Article:
Chavez, J., Campera, M., Hensley, L.E. et al. (8 more authors) (2025) Illegal wildlife trade in a tourism and biodiversity hotspot. Sustainable Development. ISSN 0968-0802

https://doi.org/10.1002/sd.70129

Sustainable Development

WILEY

Sustainable Development

RESEARCH ARTICLE OPEN ACCESS

Illegal Wildlife Trade in a Tourism and Biodiversity Hotspot

Jessica Chavez[1,2] | Marco Campera[1] | Lisa E. Hensley[3] | Kuntayuni[4] | S. Sunny Nelson[2,5] | I. Nyoman Aji Duranegara Payuse[6,7] | Anne W. Rimoin[8] | Chris R. Shepherd[9] | Erly Sintya[4,10,11] | Desak Ketut Tristiana Sukmadewi[12] | Ratna Ayu Widiaswari[6] | Vincent Nijman[2]

[1]Sustainable Agroforestry, School of Biological and Medical Sciences, Oxford Brookes University, Oxford, UK | [2]Oxford Wildlife Trade Research Group, School of law and Social Sciences, Oxford Brookes University, Oxford, UK | [3]Zoonotic and Emerging Diseases Research Unit, United States Department of Agriculture Agricultural Research Service, United States Department of Agriculture, Manhattan, Kansas, USA | [4]Center for Climate Change, Warmadewa University, Denpasar, Indonesia | [5]Lincoln Park Zoo, Chicago, Illinois, USA | [6]Faculty of law, Warmadewa University, Denpasar, Indonesia | [7]Center for International Development, Warmadewa University, Denpasar, Indonesia | [8]Department of Epidemiology, University of California, Los Angeles, Los Angeles, California, USA | [9]Monitor Conservation Research Society, Big Lake Ranch, British Columbia, Canada | [10]Faculty of Medicine and Health Sciences, Warmadewa University, Denpasar, Indonesia | [11]School of Chemical, Materials and Biological Engineering, Sheffield University, Sheffield, UK | [12]Faculty of Agriculture, Warmadewa University, Denpasar, Indonesia

Correspondence: Vincent Nijman (vnijman@brookes.ac.uk)

Received: 30 April 2025 | **Revised:** 19 July 2025 | **Accepted:** 26 July 2025

Funding: This work was supported by Re:Wild, People, Plants and Primates Action Fund, Oxford Brookes University HLS Developing Potential Research Excellence Award, Conchologists of America Grants to Malacology, and a Royal Geographical Society Geographical Fieldwork Grant. This work was supported by the United States Department for Agriculture (USDA) Agriculture Research Service (ARS) (USDA ARS NACA number 20230048, grant number 58-3022-2-020). These findings do not represent official views or endorsements of the United States Government.

Keywords: conservation | illegal wildlife trade | Indonesia | law enforcement | natural resource management | sustainable development goals

ABSTRACT

There are clear connections between tourism, development, and sustainable use—particularly in biodiversity hotspots, where tourists may unknowingly purchase souvenirs made from protected wildlife. This issue is explicitly recognized in the Sustainable Development Goals, including SDG15, Life on Land, and SDG16, Peace, Justice, and Strong Institutions. On the island of Bali, a premier tourist destination with a strong local Hindu culture, we assessed the trade in legally protected wildlife (2022–2025) with the aim of improving the effectiveness of protected species regulations. We recorded 1440 animals for sale (849 as body parts and 591 alive). Almost half the species (27/59) were globally threatened, from other biodiverse hotspots, with few links to Balinese culture or society. Tourism on the island appears to have a negative impact on the environment, and this has implications for the sustainable development of Balinese society. We advocate for promoting sustainable tourism, embedded in Balinese culture, respecting local legislation and traditions.

1 | Introduction

When considering sustainable development, especially when focussing on countries in the Global South, it is imperative to consider the mutual interactions among society, development and environment, and the social and cultural contexts of sustainable development (Awan et al. 2018; Lehtonen 2004; Sachs et al. 2019). This is explicitly recognised in the Sustainable Development Goals (SDG), for instance SDG15, Life on Land ("Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss"), SDG14 Life below Water ("Conserve and sustainably use the oceans, seas and marine resources for sustainable development") and SDG16 Peace, Justice and Strong Institutions ("Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels") (Andrew 2017;

Katila et al. 2019; Sachs et al. 2019). It is therefore paramount that when policies for sustainable development are implemented, a system is put in place for the verification and monitoring of these policies, including the retrospective assessment of its effectiveness over time (Caiado et al. 2018; Stafford-Smith et al. 2017; Nijman et al. 2024).

The United Nations World Tourism Organization focuses on promoting and developing tourism and contributing to economic development and international understanding, among other goals (UNWTO 2009). It aims to promote biodiversity conservation and to prevent environmental damage. Tourism activities should be conducted in harmony with the attributes and traditions of the host regions and countries while respecting their laws, practices, and customs (UNWTO 2001). Two articles of the Global Code of Ethics for Tourism give specific guidance on how to deal with tourism and biodiversity conservation (Chavez et al. 2024). Article 1.5 states that tourists and visitors should not commit any act considered criminal by the laws of the country visited and abstain from any conduct likely to damage the local environment, and as such, they should furthermore refrain from all trafficking in protected species, including their parts and derivatives. Section 3.4 indicates that tourism infrastructure should be designed to protect the natural heritage (ecosystems and biodiversity) and to preserve endangered species of wildlife (UNTWO 2001). However, what is protected, what is endangered, and what is considered criminal are not always clear[1]. Tourists especially are often uninformed of the protection status of animals or plants, or of the products derived from them, and inadvertently may become involved in the illegal wildlife trade (Carpenter and Andreone 2023; Chavez et al. 2024).

The illegal wildlife trade can take many forms (Phelps et al. 2016). The trade in a particular species can be illegal because of where, when, and how it was obtained, for example, harvesting plants, collecting fungi, or hunting animals in a protected area or site of outstanding natural beauty (Botha et al. 2004; Witno et al. 2023), shooting and trading animals outside a closed hunting season (Eliason 2003), capturing animals using illegal technologies (MacMillan and Nguyen 2014; Nijman 2015) or fishing with small mesh-sized nets (Kastoryano and Vollaard 2023; Osuka et al. 2021). Trade can be illegal because the volumes are above and beyond established quotas or limits (Morton et al. 2024; Daut et al. 2015), or certain restrictions are not adhered to (e.g., gravid females or individuals above or below an established size or mass that are not allowed to be harvested) (Auliya et al. 2016; Nijman 2022; Kurland et al. 2017). Trade can also be illegal when done internationally where only domestic trade is allowed (Daut et al. 2015; White 2021), or when species are traded by people outside a group that have been given exclusive access (Gomez et al. 2020). For the general public, policymakers, and judiciary, however, illegal wildlife trade is often synonymous with trade in legally protected species (Bergin et al. 2018; McEvoy et al. 2019; Janssen and Leupen 2019; Rehman et al. 2015; Phelps and Webb 2015; Ye et al. 2020; Nijman 2017, Nijman et al. 2022; Novanda and Rosnawati 2021). This has received considerable attention following the emergence of COVID-19, as several researchers explicitly linked the trade in protected species, or the illegal wildlife trade in more general, to zoonotic diseases (Guynup et al. 2020; Beirne 2021; Bezerra-Santos et al. 2021; Nijman 2021; Rush et al. 2021).

Here we focus on the interactions between sustainable development, tourism, wildlife utilization and protection, and the effectiveness of the implementation of national legislation. For this we zoom in on the illegal wildlife trade as observed on the island of Bali in Indonesia over a 3-year period (Table 1). For this we start with a short historic overview concerning protected wildlife legislation in Indonesia.

Indonesia, then under colonial rule by The Netherlands, first introduced a wildlife protection Ordinance in 1909 aimed at the total protection of all mammals and birds, other than those that were classed as game or that were considered harmful (Dammerman 1929). Indonesia, an archipelago nation of over 17,000 islands, is a highly biodiverse country (although the term "biodiverse" was not in use in the early 1900s) and protection of that many species was problematic and in practice could not be enforced. In addition, there was an inherent bias towards species occurring on the island of Java (and to a lesser degree Bali as most species that occur naturally on Bali are also found on Java). This island was seen, and to this day is seen, as the political, cultural, and economic center of the country, making Indonesia-wide species protection ineffective. In 1924 a new Ordinance was enacted that was based on the opposite of the 1909 Ordinance: here all the species (or species groups such as birds of paradise or gibbons) that were to be protected were listed by name, and this included a wide range of species from all over the archipelago. Comparison with the most current list of protected species, and considering present-day taxonomy—in 1924 all orangutans were considered one species whereas now we recognize there are three—suggests over 445 species were legally protected. In the years after gaining independence from The Netherlands in 1945, Indonesia made small incremental changes to the list of protected species, including taxa other than mammals and birds, generally by adding new ones that were deemed in need of protection. Thus, in 1968 orchids were added to the list, in 1972 certain tree species, in 1973 *Anguilla* eels, in 1978 whales, marine turtles, and crocodiles, in 1987 black corals and marine mollusks, ending with the addition of the ebony langur *Trachypithecus auratus* in 1999 (Noerjito and Maryanto 2001). No changes were made for 20 years, when a substantial change happened in 2018 with the addition of 242 species (many birds) bringing the total to 919 legally protected species.

