require a non-detriment finding and approval from the exporting country. Despite this ban pangolins were traded illegally in substantial numbers (Harrington et al. 2018; Heinrich et al. 2016; Nijman et al. 2016; Shepherd 2009). In September 2016, all species of pangolin were included on CITES Appendix I, precluding all commercial international trade. This came into effect in January 2017. Any subsequent export would require permission from both the exporting and importing countries and in an Appendix I listing may results in a higher priority in terms of enforcement and in some countries higher fines and penalties for law-breakers. Three of the four Asian pangolin species are listed as Critically Endangered (the Indian pangolin *Manis crassicaudata* is listed as Endangered) and all species of pangolin have a decreasing population trend (Challender et al. 2019). Indonesia has been identified as a significant source country for the international pangolin trade (Pantel and Chin 2009; Sopyan 2009; Takandjanji and Sawitri 2016). The market for pangolins, either their meat or their scales as medicine, is limited within Indonesia and research dating back to the earlier twentieth century indicates that most are exported to other (east) Asian countries (Dammerman 1929; Harrison and Loh 1965; Heinrich et al. 2016; Sopyan 2009; Takandjanji and Sawitri 2016). In recent years, the available evidence indeed suggests that the illegal capturing and subsequent trade in pangolins is indeed for the East Asian market (Gomez et al. 2023; Xu et al. 2016).

I here present a retrospective analysis of the effects of the CITES Appendix I listing of all pangolin species in 2016 in Indonesia. Even though over much of the last few decades commercial trade in pangolins was tightly regulated and much restricted, I expect the CITES Appendix I listing to have had a marked effect on the demand of pangolins and the (illicit) import of pangolins and their parts into consumer countries. This should have included source countries, such as Indonesia. Given cautious and systematic data collection, online media can be highly useful sources of obtaining seizure data, as this provides a proxy that reflects real-time trends, independent of governments or monitoring agencies. Using seizures data from Indonesia, I test firstly whether there is indeed a significant reduction in the number of pangolins and pangolin equivalents that are traded in Indonesia. Secondly, I test if there have been marked geographic shifts in where seizures have been made within Indonesia, potentially in response to changing availability or other external forces. Thirdly, given that live pangolins, whole bodies or carcasses are more difficult and more voluminous to smuggle than scales, because of the Appendix I listing (and possible increased perceived importance and enforcement) I expect to see a steeper decline in the trade in the former relative to the latter.

Methods

Data acquisition

Indonesia has a human population of around 275 million, and in some estimates as many as 700 separate languages are spoken. Within Indonesia, the Sunda pangolin *M. javanica* is restricted to the western part where there are some 10 "regional" widely-spoken languages. Of these, Javanese (~ 84 million speakers), Sundanese (~ 34 million speakers), and Madurese (~ 14 million speakers) are the most numerous (Lewis et al. 2014). Throughout Indonesia, however, the national lingua franca is Bahasa Indonesia, spoken by some 210 million people. Only a small proportion of Indonesians speak English and reporting by the authorities is invariably undertaken in Bahasa Indonesia. As such, English has no wide use in society, is not used as a medium of communication in official domains like government, the law courts, and the education system, and is not accorded any special status in the country's language legislation (Lauder 2008). There are several English language newspapers and magazines in circulation in Indonesia, including Jakarta Post, Jakarta Globe, Bali Times, and Tempo that report on national news, and of course significant events in Indonesia are reported in the wider English language newspapers (Nijman 2015).

Between July 2014 and August 2023, I manually searched the internet (primarily using Google as a search engine) for articles, reports, blogs, or posts related specifically to the seizure of pangolins in Indonesia, for the period 1 January 2011 to 31 December 2022 (seizures of the equivalent of 10 pangolins or more) and 1 January 2003 to 31 December 2022 (seizures of 75 pangolins or more). Searches took place from Oxford in the UK and typically during the day or early evening. Search terms used were "BKSDA and trenggiling" and "Bea Cukai and trenggiling," with BKSDA being for the government agency that is responsible for enforcing wildlife protection laws, Bea Cukai and trenggiling referring to the customs agency and being the Indonesian word for pangolin, respectively. I also searched the English equivalents, adding "Indonesia" as a search term. Google Scholar was searched for scientific articles and reports that contained

information on seizures in Indonesia. At the request of one of the reviewers in August 2023, I checked the TRAFFIC Wildlife Portal (a database containing seizure data from public sources) for additional seizures, but none were found that met the criteria outlined below.

