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RESEARCH

The illegal trade in rosewood in Indonesia

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Abstract
Rosewoods are among the most valuable traded hardwoods, and there is a significant illegal trade. From 2017 onwards the international trade in all species of *Dalbergia* rosewood is regulated through the Convention on International Trade in Endangered Species of Wild Fauna and Flora. I focus on two species of rosewood that occur in parts of Indonesia, *Dalbergia latifolia* and *D. sissoo*, to assess the extent of the illegal trade and to analyse geographical and temporal patterns of wildlife crime. Based on 67 seizure reports from 2014 to 2022 I show that (a) 117 logs of *D. sissoo* and 4,285 logs of *D. latifolia* were confiscated, (b) seizures occurred on the islands of Sumatra (16 seizures; 1,190 logs), Java (43; 1,780 logs), and Bali, Lombok, Sumbawa and Timor (8; 1,408 logs), (c) while there was an increase in the number of seizures per year, there were no seasonal differences in seizure activities. For 10% of the logs there was supporting evidence that they were taken from State managed forests and 18% was taken from conservation areas, thus causing more damage than just the removal of individual trees. Seizures in Indonesia over this period equals 0.12 ± 0.04% of the legal rosewood export. The illegal trade is dominated by Indonesians rather than foreign nationals and the direction of trade is towards Java from where > 95% will be exported to China. While policies are in place concerning rosewood seizures and stockpiling (including auctioning or destruction) in practise it is unclear where seized rosewood ends up. When used with caution, analysis of seizure data offers a valuable means to gain insights in illicit activities that normally remain hidden from view.

Keywords Cites · Conservation · Forestry · Java · Logging · Management · Wildlife trafficking · Wildlife trade

Introduction

Elephants, tigers, rhinos and pangolins and their products are commonly the first to be listed when reporting on the illegal wildlife trade. However, unbeknownst to many, in terms of monetary value, rosewood is the world's most significant trafficked wild product. For the period 2014–2018 rosewood represents 32% of monetary value of seized wildlife (UNODC 2020). Rosewoods is the term used to describe richly-hued hardwoods, including species of the genus *Dalbergia*. Rosewoods are used for furniture, veneer, handicrafts and other luxurious products but it is also bought for investment purposes (Zhu 2022). In the past decade, there has been a spike in the demand for rosewood, particularly because of China's emerging and rapidly growing group of wealthy middle-class elites and the Chinese government's commodification and lax import laws of rosewood furniture and items (Schuurman and Lowry II, 2009; Treanor 2015; Reeve 2015; EIA 2016). Several species of rosewood are protected by domestic legislation and for many more species its international trade is regulated through the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (Reeve 2015). To curb the illegal trade and to better regulate legal trade in rosewood, in 2016, with Argentina, Brazil, Guatemala and Kenya as proponents, a proposal for amendment of appendices I and II was prepared to include all ~300 species of *Dalbergia* on Appendix II of CITES (apart from the ones that were already included on Appendix I and for which international commercial trade is precluded). This allowed for regulating all international trade. The Appendix II listing became effective in early 2017.

Indonesia plays an insignificant role in terms of the illegal import of rosewood (either as a consumer or a transit

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country) as seizure data from 2005 to 2015 reported to World Wildlife Seizure database amounts to around 30 to 35 logs (with an average mass of 125 kg), or 0.5% of the total reported (UNODC 2020). But Indonesia may be, or soon become, a significant exporter of illegally harvested rosewood. At least 10 species of *Dalbergia* are naturally found in Indonesia, but in terms of commercial exploitation for timber, Indian rosewood *D. latifolia* and to a lesser degree North Indian rosewood *D. sissoo*, are the most important. Until recently there was very limited data on Indonesian rosewood species, but spurred by the 2017 CITES listing, and aided by funding and technical support from the EU, significant progress has been made in terms of distribution, genetic variation, regeneration, management and non-detriment findings (Subaktio et al. 2022; Yulita et al. 2022abcd; Arunkumar et al. 2021; Alikah et al. 2021; Fambayum et al. 2021). In parallel with this, there has been an increase in media reports on rosewood in Indonesia (Riastiwi and Damayanto 2022). Perhaps not surprisingly, the information we have on the illegal trade in Indonesian rosewood species, however, is limited.