Following Act No. 5 concerning the Conservation of Living Resources and their Ecosystems, anyone in Indonesia is prohibited to '(a) catch, [...], transport and trade in a protected animal in a live condition; (b) keep, possess, [...] transport, and trade in a protected animal in a dead condition; (c) transfer a protected animal from one place to another, within or outside Indonesia; (d) trade, keep or possess [...] bodies, or other parts of a protected animal or the goods made of parts of the animal, or transfer from one place in Indonesia to another, within or outside Indonesia'. Penalties that can be imposed when these laws are broken can total fines of up to IDR 100,000,000 (~USD 6200 at July 2024 exchange rates) and imprisonment for up to 5 years (sentences are lower if the offences were committed unintentionally)[2].

Here we test a series of specific hypotheses (Table 1) that try to explain the variation in the amount of protected wildlife that is openly offered for sale in Bali (species, individuals) by linking it to geographic, economic, legislative, and species-specific

TABLE 1 | Series of null hypotheses used to test the relationship between the trade in legally protected species in Bali and species characteristics (rarity, distribution) and external factors (legislation, number of tourists).

Hypothesis	Variables	Tests
We should not observe legally protected species in trade, or if we do, it should be concealed, not in the open	Number of protected species openly offered for sale; Number of individuals openly offered for sale	Counts and descriptive statistics
No legislative change has occurred over the study period, so observations do not differ between assessments	Number of species and individuals in curio shops and in the animal markets	One way repeated measures ANOVA
The curio trade, but not the live animal trade, targets foreign tourists. Tourist numbers are twice as high in the boreal summer than they are in the boreal winter, and this should reflect itself in what is offered for sale	Mean number of species and individuals in curio shops/animal markets for winter (December, January and February) and summer (May, June, July)	*t*-test for independent means
Global conservation status reflects abundance; the number of individuals is highest for non-threatened species, lower for species listed as Vulnerable and lowest for Endangered and Critically Endangered species	Number of individuals from species/genera listed as non-threatened, Vulnerable, Endangered and Critically Endangered, contingent on at least one detection	One way repeated measures ANOVA (animal parts); *t*-test for dependent means (live trade)
When a species was added to the protected species list has no effect on its trade	Number of individuals offered for sale grouped by date of listing (1924–1931; 1968–1980; 1987–2018), log-transformed	One way ANOVA (animal parts), *t*-test for independent means (live trade)
Animals are sourced equally from all parts of Indonesia	Number of species sourced from Bali; Sumatra; Java; Borneo; Lesser Sunda Islands; and eastern Indonesia (Sulawesi, Papua, and Moluccas)	χ^2 test

characteristics. This includes the effect of legislative changes and the time since a species was first added to the list of legally protected species, the effect of the number of foreign tourists that arrive in Bali in any given month, and the rarity and geographic origin of the species in trade.

2 | Methods

2.1 | Study Area

We focus on Indonesia's third smallest province, Bali. Its economy is largely driven by the tourism sector. In 2023, Bali welcomed over 15 million visitors, with just under 10 million being domestic tourists and over 5 million international tourists. The top six countries from where international tourists hailed were Australia, India, China, the UK, the USA, and Singapore. About a third of Bali's GDP comes directly from tourism, and it increases to two-thirds if indirect services are included (Antara and Sumarniasih 2017). In terms of GDP per capita, Bali lags behind other parts of Indonesia. It ranks 22 out of Indonesia's 38 provinces, that is, it has a GDP per capita of USD 4087, compared to a value of USD 4918 for Indonesia as a whole or USD 21,166 for Indonesia's capital Jakarta (BPS 2024).

Indonesia is one of 17 megabiodiverse countries of the world, encompassing two of the world's 25 biodiversity hotspots, Sundaland and Wallacea (Myers et al. 2000), with Bali situated where these two hotspots meet geographically. Indonesia harbors over 30,000 vascular plant species (Bali, 1600), over 700 terrestrial mammals (Bali, 30), over 1700 birds (Bali, 400) and over 2000 coral reef fishes (Bali, 800) (Girmansyah et al. 2013; Sun et al. 2024; Maryanto et al. 2019; Mason 2011; Andrew 1992; Allen and Adrim 2003; Allen and Erdmann 2013). Bali is also a known center for wildlife trade (Chavez et al. 2024; Nijman and Nekaris 2014; ProFauna 2005), including the (international) trade in birds (Chng et al. 2018; Nijman et al. 2022) and terrestrial mammals (Malone et al. 2002; Nijman et al. 2017, 2024; Chavez and Nijman 2024), but especially marine species such as corals (Reksodihardjo-Lilley and Lilley 2007), mollusks (Nijman and Lee 2016), aquarium fish (Lunn and Moreau 2004), marine turtles (Pertiwi et al. 2020), and dugongs (Lee and Nijman 2015). This trade occurs largely in the open, in shops, in permanent wildlife trade markets and online. The removal of animals for this has an unquantified impact on the environment and biodiversity of Bali and other Indonesian islands.

2.2 | Data Acquisition

Our study covers five periods, that is, 25 December 2022 to 6 January 2023, 31 May to 19 June 2023, 3 to 19 January 2024, 23 May to 11 July 2024, and 11 January to 8 February 2025. In these periods, we surveyed the trade in animals and animal parts in Bali, focusing on the cities of Kuta/Legian, Denpasar, Sanur, Ubud, and Tampaksiring. During three of these periods, we surveyed the Satria bird market in Denpasar and the Beringkit animal market in Mengwi (January 2023, June 2024, January–February 2025) for the live animal trade. See the insert in Figure 3 for a map of the study area.

For the assessment of trade in body parts, we selected shops selling wildlife along main streets in the five towns. These shops prominently display their wares, and there is no challenge locating them (Chavez et al. 2024). Most of the shops were visited two or three times during each period, and we compared the items for sale and reported only a minimum number of items, avoiding double counting (thus if at three visits in June and July 2024 to a particular shop we observed 10, 12 and 8 langur skulls the minimum count is 12, but the actual could have been anything between 12 and 30). Depending on the size of the shop, and provided wildlife was offered for sale, a visit would typically last between less than 5 min and up to about half an hour.

The Beringkit animal market is open on Wednesdays and Sundays. In the northeastern corner of the market, alongside domesticated animals, wild animals, primarily birds, are offered for sale. In the western part, there are a small number of permanent aquarium shops. Satria bird market is open every day of the week, and besides birds, a wide variety of other wild and domesticated animals are offered for sale. A visit to either market typically lasted several hours, and during each period, it was visited once.

All surveys were done by the senior author (V. Nijman), a general wildlife trade expert with more than three decades of experience surveying wildlife in Asia. He was frequently accompanied by one or more of the other authors, many of whom have good identification skills for one or more taxa. Identification (see below) was done on the spot, with discussions between surveyors and where needed in consultation with vendors. Photographs were taken to document the trade and when needed for further identification. One shop in Ubud had a sign "no photos, no videos", but otherwise taking photographs in the shops and markets was permitted.

In July 2025, we consulted the TRAFFIC Wildlife Trade Portal and filtered it for seizures on the island of Bali and seizures in Denpasar, for the period 2017 to 2025. For each entry, we read the original source to ensure a seizure was indeed made, and we grouped them as seizures made at Bali's I Gusti Ngurah Rai international airport or elsewhere in Bali, by nationality of the offender and by taxonomic grouping.

2.3 | Species Selection and Identification

For selection of legally protected species, we took our data from the most recent updated version of Indonesia's protected species list of 2018. While legally protected species cannot be traded, an exception can be made for some species that are captive-bred and that are allowed to be sold commercially (often only for specific purposes such as the live pet trade, thus precluding their sale for meat or skins). Captive-bred here refers to individuals that were born from parents that themselves were born in a captive setting, that is, these are at least second-generation offspring, thus excluding captive-born individuals, that is, those that were born in a captive setting from one or both parents that were born in the wild. In our study, this concerns a small number of species, and when reporting on these, we will single out their captive-bred status. It is also worth mentioning that not being listed on Indonesia's protected species list does not necessarily make it legal to trade in these species. For many species, strict regulations and quotas are in place concerning their harvest and trade, and in the absence of these quotas, their trade is also deemed illegal (Shepherd 2010; Lyons and Natusch 2012).

We only included species that we could identify at least to the genus level. For many species, we only observed certain body parts, including skulls, antlers, and teeth, each with their own identification challenges.