Seizure data were then transferred to a database noting, where possible, the date, location, volume, type (alive, dead, mass, scales), and destination of the shipment. Seizures were sometimes reported by different sources, often, but not always, around the time of the seizure, and the same seizure could be referred to repeatedly in subsequent reports. Data were checked to ensure the seizures reported were made on or after 1 January 2011 (large seizures) or on or after 1 January 2003 (very large seizures), and dates, locations and volumes were compared to be certain that individual seizures were not counted twice. "End of year reports" whereby in December or January agencies reported the overall number of pangolins they had seized or destroyed in the last 12 months (or possibly longer or shorter periods) were excluded as they could not be linked to individual seizures and would have resulted in double counting.

I only focus on seizures made in Indonesia. Seizures of pangolins scales from other pangolin range countries that were intercepted during in transit in Indonesia were rare (I only found one instance of a shipment of pangolin scales originating from Cameroon) and were excluded. Where there was a mismatch in details of a particular seizure incident, I used the report that contained the most relevant information, or I combined information from multiple reports. Seizures were reported in various units of measurement (individuals, kilograms of bodies, kilograms of scales, etc.), all data were converted to individuals.

Price data for pangolin meat and scales were obtained from the seizure reports but only if they specifically referred to the asking prices of the specific parts in the consignment and not when referring to general prices (which often reflected prices allegedly paid in restaurants in China or medicinal trade in Hong Kong). Prices were collected in IDR, these were corrected for inflation to January 2023 and then converted to USD at an exchange rate of USD70 for IDR1,000,000.

Analysis

Sunda pangolin is the only pangolin that occurs in Indonesia and there was no evidence to suggest that any of the seizures included here contained parts of any of the other seven species of pangolin. I found two reports of Indonesian pangolin seizures gave what appears to be accurate measurements of mass and number, i.e., one seizure of 70 individuals with a mass of 301.5 kg (mean 4.31 kg) and one of 445 carcasses with a mass of 1390 kg (mean: 3.12 kg) (Anonymous 2017; Setiawan 2015). Sulaiman et al. (2017) gave a mean mass of 4.81 kg for 61 Sunda pangolins from West Malaysia. Wu et al. (2004) gave a mean mass of 3.76 kg for 20 Sunda pangolins confiscated in China. Combining these data, I used a mean mass of 4.0 kg for an individual pangolin and 3.0 kg for a carcass (as the viscera and scales have been removed). I also assumed that three pangolins provided one kilogram of scales (Challender et al. 2015); 1 kg of pangolin scales thus equals three pangolin equivalents.

The monetary value of pangolins in trade differs for whole pangolins, pangolin meat, which includes bodies or carcasses without scales and viscera removed, and scales. When scales and bodies were reported in the same seizure, the larger figure in terms of individuals was used in the estimation of total number of pangolins, and both the value of scales and value of bodies were used to calculate the monetary values of the shipment. By default, each seizure was treated as independent of each other, although it is acknowledged that there is a small possibility that a seizure of bodies without scales in one location can be linked to a seizure of scales in another.

A very large seizure made in Belawan harbor, Medan, north Sumatra, in April 2015 was initially reported as comprising 3440 kg of frozen bodies, 100 kg of scales, and 96 live pangolins, but later changed to 5000 kg of frozen pangolin bodies, 77 kg of scales, and 96 live specimens; this would imply a total of between 1243 and 1762 pangolins. Later, when reporting on the burial of the carcasses, this figure was given as 3000 to 4000 pangolins (see also Harrington et al. 2018). While these figures do not match up, from the photographs of the carcasses being buried, it is evident that the seizure was large. I use a figure of 2000 frozen pangolins, 77 kg of scales, and 96 live pangolins for analysis.