Seizure data is increasingly used to fill data gaps on illegal trade in a variety of wildlife, including, pangolins (Challender et al. 2015; Nijman 2023), elephants and ivory (Yeo et al. 2017), bears (Gomez and Shepherd 2018), songbirds (Indraswari et al. 2020), teak (Fujisaki and Cho 2022) and indeed rosewood (Siriwat and Nijman 2018b, 2023; Nijman et al. 2022). Information obtained from even a single seizure has the potential to reveal important data on how the illegal trade operates (Reeve 2002; Paudel et al. 2022; Waeber et al. 2023). Compared to high-profile species especially confiscation data from low-profile species can be valuable as there may be less of a bias due of not or under-reporting. With caution and in aggregate, seizure data thus obtained can reveal current and predict future spatial (origin, transit, destination) and temporal patterns as well as reflect on the magnitude (species, type of products) in the rapidly evolving cycle of the illegal trade (LeClerc and Savona 2017).

I here use seizure data of rosewood in Indonesia from the period 2014 to 2022 to gain insight in the illegal trade and illegal export of these species. Specifically, I explore spatial and temporal differences in the number of seizures (reflecting enforcement activities) and the size of these seizures (reflecting the way how the illegal loggers and traders operate). Rosewood is not protected in Indonesia (that is, none of the species are included on the country's protected species list) and prior to 2017 rosewood could be exported without CITES permits, but logging, transportation and commercial trade in rosewood did require permits. From 2017 onwards the international trade requires CITES permits. Logging is only allowed in designated areas and this excludes all protected areas.

Methods

Study species, distribution, protection and regulation

Indian rosewood (*Dalberiga latifolia*, Roxb. 1799) is native to South Asia and Myanmar and is widely distributed on the Indonesian islands of Java, Bali and Lombok (it is also present on Sumatra to the west and other islands further east, as well as, less commonly, on Indonesian Borneo). There is uncertainty whether the species is native to this part of Indonesia, or whether it was introduced to Java in or prior to the 18th Century (Miguel 1855) refers to specimens under the synonym *D. javanica* collected in central Java in 1802). A disjunct distribution with drought-tolerant species from South Asia occurring also on Java is not uncommon, and for instance sour currant shrub *Antidesma acidum* and Indian hare *Lepus nigricollis* have a geographic distribution that matches that of Indian rosewood (Baker et al. 1998; Meijaard 2004). Indian rosewood grows up to 40 m tall and has a history of overexploitation for its valuable timber causing decline in its wild population; due to its slow growth rate and long rotation cycle, the declined population is yet to recover to its original level. It is listed as Vulnerable on the IUCN Red List (Lakhey et al. 2020a). The local Indonesian name for Indian rosewood is sonokeling.

North Indian rosewood (*Dalbergia sissoo*, Roxb. 1825) is native to South Asia and the Middle East and has been introduced in various parts of the world, including East and Southeast Asia, Australia, Africa and South America. In Indonesia it is mainly found on Java (Backer 1963). It grows on well-drained soils, reaches heights of 10 to 25 m, and because of its large global distribution it is not considered globally threatened (Lakhey et al. 2020b). The local Indonesian name for North Indian rosewood is sonowaseso or sonobrit (Sunardi 1993), although according to some sonobrit is the name used for a lower quality variety of Indian rosewood (Subiakto et al. 2022).