Skulls: for some species identification was straightforward as in the case of, for instance, proboscis monkey *Nasalis larvatus*, sun bears *Helarctos malayanus*, or dugong *Dugong dugon* (all monotypic genera, and all protected). For others, it was more challenging as in the case of macaque skulls. Indonesia is home to 11 species of macaques, 9 of which are legally protected, and identification typically was only possible at the genus level (Chavez and Nijman 2024). The most common species in trade were the long-tailed macaque *Macaca fascicularis* and the southern pig-tailed macaque *M. nemestrina*, neither of which is protected, and conservatively, we only included records of macaque skulls that were said to have originated from Sulawesi in our analysis (as these are protected). We were not able to identify babirusas *Babyrousa* spp. (three species) and anoas *Bubalus* spp. (two species) to the species level, but all babirusa and anoa species are legally protected.

Antlers: Antlers are frequently used for carvings, and this includes imported antlers from, for instance, moose *Alces alces*. In true deer, antlers shed annually, and here we focused only on antler sets that were still attached to either the whole skull or the skull cap (some of which were intricately carved), and hence that could only have been obtained by killing the animal. Antlers we observed in Bali comprised mostly of Javan deer *Rusa timorensis* and some sambar deer *R. unicolor*. For whole antler sets, these two species are easily distinguishable (rear tine longer than front tine in Javan deer, but of equal length in sambar deer); however, for a few carved sets, the tines were cut off, and we were no longer able to identify the species. For the barking deer, we expect that most, if not all, are from the widespread red muntjac *Muntiacus muntjak* rather than the rarer Bornean yellow muntjac *M. atherodes*, though this cannot be ruled out.

Ivory and teeth: We observed significant amounts of ivory, including that of woolly mammoth *Mammuthus primigenius*, Asian elephant *Elephas maximus*, sperm whale *Physeter macrocephalus*, dugong, and walrus *Odobenus rosmarus*. Mammoth ivory was said to be imported from Russia, and walrus from either America (which is understood in the local

context to include both the USA and Canada) or more specifically from Alaska. Invariably, these items were labelled as walrus or mammoth, or vendors pointed it out swiftly, and neither species is considered here. Other dugong parts in trade were cigarette pipes made out of rib bones or the ribs themselves, and in addition to elephant ivory, we observed elephant molars.

Black coral *Antiphates* spp.: The only parts that we were able to consistently monitor were black coral bracelets (referred to as gelang akar bahar) and black coral walking or marching sticks (tonkar).

For the trade in live birds, we excluded white eyes (*Heleia* spp., *Zosterops* spp) because of identification challenges and changing taxonomies, and the fact that only a few species are included on Indonesia's protected species list. On its protected species list, Indonesia recognizes three species of black-winged myna (*Acridotherus melanopterus, A. tricolor* and *A. tertius*); we recognize these as one (*A. melanopterus*) (Sadanandan et al. 2020). For Java sparrow *Lonchura oryzivora* we only recorded the wild type, thus excluding white, leucistic, captive-bred morphs, though we recognize that some of the wild type birds may also have originated from captive breeding operations.

2.4 | Analysis

For each survey we estimated the minimum number of individuals for each species. For the live trade this was simply the number of individuals, assuming that each individual we counted was observed only once. This implies a turn-over time of less than 6 months (the shortest interval between two of the surveys of the Satria bird market in 2024 and 2025), which is realistic. For body parts we made conservative, minimum estimates of the number of individual animals involved. Thus, when we observed ten elephant ivory pieces, we assumed these could have all been derived from the same elephant, whereas they could have come from ten different ones. We did this for each survey period separately, and then we made a best estimate of the minimum number of animals that were needed to obtain the body parts that we observed. Carved dugong ivory comprised whole tusks, and given that both males (where they are erupted) and females (where they are concealed) have one set of tusks, two carvings were estimated to have been derived from a single dugong whereas three carvings must have come from two individuals. We used the same reasoning for sun bears, with four canines for each individual bear. Regarding quills from Javan porcupine, while individual quills may be shed naturally, large bundles of them can only be obtained by killing the animal. We counted the number of quill bundles; given that most of the porcupine records refer to skulls and we had no certainty that the quills and skulls were not obtained from the same individual, we did not include them to estimate the minimum number of porcupines in trade. We have no information on how many bracelets can be produced from a single black coral, and here we counted their presence as having come from a single individual.

For three of the legally recognized songbird species that are close to extinction in the wild, that is, Java sparrow, black-winged myna, and Bali myna *Leucopsar rothschildi*, we assume that most, or even all, were captive-bred (Van Balen and Collar 2021; Nijman et al. 2021, 2018; Baveja et al. 2021; Rosyadi et al. 2019; Shepherd et al. 2016; Squires et al. 2022, 2024; Van Balen et al. 2000; Chiok et al. 2019; Leupen and Shepherd 2018). Evidence of captive breeding can come in the form of close leg rings, and indeed some individuals, especially Bali mynas, were ringed, but most were not. For some of the Asian arowana *Scleropages formosus*, it was clearly indicated that they were wild-caught but microchipped and permitted, whereas for others this was not. We expect at least some of them to be captive-bred.

For the statistical test we performed, we refer to Table 1. Statistical tests were performed on log or log x + 1 transformed data (as to approach a normal distribution more closely and to ensure equal variance) in the Social Science Statistics package. We used the Pearson correlation coefficient using the cor.test() function in R software to check for a linear association between the number of foreign visitors that arrive in a given month and the number of animals that we recorded in markets. We accept significance when $p < 0.05$ in a two-tailed test.

3 | Results

3.1 | Protected Animals in Trade

Contra to our null hypothesis that we would observe no, or very few, protected species in trade, we in fact observed a large number. These were all displayed in the open and we were not shown anything that initially was concealed (such as items that were kept in the back of the shop or under the counter). We recorded the parts of 31 species that were legally protected, including 21 species of mammal, three birds, one marine turtle, one crocodile, five species of molluscs, and one coral (Table 2). We estimate that our observations over the five periods amount to a minimum of at least 849 individual animals that must have been killed to obtain the body parts that we observed; the real number is probably considerably higher.

Likewise, in the live animal trade we observed a substantial number of legally protected species being openly offered for sale. In total we observed 591 individuals of 28 species, comprising 26 bird species, one reptile, and one fish (Table 3). We estimate that at least 353 individuals of 25 species were collected from the wild (the others were captive-born or captive-bred).

3.2 | Difference Over Time and Seasonal Differences

The five surveys differed in the number of individuals we recorded for each of these 31 species (One-way repeated measures ANOVA, $F_{4,155} = 4.660$, $p = 0.002$) but we did not see any changes over time (Figures 1 and 2). The highest numbers were recorded in January 2024 (26 species, 464 individuals) and the lowest in May–June 2023 (19 species, 316 individuals). The three surveys of live animals did not differ in the number of individuals that were recorded (One-way repeated measures ANOVA, $F_{2,78} = 0.467$, $p = 0.629$).

TABLE 2 | Trade in legally protected wildlife in Bali, Indonesia between December 2022 and February 2025.

Species (IUCN red list status)	Legally protected since	Part	December 2022–January 2023	May–January 2023	January 2024	May–July 2024	January–February 2025	Stated origin
Mammals								
Northern common cuscus *Phalanger orientalis*	1979	Skulls	0	0	0	0	1	Timor
Asian elephant *Elephas maximus* EN	1931	Ivory	11	10	6	9	2	Thailand, Sumatra
		Molars	0	0	1	2	0	Sumatra
Dugong dugong dugon VU	1972	Skulls	0	1	0	1	1	
		Ribs	8	3	6	10	5	Bali, Lombok
		Ivory	4	3	2	4	5	
Slow loris *Nycticebus* spp.	1973	Skulls	0	0	2	0	0	Java, Sumatra
Sulawesi macaque *Macaca* spp.	1970	Skulls	0	0	1	2	5	Sulawesi
Langur *Trachypithecus* spp.	1999	Skulls	48	15	29	34	59	Java, Bali, Borneo
Langur *Presbytis* spp.	1979	Skulls	3	0	1	4	7	
Proboscis monkey *Nasalis larvatus* EN	1931	Skulls	0	0	5	4	2	Borneo
Gibbon *Hylobates* spp. EN	1931	Skulls	2	0	2	1	1	Java
Bornean orangutan *Pongo pygmaeus* CR	1931	Skulls	1	0	0	0	0	Borneo
Javan porcupine *Hystrix javanica*	2018	Skulls	11	33	32	25	29	Java, Bali
		Quills	1	0	2	1	1	
Sperm whale *Physeter macrocephalus* VU	1980	Teeth	6	23	15	10	21	Lembata
		Bones	0	5	8	9	10	Lembata
Bottlenose dolphin *Tursiops* spp.	1975	Skulls	0	0	1	1	1	
Sun bear *Helarctos malayanus* VU	1973	Canines	6	8	1	2	2	
		Claws	0	0	1	2	5	
Babirusa *Babyrousa* spp.	1931	Skulls	6	6	11	9	19	Sulawesi

(Continues)

TABLE 2 | (Continued)