There is an inherent risk in relying on media reports as well as official government reporting in that the smaller seizures are underrepresented. This may be more apparent when the species is less known or when it is less high-profile, which for the Sunda pangolin in Indonesia means it has become less of a problem over time. For analysis, I therefore split my data into two periods, the first one covering the period 1 January 2011 to 31 December 2022 for seizures of the equivalent of 10 pangolins or more (these are referred to as large seizures), and 1 January 2003 to 31 December 2022 for seizures of 75 pangolins or more (these are referred to as very large seizures). The latter dataset was only used to assess geographic shifts in these very large seizures. Based on data presented by Nijman (2015) excluding seizures of less than 10 pangolins may have resulted in a very minor reduction in the estimates of the number of pangolin equivalents that were seized (i.e., in the order of 0.2%). Focusing on large seizures of 10 or more pangolins also centers the analysis on commercial trade in pangolins intended for the international market, as opposed to local small-scale trade or opportunistic trade. The monetary value of 10 pangolins in Jakarta is

around USD700 (scales only) to USD7000 (whole bodies for meat), respectively, again underscoring that this is unlikely to be opportunistic trade (the monthly minimum wage in Jakarta in 2022 is ~ USD300).

For each of the twenty provinces within the range of the Sunda pangolin I explored whether the number of pangolins that were seized in the period 2011–2022 and the number of seizures that were made over the 12-year period was related to (a) human population size (2015, i.e., mid-way during the study period), ranging from 0.7 million in the province of North Kalimantan to 47 million in West Java, obtained from the Indonesian Statistical Agency (Badan Pusat Statistik 2020), (b) land area (km^2) (Anonymous 2013), (c) human population density (Badan Pusat Statistik 2020), (d) the government recommended minimum monthly wage (2020) as a measure of purchasing power, which in the study area ranges from USD115 (province of Yogyakarta) to USD285 (province of Jakarta) (Badan Pusat Statistik 2020), and (e) international connectedness (scored from 0 to 3, with one point each for an international land border, the presence of one of the top seven busiest international airports or top seven busiest ports in terms of passengers and freight). Human population size and area were both strongly correlated with human population density (Pearson's correlation coefficient, $r = 0.661$, $P = 0.0015$ and $r = -0.816$, $P = 0.0001$) but none of the other predictor values were significantly correlated with each other. Subsequently, human population density was not included as a predictor value.

For testing if the number of seizures or the number of seized pangolins in the period 2011–2022 were linked to any of the provincial level predictor variables listed above, as well as for exploring changes over time, I calculated Pearson's correlation coefficients. Temporal monthly differences in the number of seizures or the number of seized pangolins were explored with a χ^2 test, with the expected values generated on the assumption of an equal distribution of seizures and equal numbers of pangolins for each seizure in any given month. The international connectedness score as a predictor for the number of seizures or the number of seized pangolins at a provincial level was tested with a one-way ANOVA, followed by post-hoc Tukey tests. I ran a break point analysis (Chahuán-Jiménez et al. 2021) to assess whether there was any temporal change in the trend recorded for the average number of individuals seized, the total number of individuals seized and the number of seizures over the studied period. This was done using 6-month periods. I used the function "breakpoints" in the R-package "strucchange" (version: 1.5–2), which informs the existence of structural changes in linear regression models. For the statistical analysis I used R software (version 3.6.3) and considered significance at $P < 0.05$. I present means ± s.e.m.

Results

Geographic shifts in seizures

Over the last two decades, there were 52 very large seizures of 75 pangolins or more (mean 529 ± 98 pangolins) on Java, Sumatra, and Indonesian Borneo, for a total of 27,518 pangolins (Table 1). Visual inspection of the data (Fig. 1) allows for the recognition of four periods. In the first period (2003–2007), most of the seizure activities took place on Java, and in particular in and near the capital Jakarta, with one 850 pangolin seizure in Medan, North Sumatra. In the second period (2008–2012), two very large seizures in Palembang, South Sumatra indicated a shift to Sumatra, although large seizures were still made in Jakarta, and the first large seizures were made in Borneo. In the third period (2013–2017), the most seizures were recorded of any of the 5-year periods, with similar prominence for Sumatra and Java, and with regular seizures made in Borneo. In the most recent period (2018–2022), fewer seizures were made, possibly due to COVID-19 restrictions hampering between island transport, and most of them were on Sumatra.