In Indonesia, Indian rosewood grows in monocultures in the eastern part of its range (e.g., the islands of Lombok or Sumbawa), in mixed plantations (together with teak *Tectona grandis* and / or mahogany *Swietenia macrophylla*) and in agroforestry areas where it is often planted along the edges as boundary trees or along roads (Yulita et al. 2022b). North Indian rosewood is mostly grown in mixed plantations and in agroforestry landscapes. The harvest of Indian rosewood on Java is managed largely by the Indonesian State Forestry Company (Perusahaan Umum Kehutanan Negara Indonesia, abbreviated as Perum Perhutani, and referred to as Perhutani), and currently trees are harvested that have been planted around 50 years ago (Yulita et al. 2022b). The harvest of Indian rosewood is planned annually

by means of a preapproved management plan, it is licenced, and involves replanting trees from seeds from nurseries. Harvest of Indian rosewood on community-owned land (in this part of Indonesia this includes village forests or hutan desa, community forests or hutan kemasyarakatan, community plantation forests or hutan tanaman rakyat and forestry partnerships or kemitraan kehutanan: Siscawati et al. 2017) tends to be unplanned and is based on the owner's needs (Yulita et al. 2022b).

CITES listed species in Indonesia are subject to an annual harvest quota; rosewoods are exempt as they are exported as "artificially propagated" (source code A in CITES terminology) or "assisted production" (source code Y), and hence are not considered wild (note that this regulatory decision has no bearing on whether Indian rosewood is native to Java or has been introduced, as native species can be artificially propagated). Harvest and transport of rosewood from State-managed forests requires a Certificate of Legal Timber Products (as part of Forestry Regulation number 8 of 2021) and is overseen by Perhutani. The harvest of rosewood trees from community owned land does not require a logging permit but its transport requires a People's Timber Transport Letter (indicating species, volume, source and destination), proof of timber ownership, and, given that it is a CITES listed species, a Document for Domestic Transport of Wild Plants and Animals. Because of the complexity of trading rosewood, rosewood tree owning farmers often hand over the licensing arrangement to buyers (Yulita et al. 2022b).

Data collection

In February 2019 and February 2023 I collected online reports of seizures of Indian rosewood and North Indian rosewood in Indonesia, using the keywords sonokeling (also written as sono keling) or Dalbergia latifolia or sonowaseso / sonobrit or Dalbergia sissoo in combination with bksda (the abbreviation of the natural resource management agency, responsible for forest management), or gakkum (the abbreviation of the law enforcement agency under the Ministry of Environment and Forestry) or polisi (police) or sita (seizure), for each of the years 2014 to 2022 separately. Online reports include press releases from government agencies or NGOs, news reports in written media, blogs or vlogs, reports from seizure organisations and any other open source data. A similar search was also conducted in English, but no new results were retrieved. I also consulted the Wildlife Trade Portal, an interactive tool that displays TRAFFIC's open-source wildlife seizure and incident data, but few Indonesian rosewood seizures were included (2014 to 2018, 0; 2019, 2; 2020, 4; 2021, 3; 2022, 4) and none that was not picked up by the earlier search.

Cases where theft of rosewood was reported, either in protected areas, in forest concessions, along roads or in community forests, but without the timber being seized, were discarded. For most seizures the number of logs was reported; from photographs that accompanied many of the seizure reports it was clear that this mostly indeed consisted of raw logs, sometimes with the edges sawn off to square them. For each report I noted the location of the seizure, the province, the date, the amount that was seized, and if there was any evidence of arrests and successful prosecution. In case a seizure was reported on multiple times (e.g., at the time of the seizure and during further legal procedures) the report with the most information was included. For a summary of the data that were collected see Table 1.

Table 1 Information collected from rosewood seizure reports used for the analysis

Variable	Measurement
Species	Dalbergia latifolia or D. sissoo – no other species reported
Date of seizure	Between 1 January 2014 and 31 December 2022
Location	Village, regency, province, island
Amount	Number of logs, volume
Geographic origin	Island, province, regency, village
Forest status	Protected area; State forestry owned forest; community forest
Direction of movement	For instance, towards Java
Arrests	Number and identity / nationality of people that were arrested, if any
Prosecution	Evidence of any successful prosecution

Analysis

For 60 out of 64 reports for Indian rosewood data on the number of logs was included; for the missing four reports the average number of logs (i.e., 67) was used to calculate annual and provincial totals. For each year I calculated the mean ± sem of the number of logs that were seized, and I compared the number of logs confiscated in each seizure for the years 2018 to 2022 with a one-way ANOVA, followed by post-hoc Tukey HSD (honest significant difference) tests.