Species (IUCN red list status)	Legally protected since	Part	December 2022–January 2023	May–January 2023	January 2024	May–July 2024	January–February 2025	Stated origin
Sunda leopard cat *Prionailurus javanensis*	1973	Skulls	0	0	0	0	1	
Anoa *Bubalus* spp. EN	1931	Skulls	0	1	0	0	0	Sulawesi
Barking deer *Muntiacus muntjac*	1931	Skull/antlers	31	62	39	50	27	Java
Javan deer *Rusa timorensis* VU	1931	Skull/antlers	23	14	38	33	34	Java, Flores, Timor
Sambar deer *Rusa unicolor* VU	1931	Skull/antlers	2	2	4	5	1	Borneo, Sumatra
Deer *Rusa* spp. VU	1931	Skull/antlers	0	1	0	2	2	
Birds								
Cassowary *Casuarius* spp.	1970	Feathers	2	0	8	5	11	Papua
Green peafowl *Pavo muticus* EN	1973	Feathers	0	0	1	0	1	Java
Great argus pheasant *Argusianus argus* VU	1970	Feathers	0	0	0	0	2	
Reptiles								
Hawksbill turtle *Eretmochel ys imbricata* CR	1999	Bekko	0	2	1	2	15	
Saltwater crocodile *Crocodylus porosus*	1980	Heads	1	2	1	3	2	Papua
Molluscs								
Chambered nautilus *Nautilus pompilius*	1987	Shells	117	99	211	97	124	Lombok, Flores
		Botted oil	0	0	14	8	6	
Giant clam *Tridacna gigas* VU	1987	Shells	11	7	2	4	3	Eastern Indonesia
Horse hoof clam *Hippopus hippopus*	1987	Shells	12	27	28	12	18	
Triton's trumpet *Charonia tritonis*	1987	Shells	24	17	29	10	16	
Horned helmet *Cassis cornuta*	1987	Shells	25	22	20	26	29	
Corals								

(Continues)

TABLE 2 | (Continued)

Species (IUCN red list status)	Legally protected since	Part	December 2022–January 2023	May–January 2023	January 2024	May–July 2024	January–February 2025	Stated origin
Black coral *Antipatharia* spp.	1987	Bracelets	15	30	150	90	230	Bali
		Sticks	0	0	0	2	3	
Species			21	19	26	24	28	
Minimum number individuals			324	316	464	322	396	

Note: Origin refers to the most frequently mentioned location from where traders sourced the raw materials (carving was often done in Bali) and may not be the same as the area from where the animals were found.
Abbreviations: bekko, ornamental products made of the keratinous scutes of the carapace of hawksbill turtles, feathers refer to bundles either on their own or worked into clothing or ornaments, and not to individual feathers; CR, critically endangered; EN, endangered; N.a., not assessed; VU, vulnerable.

We expected to observe more and perhaps a more diverse offer of animal body parts in the boreal summer when tourist numbers are highest. We did see a difference in the number of individuals between summer and winter (t-test for dependent means, $t = 2.394$, $p = 0.023$) but it was in the opposite direction from what we expected. More individuals and more species were recorded in winter. We observed the same for the live bird trade, where on average more individuals were observed in the boreal winter than in the summer ($t = 2.082$, $p = 0.047$). We did, however, not find a statistically significant correlation between the number of foreign visitors that arrived in Bali in a given month and the number of animals we recorded in the markets in that same month ($r = -0.11$, $p = 0.858$).

3.3 | Global Threat Status

Almost half of the species (27/59) are considered globally threatened, including 14 that are assessed as Endangered or Critically Endangered by the IUCN Red List of Threatened Species (Tables 1 and 2). For the animals we observed as body parts, we did not see a difference in the number of individuals of species that were listed as Critically Endangered, Endangered, Vulnerable, or ones that are not considered globally threatened (One-way ANOVA, $F_{2,28} = 2.269$, $p = 0.122$) (Figure 3). The same was true for the live trade, as here we did not observe a difference between the numbers we observed for globally threatened species and ones that were not listed as threatened ($t = 1.375$, $p = 0.181$).

3.4 | Time Since Being Added on the Protected Species List

For the animals observed as body parts, there was an effect of the time since the species became legally protected (One-way ANOVA, $F_{2,28} = 10.541$, $p = 0.0004$). Species that were added to the protected species list in 1924 or 1931 were not more or less commonly observed in trade than the ones that were added in the period 1968 to 1980 ($Q = 2.26$, $p = 0.23241$), but species that were added to the list most recently in the period 1987 to 2018 were more common in trade than the ones that were added in 1968–1980 ($Q = 6.30$, $p = 0.0004$) or in 1924 or 1931 ($Q = 3.94$, $p = 0.0245$). For the live trade, there was no difference between species that were listed between 1931 and 1980 and the ones that were added to the protected species list in 2018 (*t*-test, $t = 1.404$, $p = 0.173$).

3.5 | Origin of Protected Wildlife for Sale

The only time wildlife was said to have been sourced from outside Indonesia was once when a trader informed us that a carving of Asian elephant ivory was sourced from Thailand. All the other observations referred to species that were obtained from Indonesia. We recorded species that (were said to) originate, or most likely originated, from Bali (16 species), Java (13 species), Sumatra (9 species), Borneo (6 species), the Lesser Sunda Islands (6 species) or eastern Indonesia (7 species). For those species that could not have been sourced from Bali, we found a significant difference in the region or island from which they were sourced

TABLE 3 | Legally protected birds, reptiles, and fish recorded at two animal markets in Bali between January 2023 and February 2025.

Species (IUCN red list status)	Legally protected since	January 2023	January 2024	January–February 2025	*N*	Most likely origin	Native to Bali (if no, nearest island)
Birds							
Java sparrow *Lonchura oryzivora* EN	2018	59	34	122	215	Captive-bred	No (Java)
Greater green leafbird *Chloropsis sonnerati* VU	2018	42	24	17	83	Wild-caught	Yes
Sumatran laughingthrush *Garrulax bicolor* EN	2018	9	13	14	36	Wild-caught	No (Sumatra)
Lineated barbet *Psilopogon lineatus*	2018	2	12	23	37	Wild-caught	Yes
Yellow-throated hanging parrot *Loriculus pusillus*	2018	24	11	0	35	Wild-caught	Yes
Common hill myna *Gracula religiosa*	1970	14	9	0	23	Wild-caught	Yes
Javan leafbird *Chloropsis cochinchinensis*	2018	9	9	4	22	Wild-caught	No (Java)
Flame-fronted barbet *Psilopogon armillaris*	2018	19	2	0	21	Wild-caught	Yes
Red lory *Eos bornea*	2018	15	1	0	16	Wild-caught	No (Buru)
Racket-tailed treepie *Crypsirina temia*	2018	2	5	4	11	Wild-caught	Yes
Tawny-breasted parrotfinch *Erythrura hyperythra*	2018	0	0	11	11	Wild-caught	Yes
Sumatran mesia *Leiothrix laurinae*	2018	0	3	7	10	Wild-caught	No (Sumatra)
Black-winged myna *Acridotheres melanopterus* EN	1979	0	6	2	8	Captive-bred	Yes
Blue-crowned hanging parrot *Loriculus galgulus*	2018	0	6	2	8	Wild-caught	No (Java)
Fire-tufted barbet *Psilopogon pyrolophus*	2018	6	1	0	7	Wild-caught	No (Sumatra)
Bali myna *Leucopsar rothschildi* CR	1970	1	0	4	5	Captive-bred	Yes
Sunda pied fantail *Rhipidura javanica*	1979	0	2	2	4	Wild-caught	Yes
Javan coucal *Centropus nigrorufus* VU	2018	0	1	2	3	Wild-caught	No (Java)
Black-banded barbet *Psilopogon javensis*	1979	0	0	2	2	Wild-caught	Yes
Chinese sparrowhawk *Accipiter soloensis*	1970	2	0	0	2	Wild-caught	Yes

(Continues)

TABLE 3 | (Continued)

Species (IUCN red list status)	Legally protected since	January 2023	January 2024	January–February 2025	*N*	Most likely origin	Native to Bali (if no, nearest island)
Sumatran leafbird *Chloropsis media* EN.	2018	0	0	2	2	Wild-caught	No (Sumatra)
Lesser green leafbird *Chloropsis cyanopogon*	2018	0	0	2	2	Wild-caught	No (Borneo)
Helmeted friarbird *Philemon buceroides*	1931	0	1	0	1	Wild-caught	No (Lombok)
Sunda minivet *Pericrocotus miniatus*	2018	0	0	1	1	Wild-caught	No (Java)
Common green magpie *Cissa chinensis*	2018	0	0	1	1	Wild-caught	No (Sumatra)
Blue masked leaf bird *Chloropsis venusta*	2018	0	0	1	1	Wild-caught	No (Sumatra)
Reptiles							
Cameleon angelhead lizard *Gonocephalus* spp.	1978	0	2	8	10	Wild-caught	No (Java)
Fish							
Asian arowana *Scleropages formosus* EN	1980	0	2	12	14	Wild-caught/ Captive-bred	No (Borneo)
Species		13	19	21	28		
Number of individuals		204	144	243	591		

Abbreviations: CR, critically endangered; EN, endangered; VU, vulnerable.

($\chi^2 = 4.250$, df = 1, $p = 0.039$); more species originated from Java than from the other four regions combined ($\chi^2 = 3.906$, df = 1, $p = 0.481$) (Figure 4).