Numbers and temporal changes

For the period 1 January 2011 to 31 December 2022 I documented 81 seizures of 10 or more pangolins totaling the equivalent of 18,024 pangolins, or a mean of 223 pangolins

Table 1 Examples of some of the largest seizures of Sunda pangolins *Manis javanica* in Indonesia, with information on the location of the seizure and the intended destination

Date	Location (island)	Destination	Pangolin equivalents	Notes
17 Oct 2008	Palembang (Sumatra)	China	2691	
10 Nov 2012	Jakarta (Java)	n.a.	2127	
29 Apr 2015	Medan (Sumatra)	Malaysia	2096*	In harbor
26 May 2011	Jakarta (Java)	Vietnam	1875	In harbor
29 Oct 2016	Kilangan (Sumatra)	n.a.	1595	
10 Jul 2011	Tangerang (Java)	Singapore	1140	At airport
10 May 2012	Merak (Java)	China	1031	In harbor
30 Sep 2006	Medan (Sumatra)	Hong Kong	850	
10 Dec 2005	Jakarta (Java)	Hong Kong	804	
27 Jan 2015	Cibinong (Java)	Hong Kong	792	
27 Oct 2016	Pontianak (Borneo)	Malaysia	640	In harbor

n.a. not available

*See text for details

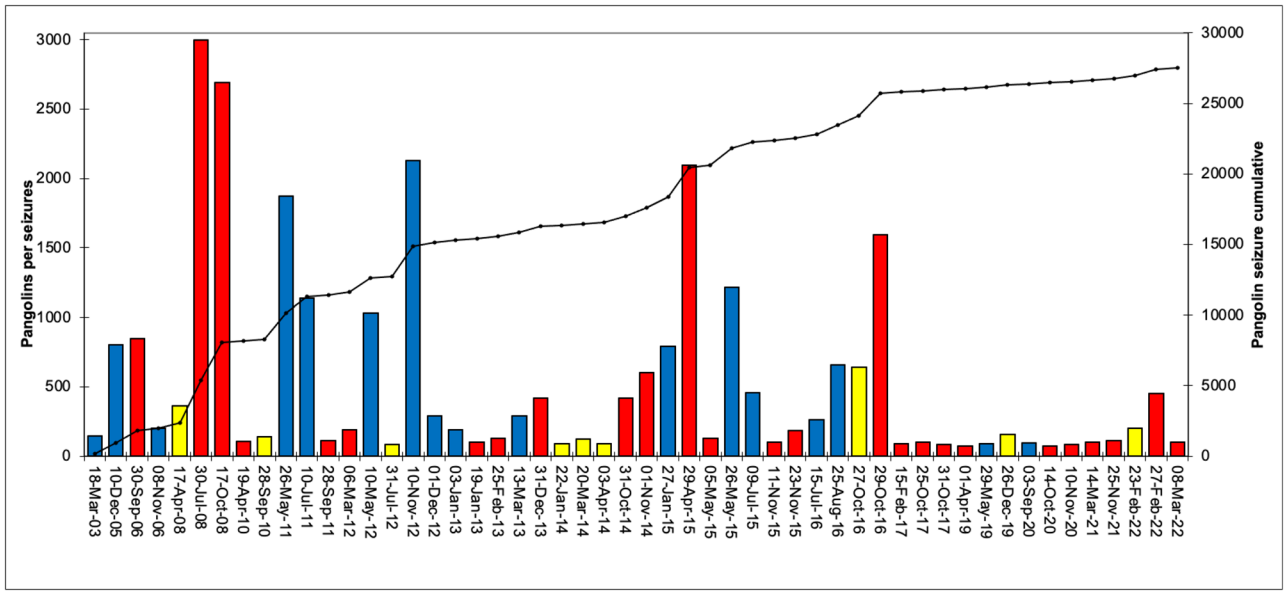

Fig. 1 Large-scale seizures of at least 75 pangolins (or pangolin equivalents) in Indonesia between January 2003 and December 2022, with ones made on the island of Sumatra in red, on Java in blue, and in Indonesian Borneo in yellow