For each of the following regions I compared the number of logs per seizure to explore spatial variation: South Sumatra and Lampung; Banten, West Java, Central Java and Yogyakarta; East Java; Bali, Lombok, Sumbawa and Timor, again using a one-way ANOVA.

To explore if there is a temporal bias in the number of seizures that are made (reflecting differences in seizure effort, harvest levels or demand), I calculated the expected number of seizures for any given month and used a χ^2 test compared that with the observed number of seizures that were made for each month for the period 2014 to 2022. To put the seizures in context I downloaded the export data as reported by Indonesia to the CITES Secretariat from the

CITES trade database, focussing on volumes reported in m^3, and excluding re-exports. I converted this to logs (one $m^3 = 780$ kg = 6.24 logs). Only data from 2017 to 2021 were available. I report mean ± sem, and I accept significance when $P < 0.05$ in a two-tailed test.

Results

Modus operandi

I found three reports of seizures of North Indian rosewood, two in May and October 2021 (in the provinces of Central Java and Yogyakarta) and one in July 2020 (in West Java) for a total of 117 logs. Two-thirds of these were taken from Perhutani managed forest. The remainder of this section refers to Indian rosewood, for which I found 64 reports of seizures, from most of the species' range (Fig. 1). No seizures were reported from the provinces of South Sumatra, Sumba or Banten. When reported, most of the seizures were made when articulated lorries or pickup trucks were searched, with ordinary cars being used less frequently. Once rosewood was found on a truck that had toppled over. Seizures during active logging was rare and comprised only a small number of logs, although twice the detection of active logging resulted in the detection of rosewood storage facilities. For most of the seizures it was not indicated what the end destination was, but especially for trucks, the general direction was towards Java (i.e., rosewood seized in Sumatra may have been transported by Javanese drivers or a truck stopped at a harbour in Bali came from Lombok and was heading to Java). Only once was the nationality of those involved *not* Indonesian (when a Russian nationalised Indonesian was arrested in Lampung) and it is evident that this stage of the illegal trade chain is fully Indonesian (although the financial backers may be foreign investors).

The main destination for rosewood, both legal and illegally harvested, is China, with the main trade hubs being situated in the cities of Madiun, Probolinggo, Malang, Surabaya (for rosewood mainly from eastern Java, Bali, Lombok, Sumbawa and Timor), Tegal, Cepu, Solo, Semarang (for central and eastern Java), and Bandung (for western Java and Sumatra) (Fig. 1).

Thirteen times, all on Java, it was specified that Indian rosewood was taken from Perhutani managed forest, for a total of 365 logs (9% of the total). Eight times rosewood (784 logs, 18%) was taken from protected forests, including two wildlife reserves (suaka margawatwa), three national parks (taman nasional) and one strict nature reserve (cagar alam). For the remainder, rosewood may have been taken from community managed forest, from Perhutani managed forest, from protected areas or private land but this was either not specified or simply was not known. Prosecutions were rare, and I found only two cases where perpetrators were arrested and successfully prosecuted.