3.6 | Seizures at the Airport and Elsewhere in Bali

For the period 2017–2025, the TRAFFIC Wildlife Trade Portal lists five seizures of wildlife made at Bali's I Gusti Ngurah Rai International Airport and 15 seizures that were made elsewhere on Bali. The ones at the airport concerned the trafficking of one Bornean orangutan *Pongo pygmaeus*, four Asian small-clawed otters *Aonyx cinereus*, live snakes, Tokay geckos *Gekko gecko*, and skinks, as well as a variety of marine species such as live corals, clams, crabs, and lobsters. Most of these are protected species, but not all (e.g., Tokay geckons, skins, crabs and lobsters). The animals' intended destinations were Vietnam, India, and three times Russia. Four of the five seizures involved foreign nationals, leading to three arrests.

The seizures away from the airport were dominated by green turtles *Chelonia mydas* (eight seizures, at least 146 turtles and 45 eggs) and birds (three seizures, at least 26 birds). As far as we were able to assess, all of these were legally protected species. It is unclear how many people were arrested, but in the reports, no mention was made of foreigners being involved.

4 | Discussion

4.1 | General Findings of Wildlife for Sale in Bali

In our surveys, despite legal protections, we recorded a minimum number of 1440 individuals, that is, 849 individuals to account for the body parts we observed and 591 individuals we observed offered for sale alive. These were from 21 mammal species, 29 bird species, 3 reptiles, 1 fish, 5 molluscs, and 1 coral. Combining the trade in animal parts and the trade in live animals, at least 27 species are considered globally threatened, with 3 listed as Critically Endangered (1 mammal, 1 marine turtle and 1 bird), 11 as Endangered (5 mammals, 5 birds, 1 fish) and 13 as Vulnerable (9 mammals, 3 birds, 1 mollusc). These numbers likely underestimate the true scale of exploitation. Our results align with previous studies indicating that Bali remains a hub for wildlife trade in Southeast Asia, facilitated by strong domestic demand, tourism, and limited enforcement capacity (Chavez and Nijman 2024; Chavez et al. 2024; Chng et al. 2018; Lee and Nijman 2015; Lunn and

FIGURE 1 | Parts of legally protected animals for sale in Bali, from top left, clockwise, Babirusa skull; shop in Tampaksiring; primate skulls; chambered nautilus shell; bekko from hawksbill turtle; black coral bracelets; saltwater crocodile head [photos Jessica Chavez and Vincent Nijman].

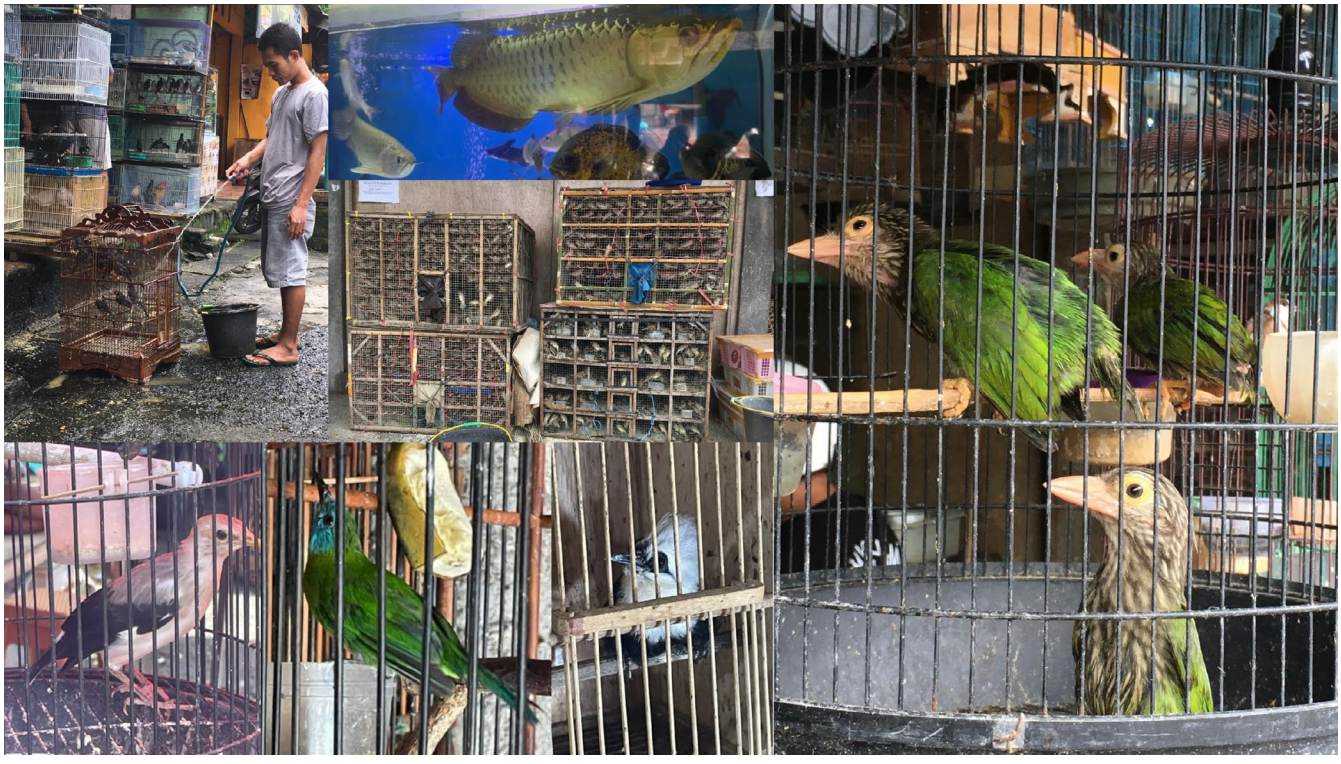

FIGURE 2 | Trade in live protected animals in Bali, from top left, clockwise, bird seller washing songbirds; Asian arowanas, lineated barbets, Sumatran laughingthrush, blue masked leaf bird, black-winged myna, with in the centre birds in cages [photos Jessica Chavez and Vincent Nijman].

Moreau 2004; Malone et al. 2002; Nijman and Lee 2016; Nijman et al. 2024; Pertiwi et al. 2020; Reksodihardjo-Lilley and Lilley 2007; Widodo 2005).

While both the number of individuals and species we observed is large enough for it to raise concerns, what is especially disconcerting is that during each survey we recorded

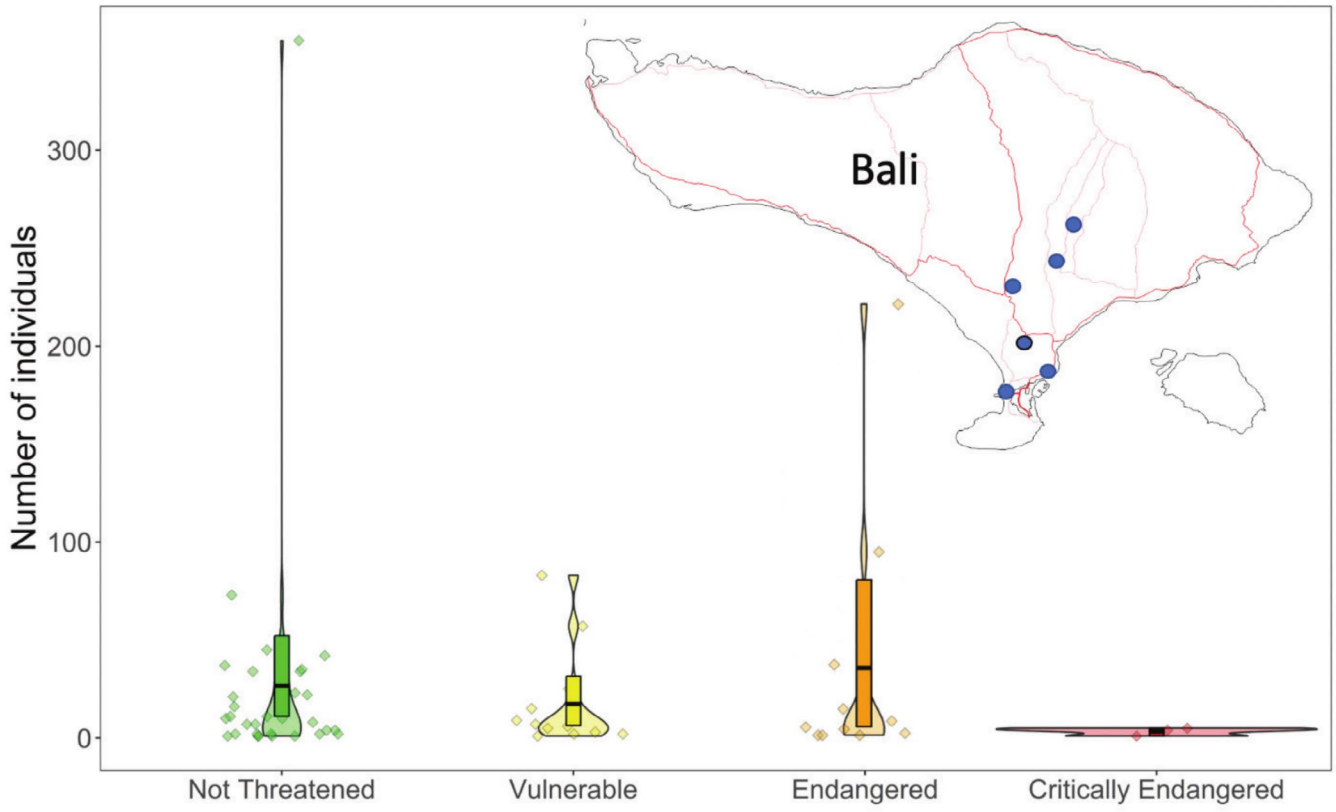

FIGURE 3 | Number of individuals of legally protected species observed in trade in Bali, Indonesia between 2022 and 2025, and their global threat status; each diamond represents one species. The insert shows the island of Bali with the six cities we surveyed (from North to South: Tampaksiring, Ubud, Mengwi, Denpasar, Sanur, Kuta/Legian).