for each seizure. There was a significant decline in the mean number of pangolins seized over this period (Pearson's $R = -0.683$, $R^2 = 0.466$, $N = 12$, $P = 0.0206$) (Fig. 2). While in 2011, some 70% of the seized pangolin equivalents were live pangolins or carcasses, in 2020, 2021, and 2022, the only large seizures (i.e., more than 10 pangolins or equivalents) comprised pangolin scales. Seizures occurred at all months of the year, without any indication of "end-of-year" reporting (Fig. 3). Neither the mean number of pangolins nor the number of seizures that were made were equally distributed across the year (number, $\chi^2 = 990.5$, $P < 0.0001$; seizures, $\chi^2 = 24.4$, $P < 0.001$), with more pangolins seized in April and May and fewer in June and September, and more seizures being made in December and May and fewer in September.

The break point analysis showed that in the second half of 2014 there was an increase in the mean number of pangolins that were seized considering the decreasing trend that was observed up to that period (breakpoint = mid-2014; CI = end-2013, end-2014; $F = 6.63$, $P = 0.001$). A similar, albeit non-significant pattern was observed when focusing on the total number of pangolins that were seized (breakpoint = end-2014;

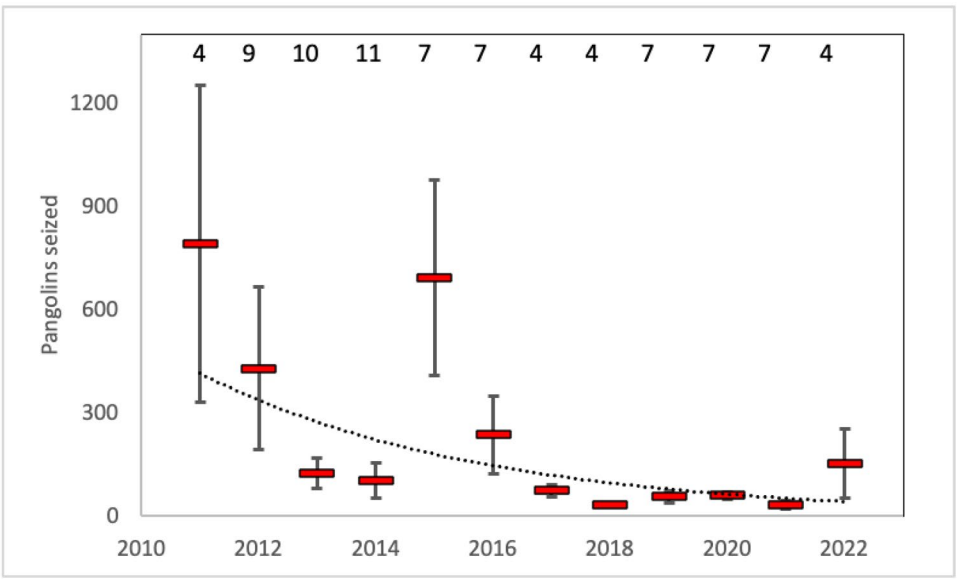

Fig. 2 Pangolin seizures of more than 10 pangolins each in Indonesia between January 2011 and December 2022 showing that the number of pangolins per seizure (mean ± s.e.m, sample seizes at the top) has declined over time