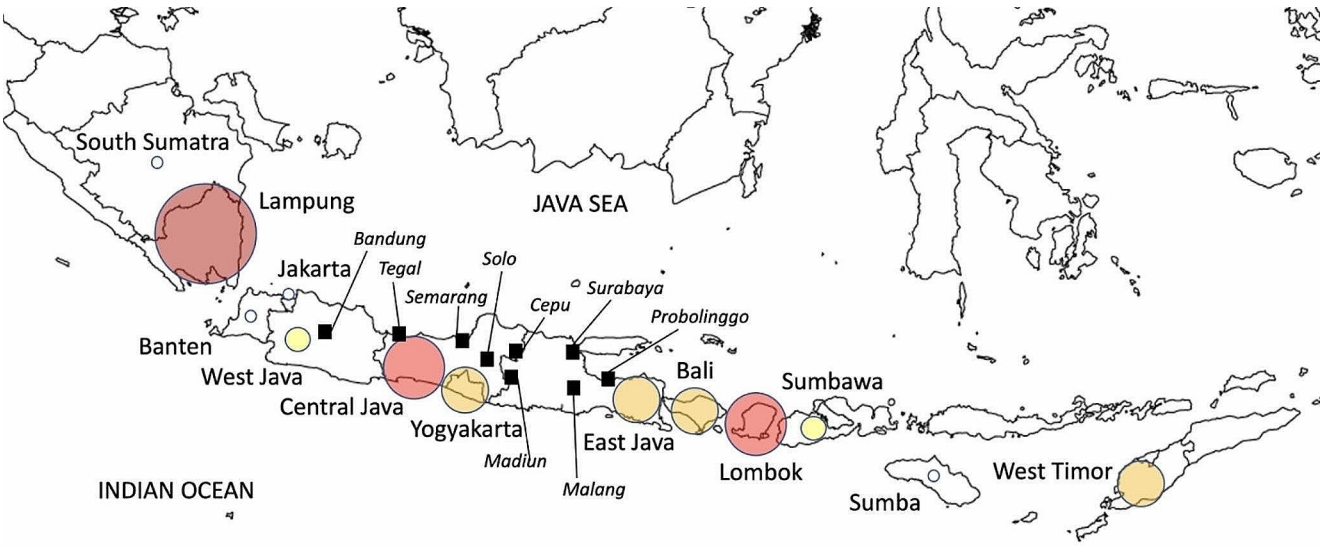

Fig. 1 Indian rosewood *Dalbergia latifolia* seizures in Indonesia between 2014 and 2022 by province; smallest open circles: provinces with rosewood but no seizures; small circle: 1-250 logs; intermediate circle: 251–500 logs; large circles: 501–1000 logs; very large circle: 1001–1500 logs. City names in Italics are the major Indonesian rosewood trade centres

Spatial and temporal patterns

The number of seizes steadily increased from 1 to 2 in 2014 to 2016 to 8 to 18 in 2020 to 2022. In total 4,285 Indian rosewood logs were confiscated (annual mean 474 ± 161 logs) (Fig. 2). While the number of seizures increased over time (Pearson's $R = 0.9245$, $N = 9$, $P = 0.0004$), the mean number of logs that were seized in each seizure remained similar over time (2018–2022: ANOVA, $F_{4,46} = 0.595$, $P = 0.595$).

Seizures occurred in every month of the year (Table 2), with a mean of 0.58 ± 0.07 seizures month^{-1}. The highest number of seizures was in May and June, at 1.00 ± 0.33 and 0.89 ± 0.45 seizures month^{-1}, but this was not statistically more than what was expected ($\chi^2 = 2.82$, df = 1, $P = 0.093$ and $\chi^2 = 1.50$, df = 1, $P = 0.220$, for May and June, respectively) and the lowest number of seizures were made in February, with 0.11 ± 0.11 seizures month^{-1}, which was somewhat lower than expected ($\chi^2 = 3.81$, df = 1, $P = 0.051$).

There were clear regional differences in the size of the seizure ($F_{3,53} = 4.819$, $P = 0.005$), with significant differences between Bali, Lombok and Timor (mean seizure 199 ± 77 logs, $N = 7$) and Lampung (mean 74 ± 31 logs, $N = 16$) (Post-hoc Tukey HSD test, Q = 3.84, $P = 0.043$) as well as between Bali, Lombok, Sumbawa and Timor and East Java (mean 16 ± 2 logs, $N = 23$) (Q = 5.66, $P = 0.001$). Excluding provinces from which no seizures were reported, there was a very strong relationship between the size of the seizure and the number of reports ($R = 0.929$, $N = 8$, $P = 0.001$); this may suggest that the authorities in some regions (e.g., West Timor, Yogyakarta) only make very large seizures public, whereas other regions (e.g., East Java, Lampung) announce both large and small seizures.