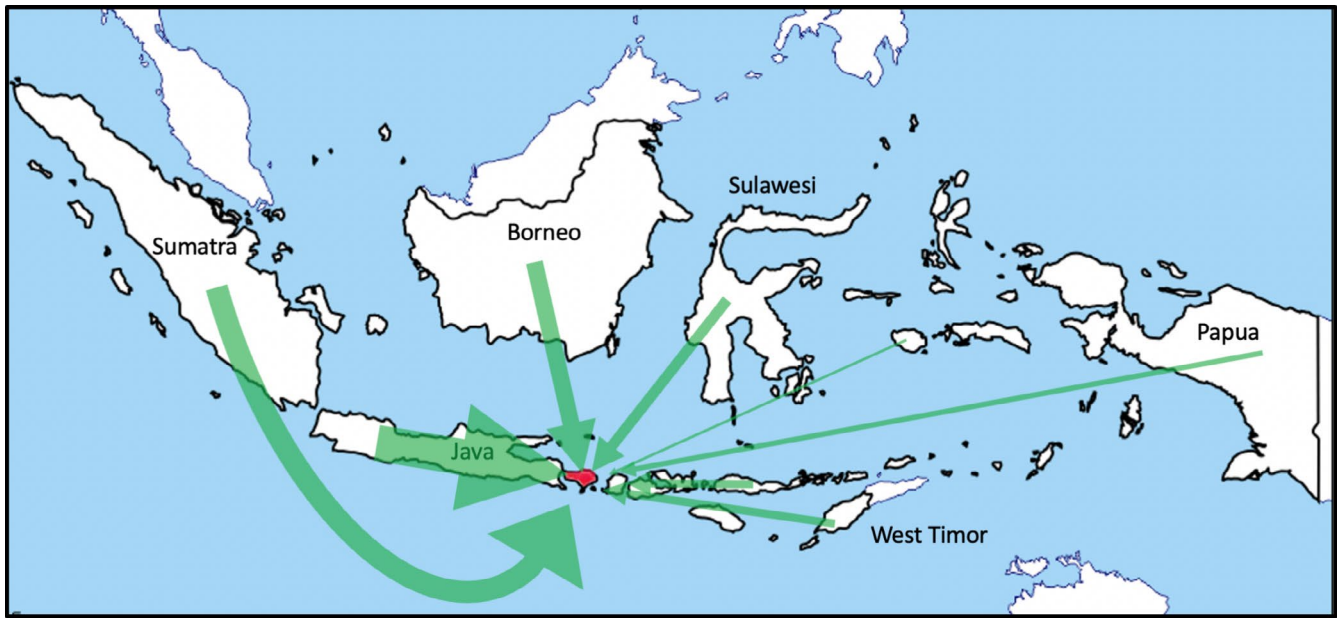

FIGURE 4 | Indonesia-wide wildlife trade network in terms of the stated or inferred origin of legally protected animal species observed in trade on the island of Bali (in red) in 2022–2025. The thickness of the lines corresponds with the number of species, ranging from one or two (the Moluccas and Papua) to 13 (Java). In addition, 16 species observed in trade were, or could have been, sourced internally on Bali.

protected species openly offered for sale, with often dozens of items derived from protected species, or indeed dozens of protected live birds, present in a single shop. In Bali, the trade in legally protected wildlife is not hidden, clearly indicating a blatant disregard for legislation and a confidence that enforcement agencies will not disrupt this business. Our findings challenge the assumption that the trade in protected wildlife is minimal or hidden from public view. Instead, we

documented substantial numbers of legally protected species being openly sold in Bali, both as body parts and live animals. The magnitude of this trade underscores the continued demand for wildlife products and the obvious lack of enforcement of existing regulations. The publicly available data on seizures of protected wildlife supports this conclusion, as on average only some five seizures were made every 2 years (one at the international airport and four elsewhere in Bali).

Our expectation that wildlife trade would peak during the boreal summer, coinciding with the highest influx of tourists, was not supported by our data. Instead, more individuals and a greater number of species were recorded in the boreal winter. The reasons for this counterintuitive pattern are unclear but could be influenced by seasonal fluctuations in the availability of wildlife, trader behavior, or enforcement patterns. The absence of a significant temporal trend suggests that the trade persists year-round, without a clear decline despite increasing conservation awareness and legal restrictions.

4.2 | Conservation Status and Trade Prevalence

We found no significant difference in the number of individuals observed among species classified as Critically Endangered, Endangered, Vulnerable, or not globally threatened. This suggests that trade pressure is not necessarily linked to a species' global conservation status but may instead be driven by factors such as cultural value, availability, and consumer demand. Similarly, in the live animal trade, we found no significant difference in the numbers of threatened versus non-threatened species, reinforcing the idea that local trade dynamics are complex and not strictly determined by conservation prioritization at a global level.

A notable finding was the higher prevalence of species recently added to Indonesia's protected species list (1987–2018) compared to those protected earlier (1924–1980). This may indicate a lag in enforcement or a lack of awareness among traders and consumers about newly protected species. Alternatively, species that were protected earlier may have experienced more effective conservation measures, leading to reduced availability in trade, or that these species have become increasingly rare and difficult to obtain. Finally, while it is likely that those species with the strongest cultural links, and thus with the strongest support from society, were the first ones to be legally protected, it is worth noting that the first protected species lists were very much Java-centered (Dammerman 1929), and the cultural relevance of species differs considerably between Java and Bali.

The vast majority of species observed in trade were sourced from within Indonesia, with only a single instance of international sourcing (elephant ivory purportedly from Thailand). Java was the most common source region, significantly exceeding other islands. This may reflect Java's high biodiversity and accessibility (it being the island closest to Bali), as well as well-established supply chains for wildlife trade. The presence of species from across Indonesia highlights the interconnected nature of wildlife trafficking networks, with Bali serving as a central marketplace catering to tourists and international traders.

As noted in the Introduction, for policymakers and the general public, the trade in protected wildlife now is frequently associated with zoonotic diseases (Guynup et al. 2020; Beirne 2021; Bezerra-Santos et al. 2021; Nijman 2021; Rush et al. 2021). In spite of these regulations, the ongoing demand for wildlife and their derivatives—whether for exotic pets, traditional medicine, or luxury goods—maintains illegal trade networks. This trade jeopardizes conservation initiatives and heightens the potential of zoonotic spillover events by multiplying human-wildlife interactions, especially in unregulated markets where diseases might overcome species barriers (UNEP-WCMC and JNCC 2021). Prioritizing the prevention of illicit wildlife trade is imperative for both global health security and conservation, given the increasing recognition of One Health principles (Karesh et al. 2025).

Seizures made at the airport were distinctly different from those made in other parts of Bali. The former concerned smuggling attempts of live trade of animals by foreign nationals, whereas the latter concerned seizures of primarily green turtles traded by the Balinese. Green turtles are protected, but part of Balinese society sees that there is a sustained need for them to be used in religious ceremonies and local dishes. This trade occurs throughout Bali and includes few, if any, foreign tourists (although some may opt to consume their meat when prepared in local dishes). With a quarter of all seizures taking place at the international airport, there is a clear evidence of an "airport bias" when it comes to law enforcement (Phelps et al. 2010).