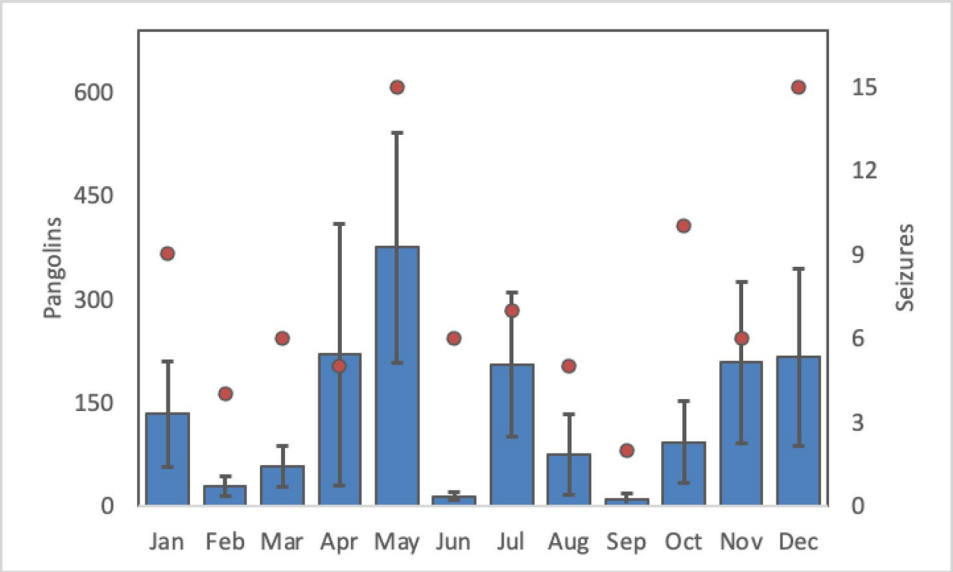

Fig. 3 Number of seizures (red circles) and number of pangolin equivalent seized (mean ± s.e.m.) in Indonesia over the period January 2011–December 2022, showing that there is no seasonality in the seizure activities

CI = end-2013, mid-2015; $F = 1.02$, $P = 0.39$). With respect to the number of seizures, there was an initial increase until 2014, followed by a steep decline, after which it stabilized; again mid-2014 emerged as a breakpoint (CI = end-2013, mid-2015; $F = 8.68$, $P = 0.0002$).

The price of scales within Indonesia as part of large seizures was US$232 ± 101 kg^{-1} ($n = 13$). The prices of meat or carcasses without scales and the viscera removed were US$223 ± 32 kg^{-1} ($n = 7$). Based on the monetary value of meat and scales, the overall monetary value of the seizures for the period 2011–2022 was US$9.42 million. Many of the seizure reports provided information on the suspects that were arrested, including their place of residence, age, and sex; it is noteworthy that none of the suspects was a foreign national (there were reports of a small number of foreigners that were arrested at international airports for trying to export pangolin scales out of Indonesia, but the quantities were fewer than 10 pangolin equivalents). Some of the larger seizures were linked to containers or ships that may have been registered abroad, but I did not find information of arrest of foreign nationals in these instances. Data on successful prosecutions linked to each of the seizures remains elusive and was not sufficiently consistent to allow for a detailed analysis.

Spatial analysis: predictor variables at the provincial level

The number of seizures was positively correlated with the number of pangolins that were seized in a province ($R = 0.690$, $R^2 = 0.477$, $P = 0.0007$). The number of seizures was not correlated with any of the predictor variables (human population size $R = 0.215$, $R^2 = 0.046$, $P = 0.362$; size of the province $R = 0.304$, $R^2 = 0.092$, $P = 0.193$; minimum wage $R = -0.041$, $R^2 = 0.002$, $P = 0.8627$). The number of pangolins that were seized was positively correlated with the human population size in the province ($R = 0.567$, $R^2 = 0.322$, $P = 0.009$) but not with the size of the province ($R = 0.021$, $R^2 = 0.0004$, $P = 0.930$), or the minimum wage ($R = -0.01$, $R^2 = 0.000$, $P = 0.966$). There was no difference in the number of seizures and the provincial international connectedness score ($F_{2,17} = 2.524$, $P = 0.110$), but there was a difference in the number of pangolins that were seized and the provincial international connectedness score ($F_{2,17} = 6.263$, $P = 0.009$). Post-hoc Tukey tests showed that the interpretation of this was not straightforward. Provinces that were well connected (at least two of a land border, a large port or a large international airport) had higher numbers of pangolins seized than provinces that showed intermediate levels of connectedness (a land border or a large port or a large international airport) ($Q = 5.31$, $P = 0.043$), but it was not higher than provinces that had low levels of connectedness ($Q = 2.30$, $P = 0.261$). Provinces with low or intermediate levels of connectedness likewise did not differ in the number of pangolins that had been seized ($Q = 3.01$, $P = 0.114$). Thus, the only patterns that emerges from this is that in provinces with a larger human population more pangolins have been seized, and international connectedness may partially explain the causal reason behind this (Fig. 4).