Indonesia reported the (legal) export of Indian rosewood for the period 2017 to 2021, 97.6% of which went to China. The mean volume was 84,334 ± 3,721 m^3 and this was consistent over the years (maximum of 96,673 m^3 in 2017 and minimum of 76,716 m^3 in 2020). This is the equivalent of 526,244 ± 23,220 logs per year and the seizures in Indonesia over this period equals 0.12 ± 0.04% of the legal export.

Discussion

Hitherto the illegal trade in rosewood in Indonesia has received limited attention, despite rosewood being one of the most significant items of wildlife that is traded illegally (UNODC 2020) and Indonesia playing a prominent role in the international wildlife trade (Nijman 2010). But this trade appears to be substantial. In the period 2014 to 2022 67 seizures were made during which 117 North Indian rosewood and 4,285 Indian rosewood logs were confiscated. This contrasts sharply with the 30 to 35 seized logs that had Indonesia as the end destination for the period 2005–2015 and that were included in the global seizure record database (UNODC 2020). In subsequent years several additional seizures have been made of rosewood that was exported by Indonesia. In February 2019 a container containing 20,000 *Dalbergia* wood products were seized in the Netherlands,

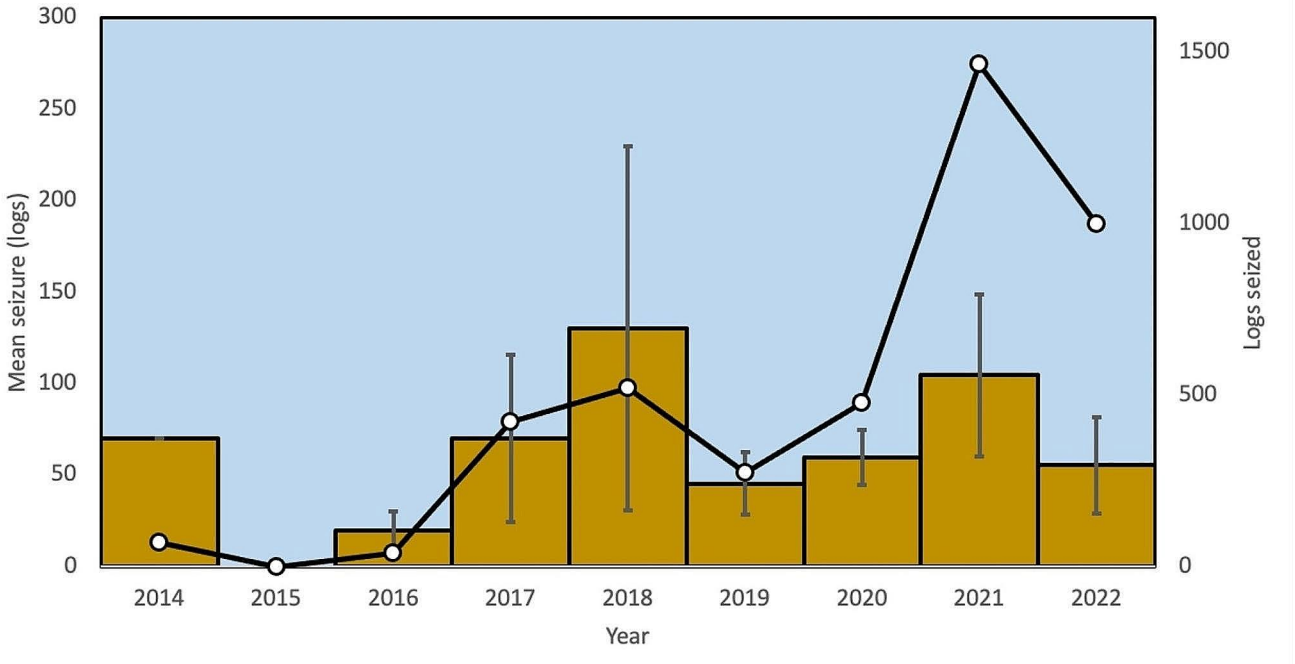

Fig. 2 The number of Indian rosewood *Dalbergia latifolia* seized by the Indonesian authorities between 2014 and 2022 (line) and the number of logs in each seizure (mean ± sem) (bars) for each year. The species was included on CITES in 2017