4.3 | Sustainable Development, Tourism and Conservation

From our work, and that of others (Adhiasto et al. 2023; Awan et al. 2018; Auliya et al. 2016; Caiado et al. 2018; Lehtonen 2004; Sachs et al. 2019), it is clear that the interactions between tourism, sustainable development, and wildlife utilization and protection cause frictions at the international, national, and regional levels. Indonesia has committed to the UN Sustainable Development Goals (Sari et al. 2022), specifically through its Roadmap of SDGs (MNDP 2020), but with respect to dealing with wildlife trade and effectively enforcing its protected species legislation, it is falling short (Gomez and Shepherd 2019, 2021). Our findings emphasize the urgent need for improved enforcement of existing wildlife protection laws (cf. Febrian et al. 2021). The open sale of protected species suggests low risk perception among traders and insufficient regulatory oversight(Wibisana and Nuning 2018). Targeted enforcement actions, coupled with awareness campaigns, may help reduce demand and disrupt supply chains (Sherman et al. 2022). Additionally, further research is needed to understand consumer motivations and the socioeconomic drivers sustaining this trade. Longitudinal studies could assess whether interventions lead to measurable declines in illegal wildlife trade over time. It should be noted that no signage or other forms of information were observed warning international tourists of the perils of taking illegally sourced wildlife out of the country (this is even more so the case for those species for which their international trade is regulated by the Convention on International Trade in Endangered Species of Wild Fauna and Flora, and that require permits issued by the

Indonesian government, and in many cases, import permits from the destination countries: Wijnstekers 2018).

Specifically, in the context of Bali, with strong cultural and religious reverence for the environment and specific species, and with tourism being a major economic driver (Antara and Sumarniasih 2017), solutions must be found by engaging with various sectors and stakeholders. At a minimum, this should include law enforcement agencies (forestry officials, fisheries agencies, police, customs, prosecutors), conservation organizations, local governments, the tourism sector (tour operators, hotels, travel agencies), local communities, and international agencies (CITES, United Nations World Tourism Organization). This could include work that looks to not only engage with stakeholders to get better levels of protection, but explicitly interviews politicians, policymakers, and other parties to understand how they can be better supported to enforce existing laws as well as to understand vendor motivations (beyond mere monetary gain) (Wibisana and Nuning 2018). This then can be a basis to develop behavioral interventions to leverage the cultural and religious reverence of the Balinese people to encourage vendors not to sell illegal wildlife. By implementing coordinated strategies that engage stakeholders across sectors, Indonesia can mitigate the ecological and cultural impacts of the illegal trade in protected wildlife, ensuring the long-term survival of both the animals and their habitats (Chavez and Nijman 2024).

Author Contributions

Initiation: V.N., J.C., M.C., K.; data collection: J.C., K., S.S.N., I.N.A.D.P., E.S., D.K.T.S., L.E.H, A.W.R., R.A.W., V.N.; analysis: V.N., M.C., J.C., C.R.S.; visualization: V.N., J.C., M.C.; supervision and administration: K., M.C., L.E.H., A.W.R., D.K.T.S.; funding: J.C., V.N., M.C., K., L.E.H., A.W.R., C.R.S. writing – original draft: J.C., V.N., M.C., S.S.N., C.R.S.; writing – editing and revision: J.C., M.C., K., S.S.N., I.N.A.D.P., C.R.S., E.S., L.E.H., A.W.R., D.K.T.S., R.A.W., V.N.

Acknowledgements

We thank members of the Oxford Wildlife Trade Research Group for valuable feedback and comments, and our colleagues at Oxford Brookes University and Universitas Warmadewa for logistic and administrative support. We thank two anonymous reviewers for constructive comments and suggestions to increase the clarity of our arguments.

Ethics Statement

No identifiable information on individuals or businesses was collected during this study. This study did not involve any experiment on animals or research involving human participants, and while we did not require institutional permission for observational research in wildlife markets, they were added to Oxford Brookes University's Register of Activities Involving Animals (2022–2025). The research was conducted in compliance with Monitor Conservation Research Society's Code of Ethics. Our research in Indonesia is underpinned by a Memorandum of Understanding between Oxford Brookes University (Oxford, UK) and Universitas Warmadewa (Denpasar, Indonesia). Indonesia's National Research and Innovation Agency granted permission to conduct the research (039/SIP/FRP/SM/22, 202A/SIP/IV/FR/5/23, 173/SIP/IV/FR/4/24).

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

All newly obtained data are included in the text; data on the red list status can be obtained from the IUCN Red List of Threatened Species at https://www.iucnredlist.org/; data on protected species status in Indonesia can be obtained from the Ministry of Environment and Forestry https://ppid.menlhk.go.id/siaran_pers/browse/1408; data on seizures can be obtained from TRAFFIC Wildlife Trade Portal https://www.wildlifetradeportal.org/; for any additional request, please contact the corresponding author.

Endnotes

[1] For instance, in the Indonesian context, the black-winged myna *Acridotheres melanopterus*, a popular cagebird, is a legally protected species, and hence wild-caught individuals are not allowed to be traded. However, certain individuals and companies have been given permission to breed the species and to sell second (third, fourth, etc.) generation offspring. A second-generation bird from these facilities can thus be legally purchased, but a first generation or wild-caught bird from these same facilities cannot. It would also be illegal to purchase second generation birds from facilities or individuals that have not obtained government approval. It is challenging for a consumer (both Indonesian and foreign) to accurately assess the origin of individual birds that are offered for sale in a bird market or pet shop. The black-winged myna is endemic to the islands of Java and Bali and the wild population numbers in the hundreds; it is listed as Endangered on the IUCN Red List of Threatened Species. However, 7 years ago Nijman et al. (2018) estimated that the number of black-winged mynas in private ownership in Indonesia was in the order of 40,000 birds, and this number has undoubtedly increased in recent years. The species is thus rare in the wild but increasingly common in captivity and trade. Finally, while it is illegal to trade in first generation or wild-caught black-winged mynas, Nijman et al. (2018, 12) noted that "Thus far there is no evidence that anyone has ever been prosecuted for illegally trading or owning black-winged mynas." It is thus understandable that there is confusion concerning the buying, selling and keeping of this restricted range, globally threatened, rare and legally protected bird.

[2] In 1990 when Act 5 was introduced, a fine of IDR 100,000,000 was the equivalent of USD 55,000 but this has greatly diminished by inflation. In September 2024 the maximum fine was increased to IDR 5,000,000,000 (USD 314,000) and the maximum prison sentence was increased to 15 years.

References

Adhiasto, D. N., I. Exploitasia, P. Fahlapie, et al. 2023. "A Criminal Justice Response to Address the Illegal Trade of Wildlife in Indonesia." *Conservation Letters* 16: 12937.

Allen, G. R., and M. Adrim. 2003. "Coral Reef Fishes of Indonesia." *Zoological Studies-Taipei* 42, no. 1: 1–72.

Allen, G. R., and M. V. Erdmann. 2013. "Reef Fishes of Bali, Indonesia." In *Bali Marine Rapid Assessment Program 2011*, 15. Conservation International.

Andrew, D. 2017. "Trade and Sustainable Development Goal (SDG) 15: Promoting Life on Land Through Mandatory and Voluntary Approaches." ADBI Working Paper, Asian Development Bank, Tokyo, Japan.

Andrew, P. 1992. *The Birds of Indonesia, a Checklist (Peter's Sequence)*. Indonesian Ornithological Society.

Antara, M., and M. S. Sumarniasih. 2017. "Role of Tourism in Economy of Bali and Indonesia." *Journal of Tourism and Hospitality Management* 5: 34–44.

Auliya, M., S. Altherr, D. Ariano-Sanchez, et al. 2016. "Trade in Live Reptiles, Its Impact on Wild Populations, and the Role of the European Market." *Biological Conservation* 204: 103–119.

Awan, U., A. Kraslawski, and J. Huiskonen. 2018. "Governing Interfirm Relationships for Social Sustainability: The Relationship Between Governance Mechanisms, Sustainable Collaboration, and Cultural Intelligence." *Sustainability* 10: 4473.

Baveja, P., K. M. Garg, B. Chattopadhyay, et al. 2021. "Using Historical Genome-Wide DNA to Unravel the Confused Taxonomy in a Songbird Lineage That Is Extinct in the Wild." *Evolutionary Applications* 14: 698–709.

Beirne, P. 2021. "Wildlife Trade and COVID-19: Towards a Criminology of Anthropogenic Pathogen Spillover." *British Journal of Criminology* 61: 607–626.

Bergin, D., S. C. Chng, J. A. Eaton, and C. R. Shepherd. 2018. "The Final Straw? An Overview of Straw-Headed Bulbul *Pycnonotus zeylanicus* Trade in Indonesia." *Bird Conservation International* 28: 126–132.

Bezerra-Santos, M. A., J. A. Mendoza-Roldan, R. A. Thompson, F. Dantas-Torres, and D. Otranto. 2021. "Illegal Wildlife Trade: A Gateway to Zoonotic Infectious Diseases." *Trends in Parasitology* 37: 181–184.

Botha, J., E. T. F. Witkowski, and C. M. Shackleton. 2004. "The Impact of Commercial Harvesting on *Warburgia Salutaris* ('Pepper-Bark Tree') in Mpumalanga, South Africa." *Biodiversity and Conservation* 13: 1675–1698.

BPS. 2024. *Produk Domestik Regional Bruto Per Kapita (Ribu Rupiah), 2022–2023*. Badan Pusat Statistik.

Caiado, R. G. G., W. Leal Filho, O. L. G. Quelhas, D. L. de Mattos Nascimento, and L. V. Ávila. 2018. "A Literature-Based Review on Potentials and Constraints in the Implementation of the Sustainable Development Goals." *Journal of Cleaner Production* 198: 1276–1288.