Discussion

Information from the last two decades shows that very large seizures were made throughout this period on all three major western Indonesian islands (Java, Sumatra, and

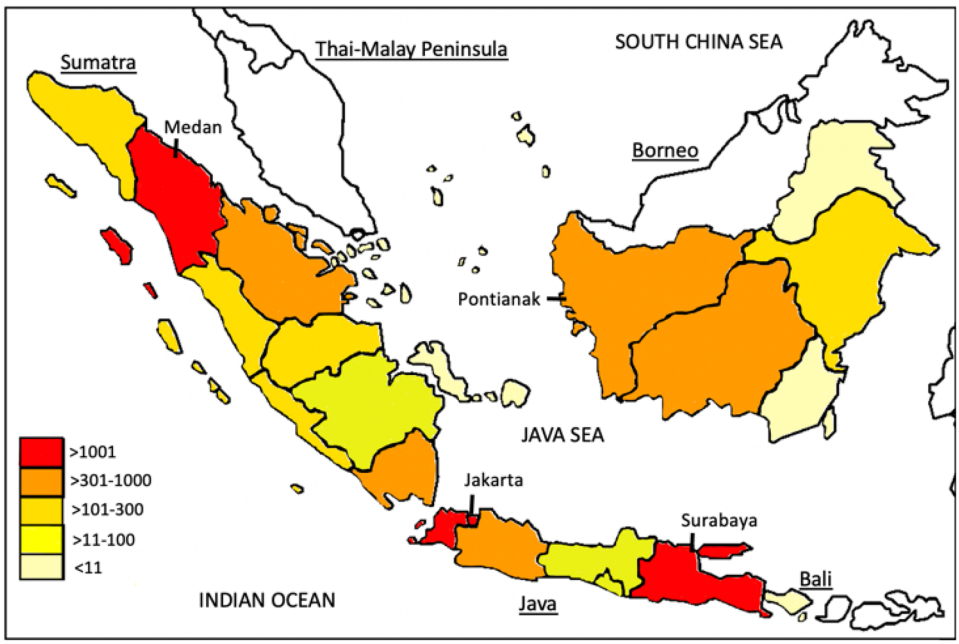

Fig. 4 Indonesian provinces with the number of pangolin equivalents seized between 2011 and 2022. Sunda pangolins (*Manis javanica*) occur throughout this region, including on many of the smaller islands; indicated are several cities where large seizures have been made

Borneo) without any clear evidence of geographic shifts over time. The 81 large seizures within Indonesia over the last decade are the equivalent of over 18,000 pangolins represents a monetary value of USD9.4 million. Over this period, the number of large seizures in Indonesia remained stable at around seven a year, but there was a decrease in the number of pangolins that were seized, from 3000 to 4000 in 2011 and 2012 to 400 to 600 in 2021 and 2022. The changes in the mean number of pangolins that were seized occurred around the middle of 2014, predating the listing of pangolins on CITES Appendix I by two to two-and-a-half years (i.e., listing in September 2016 or coming into effect in January 2017). It is quite likely that one of the causal factors of a decline of the number of pangolins that were seized is their demise in the wild. While the number of seizures remained more or less constant over time, fewer and fewer pangolins ended up in trade. There was a clear shift in the nature of the seizures in that in the early years often large amounts of pangolin carcasses were confiscated and relatively few seizures of scales only, whereas in later years most seizures comprised scales only. These latter seizures, occasionally, did represent the scales of many pangolins, e.g., 52 kg of scales in West Kalimantan in December 2021 or more recently, 150 kg of scales in North Sumatra in February 2022. Given that it is impossible to obtain scales without killing the animals, and given that the carcasses represent a significant value, this seems to reflect as decrease in the ability of the authorities to detect (or act upon) the trade in pangolin carcasses.