Table 2 Monthly records of seizures of Indian rosewood *Dalbergia latifolia* in Indonesia between 2014 and 2022

Month	January	February	March	April	May	June	July	August	September	October	November	December
Seizures	7	1	3	6	9	8	4	6	5	5	4	5

and in May 2019, 3,421 kg of rosewood products were seized in France (TRAFFIC 2019). A year later, in September 2020 1,740 kg of *Dalbergia* wood, also originating from Indonesia, was confiscated in Zhongshan port in southern China.

Seizures in Indonesia occurred during all months of the year and the number of logs that were confiscated during each seizure remained constant, suggesting some form of year-round surveillance. The number of seizures, and hence the total number of logs seized, increased over time. This does not seem to have been because of a change in the legal export of rosewood from Indonesia as that remained constant; it could have increased because of an increase in demand from consumer countries (primarily China) or a diminishing supply from other exporting countries. In light of possible under-reporting of the smaller seizures from some provinces, the number of seizures that has occurred over this period is likely to be higher than reported here. Seizures rarely led to successful prosecution of offenders. The temporal and spatial patterns observed in the seizure data (with an increase over time and a preponderance of seizures from the southernmost part of Sumatra, eastern Java, Bali and Lombok and few data from western Java) match closely that of rosewood being mentioned in the Indonesian news media over the same period (Riastiwi and Damayanto 2022). There appears to be a lack of seasonality in the logging of rosewood trees (due to for instance other commitment during harvest of agricultural products, variability in the demand of rosewood overseas or even differential enforcement efforts). The increase in seizures does not to be linked to an increase in legal exports or a change in destination countries as at least for the years 2017 to 2021 China was by far the most dominant trading partner and volumes remained stable. Limited information is available on the domestic trade in Indian rosewood in Indonesia but at least in Bali some of this is available in tourists' shops in the absence, however, of CITES permits (Chavez et al. 2023).

It has been estimated that a mere 20% of the Indian rosewood is harvested from Perhutani (State-owned) forests and because of a lack of data on the standing stock, harvest regime and an absence of quotas, it is not possible to make a non-detriment finding for rosewood in community forests where the remaining 80% is harvested (Yulita et al. 2022b). Hence, the sustainability of the legal harvest and trade in Indonesian rosewood has yet to be assessed (see also Hughes et al. 2023). Yulita et al. (2022b, c) gave a brief overview of the illegal harvest of Indian rosewood for the period 2020–2022 but only included 22 seizures in their analysis leading them to conclude that the quantity of illegal harvest is small compared to legal harvest and trade (noting, however, that we have limited data on the legal trade). However, when more data are available from more seizures,

as in the present study, and considering low likelihood of detection, illegal harvest and trade may appear to be more serious of a challenge when managing rosewood stands than previously considered. For instance, Yulita et al. (2022b, c) indicate that 118 logs were illegally taken from Perhutani managed forest and 208 logs from protected areas, whereas here it is reported as three and four times as much. Especially the observation that 18% of the illegally harvested rosewoods were logged from conservation areas is disconcerting as the effect this has on the wider ecosystem is larger than 'just' the removal of individual trees. In terms of the volume of legal trade, and specifically the legal export, the number of rosewood logs that are seized in Indonesia is small, representing at most a quarter of a percent. Seizure data from importing countries may add to this but unfortunately these data are not available at present.