The 2016 CITES Appendix I listing or the 2000 zero export quota of Sunda pangolins prior to that may have had limited effect in Indonesia given that the harvest, buying, selling, and keeping of pangolins have not been permitted since at least 1931 (Nijman 2015). The effectiveness of these protective measures may have been limited as for instance in the 1920s, 1950s, and 1960s, at least, 10,000 s pangolins were exported from Indonesia (Dammerman 1929; Harrison and Loh 1965). It appears that it is only in the last decades that there is more stringent enforcement of existing legislation (Challender et al. 2019; Semiadi et al. 2009), but the findings from Indonesia suggests that there is little evidence that this is linked to external developments, including changes in CITES regulations.

Several attempts have been made to obtain insight into the scale of the pangolin trade, but most of this is focused on the international aspect of this trade (e.g., Challender et al. 2019; Gomez et al. 2023; Heinrich et al. 2016; Vigne and Nijman 2022; Pantel and Chin 2009). Many of the seizures reported in the Indonesian media are reported in Bahasa Indonesia only and are typically not considered in global assessments (Nijman 2015). Takandjandji and Sawitri (2016) reported on 15 seizures of pangolins made in Indonesia between 2011 and 2015. When meat and scales were seized both were converted to pangolin equivalents, thus counting the same individual twice; excluding this they document on 5511 pangolins being seized. Apriando (2019) reported that between 2015 and 2018 there were 23 interceptions, seizing 3369 pangolins, although it seems that seven of the seizures were made abroad so it is unclear how many were seized within Indonesia. For the period 2011–2015 and 2015–2018, I recorded 41 large seizures (14,221 pangolins) and 22 large seizures (6904 pangolins). The total number

Fig. 5 Sunda pangolin seizure, Palembang, South Sumatra, 17 October 2008 (Hasan Zainudin, CC-BY-SA 4.0)

of pangolins that were seized over this period must have been considerably higher as I excluded "end of year" or "destruction reports" whereby certain authorities give information on the total number of pangolins they seized over a prolonged, and often undefined, period, from a wider, again undefined, region. While it is important to stress that seizure reports (either obtained directly from the authorities or from the media) cannot give a complete picture of the illegal trade, it does provide a proxy of real-time trends, and gives insight into how trade networks operate (Indraswari et al. 2020), and indeed seizure reports are increasingly used to gain insight into the trade of pangolins (e.g., Gomez et al. 2023; Ingram et al. 2019; Omifolaji et al. 2022; Suwal et al. 2023).

While some of the largest seizures in Indonesia were made in cities with harbors and international airports (e.g., Medan, Jakarta, Surabaya, Pontianak, see Fig. 4), the international connectedness of a province explained little in terms of the number of seizures that were made or the number of pangolins that were seized. It appears from the arrests that the trade network within Indonesia is dominated by Indonesian nationals rather than individuals from transit or end destination countries. The best predictor for the number of pangolins that were seized in a province was human population size; where there are more people, more pangolins were seized. Apart from the island of Lombok, part of the province of West Nusa Tenggara, pangolins were seized in every of the 22 provinces and special regions where pangolins occur (for four three provinces, South Kalimantan, North Kalimantan, Bangka-Belitung and Riau Islands, this was ten pangolins or less), underscoring the geographic scale of the harvest and trade in pangolins (Fig. 5).

Reflecting on more than a decade of seizure data, it is perhaps encouraging to demonstrate a decline in the number of pangolin equivalents that are being seized, it is still discouraging that the frequency of seizures has not diminished. Between December 2019 and November 2022, 19 large seizures were made in ten provinces, totaling 490 kg of scales, for which some 1400 pangolins must have been killed. Yet, none of the seizure reports mention the presence of bodies, meat or carcasses. Given that this represent a monetary value of some USD900,000 in Indonesia (more overseas), it is unlikely that this has been discarded. Hence, it appears there may be a well concealed hidden trade in pangolin bodies and carcasses from Indonesia. The scale of these exports, quite likely numbering in the thousands of pangolins a year, it is unlikely that this is able to persist without the tacit approval of at least part of the enforcement agencies. This is something that needs to be addressed with urgency.

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Declarations

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