In none of the seizure reports, nor in other documents (Yulita et al. 2022ac), is it made clear what is done, and what needs to be done, with seized rosewood. Following Law 18/2013 seized goods need to be retained during criminal procedures (if indeed the perpetrators of the illegal trade in rosewood are arrested and prosecuted, which does not seem to be the case), after which the seized timber can be auctioned if it originates from non-conservation forests (the proceeds of which are to be placed in a government bank account) or can be destroyed. However, in practise it is unclear what happens with the timber after sentencing or when no further judicial actions are taken, and much of the rosewood is seized during transit and it is unclear from where it exactly originated. The seized goods reported here represent not only a large volume (and hence the authorities may incur considerable costs stockpiling it) but it also represents a significant monetary value. There is a risk that seized rosewood enters the legal trade chain without having any direct consequences for those involved in the illegal harvest and trade (see also Wilmé et al. 2020 and Waeber et al. 2023).

Seizure data offer valuable insights into the specific nuances, patterns, and complexities of illegal wildlife trade networks, and analysis of these data allows us to move beyond the mainstream avenues of criminology that traditionally focuses on individual offenders, to explore larger trade networks to inform data gaps in green criminology (Nurse 2017). Several attempts have been made to obtain insight into the scale of the rosewood trafficking, but most of this is focussed on the international aspect of this trade (e.g., Schuurman and Lowry 2009; Innes 2010; Reeve 2015) and little of it involved Indonesia. Many of the seizures reported in the Indonesian media are reported in Bahasa Indonesia only and are typically not taken into account in global assessments. Indeed when comparing the data collected here with that what is available in TRAFFIC's Wildlife Trade portal there are large differences (i.e., 13 v 63 seizures). Indonesia is not unique in this respect as for instance Thailand, where most of the reporting is done only in Thai, is likewise rarely included in wider assessments (Siriwat and Nijman 2018ab).

From the seizure reports it is clear that much of the illegal trade occurs on Java and that rosewood trees harvested outside Java are transported to Java. The main rosewood timber trade centres are located in West Java (Bandung), Central Java (Tegal, Cepu, Solo, Semarang), and East Java (Madiun, Probolinggo, Malang, Surabaya), and from there over 95% of rosewood is exported to China (Yulita et al. 2022c). While Indonesia operates a Timber Legality and Sustainability Verification System that integrates with export permits, it is unclear if when the illegally felled and illegally transported rosewood trees are exported, they are accompanied by the appropriate CITES paperwork, and hence enter the 'legal' trade, or whether these are exported without permits. If the latter is the case, then closer cooperation between the Indonesian and Chinese authorities is needed to ensure that the export and import of rosewood does not violate the rules and intentions of CITES.

Conclusion

Seizure data from Indonesia from the period 2014 to 2021 show that there is a consistent illegal trade in rosewood at a scale much larger than previously indicated. Seizures are mostly done in southernmost Sumatra and Java, and the trade is directed towards Java from where the rosewood would have been exported to China (this is also the main partner for the legal rosewood trade importing almost 98% of Indonesia's export). Almost a fifth of the rosewood was taken from conservation areas rather than plantations, but for many seizures it was unclear where the trees were felled. Following the CITES appendix II listing that came into effect in 2017 there appears to be an increase in seizures. The illegal trade is dominated by Indonesians rather than foreign nationals, and while there is a year-round effort in inspections and seizures, effective prosecutions of offenders appear to be minimal. Policies are in place concerning stockpiling (including auctioning or destruction) but it is unclear where seized rosewood ends up; following auction much of it may be exported. While it is demonstrated here that, when used with caution, analysis of seizure data offers a valuable means to gain insights in illicit activities that normally remain hidden from view, law enforcement thus far has had limited impact on the on the ground management of rosewood stands.

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Author contributions V.N.: Conceptualization, Investigation, Methodology, Formal analyses, Writing, Visualization.

Data availability Data that are not included in the paper are available from the author at a reasonable request.

Declarations

Competing interest The author declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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