Carpenter, A. I., and F. Andreone. 2023. "Valorisation of Madagascar's Wildlife Trade and Wildlife Tourism: What Are the Conservation Benefits?" *Conservation* 3: 509–522.

Chavez, J., and V. Nijman. 2024. "The Open Sale of Primate Skulls on Bali Reveal Complex Indonesia-Wide Wildlife Trade Networks." *Primate Conservation* 38: 175–184.

Chavez, J., I. N. A. D. Payuse, Kuntayuni, M. Campera, and V. Nijman. 2024. "Tourism, International Wildlife Trade and the (In)effectiveness of CITES." *Environmental Conservation* 51, no. 1: 64–70.

Chiok, W. X., A. E. Miller, S. E. Pang, J. A. Eaton, M. Rao, and F. E. Rheindt. 2019. "Regional and Local Extirpation of a Formerly Common Sundaic Passerine, the Straw-Headed Bulbul *Pycnonotus zeylanicus*." *Forktail* 35: 3–11.

Chng, S. C., K. Krishnasamy, and J. A. Eaton. 2018. "In the Market for Extinction: The Cage Bird Trade in Bali." *Forktail* 34: 35–41.

Dammerman, K. W. 1929. "Preservation of Wild Life and Nature Reserves in The Netherlands Indies." In *Proceeding 4th Pacific Scientific Congress, Java 1929*, 1–91. Pacific Science Association.

Daut, E. F., D. J. Brightsmith, A. P. Mendoza, L. Puhakka, and M. J. Peterson. 2015. "Illegal Domestic Bird Trade and the Role of Export Quotas in Peru." *Journal for Nature Conservation* 27: 44–53.

Eliason, S. 2003. "Illegal Hunting and Angling: The Neutralization of Wildlife Law Violations." *Society and Animals* 11: 225–243.

Febrian, F., L. Apriyani, and V. Novianti. 2021. "Rethinking Indonesian Legislation on Wildlife Protection: A Comparison Between Indonesia and the United States." *Sriwijaya Law Review* 5: 143–160.

Girmansyah, D., Y. Santika, A. Retnowati, et al. 2013. "Flora of Bali: An Annotated Checklist; Research Center for Biology-LIPI and Yayasan Pustaka Obor Indonesia: Bogor, Indonesia."

Gomez, L., and C. R. Shepherd. 2019. "Bearly on the Radar–an Analysis of Seizures of Bears in Indonesia." *European Journal of Wildlife Research* 65: 89.

Gomez, L., and C. R. Shepherd. 2021. "The Illegal Exploitation of the Javan Leopard (*Panthera pardus melas*) and Sunda Clouded Leopard (*Neofelis diardi*) in Indonesia." *Nature Conservation* 43: 25–39.

Gomez, L., C. R. Shepherd, and M. S. Khoo. 2020. "Illegal Trade of Sun Bear Parts in the Malaysian States of Sabah and Sarawak." *Endangered Species Research* 41: 279–287.

Guynup, S., C. R. Shepherd, and L. Shepherd. 2020. "The True Costs of Wildlife Trafficking." *Georgetown Journal of International Affairs* 21: 28–37.

Janssen, J., and B. T. Leupen. 2019. "Traded Under the Radar: Poor Documentation of Trade in Nationally-Protected Non-CITES Species Can Cause Fraudulent Trade to Go Undetected." *Biodiversity and Conservation* 28, no. 11: 2797–2804.

Karesh, W. B., T. Grillo, C. Machalaba, et al. 2025. "Guidelines for Addressing Disease Risks in Wildlife Trade." *One Health* 20: 100998.

Kastoryano, S., and B. Vollaard. 2023. "Unseen Annihilation: Illegal Fishing Practices and Nautical Patrol." *Journal of Environmental Economics and Management* 122: 102881.

Katila, P., C. J. P. Colfer, W. De Jong, G. Galloway, P. Pacheco, and G. Winkel. 2019. *Sustainable Development Goals*. Cambridge University Press.

Kurland, J., S. F. Pires, S. C. McFann, and W. D. Moreto. 2017. "Wildlife Crime: A Conceptual Integration, Literature Review, and Methodological Critique." *Crime Science* 6: 1–15.

Lee, P. B., and V. Nijman. 2015. "Trade in Dugong Parts in Southern Bali." *Journal of the Marine Biological Association of the United Kingdom* 95: 1717–1721.

Lehtonen, M. 2004. "The Environmental–Social Interface of Sustainable Development: Capabilities, Social Capital, Institutions." *Ecological Economics* 49: 199–214.

Leupen, B. T., and C. R. Shepherd. 2018. "The Critically Endangered Strawheaded Bulbul *Pycnonotus Zeylanicus* Lacks Full Legal Protection in Indonesia—The Main Source of Its Problems." *BirdingASIA* 30: 12–15.

Lunn, K. E., and M. A. Moreau. 2004. "Unmonitored Trade in Marine Ornamental Fishes: The Case of Indonesia's Banggai Cardinalfish (*Pterapogon kauderni*)." *Coral Reefs* 23: 344–351.

Lyons, J. A., and D. J. D. Natusch. 2012. "Over-Stepping the Quota. The Trade in Sugar Gliders in West Papua, Indonesia." *TRAFFIC Bulletin* 24: 5–6.

MacMillan, D. C., and Q. A. Nguyen. 2014. "Factors Influencing the Illegal Harvest of Wildlife by Trapping and Snaring Among the Katu Ethnic Group in Vietnam." *Oryx* 48, no. 2: 304–312.

Malone, N., A. R. Purnama, M. Wedana, and A. Fuentes. 2002. "Assessment of the Sale of Primates at Indonesian Bird Markets." *Asian Primates* 8: 7–11.

Maryanto, I., Maharadatunkamsi, A. S. Achmadi, S. Wiantoro, E. Sulistyadi, and M. Yoneda. 2019. *Checklist of the Mammals of Indonesia*. Research Center for Biology, Indonesia Institute of Sciences (LIPI).

Mason, V. 2011. "A Revised Checklist for the Birds of Bali, With Notes on Recent Additions to the Avifauna." *Kukila* 15: 1–30.

McEvoy, J. F., G. Connette, Q. Huang, et al. 2019. "Two Sides of the Same Coin–Wildmeat Consumption and Illegal Wildlife Trade at the Crossroads of Asia." *Biological Conservation* 238: 108197.

MNDP. 2020. *Roadmap of SDGs Indonesia: A Highlight*. Ministry of National Development Planning/National Development Planning Agency.

Morton, O., V. Nijman, and D. P. Edwards. 2024. "International Wildlife Trade Quotas Are Characterized by High Compliance and Coverage

but Insufficient Adaptive Management." *Nature Ecology & Evolution* 8: 1–10.

Myers, N., R. A. Mittermeier, C. G. Mittermeier, G. A. Da Fonseca, and J. Kent. 2000. "Biodiversity Hotspots for Conservation Priorities." *Nature* 403: 853–858.

Nijman, V. 2015. *The Conservation Status of Mammals and Birds in the Imawbum Mountains, Myanmar*. Fauna and Flora International.

Nijman, V. 2017. "Orangutan Trade, Confiscations, and Lack of Prosecutions in Indonesia." *American Journal of Primatology* 79: 22652.

Nijman, V. 2021. "Illegal *and* Legal Wildlife Trade Spreads Zoonotic Diseases." *Trends in Parasitology* 37: 359–360.

Nijman, V. 2022. "Harvest Quotas, Free Markets and the Sustainable Trade in Pythons." *Nature Conservation* 48: 99–121.

Nijman, V., A. Abdullah, E. Adinda, et al. 2024. "Indonesia's Sustainable Development Goals in Relation to Curbing and Monitoring the Illegal Wildlife Trade." *Sustainable Development* 32: 5393–5403.

Nijman, V., M. Campera, A. Ardiansyah, et al. 2021. "Large-Scale Trade in a Songbird That Is Extinct in the Wild." *Diversity* 13: 238.

Nijman, V., A. Langgeng, H. Birot, M. A. Imron, and K. A. I. Nekaris. 2018. "Wildlife Trade, Captive Breeding and the Imminent Extinction of a Songbird." *Global Ecology and Conservation* 15: 00425.

Nijman, V., and P. B. Lee. 2016. "Trade in Nautilus and Other Large Marine Molluscs as Ornaments and Decorations in Bali, Indonesia." *Raffles Bulletin of Zoology* 64: 368–373.

Nijman, V., T. Q. Morcatty, K. Feddema, M. Campera, and K. A. I. Nekaris. 2022. "Disentangling the Legal and Illegal Wildlife Trade–Insights From Indonesian Wildlife Market Surveys." *Animals* 12, no. 5: 628.

Nijman, V., and K. A. I. Nekaris. 2014. "Trade in Wildlife in Bali, Indonesia, for Medicinal and Decorative Purposes." *TRAFFIC Bulletin* 26, no. 1: 31.

Nijman, V., D. Spaan, E. J. Rode-Margono, Wirdateti, and K. A. I. Nekaris. 2017. "Changes in the Primate Trade in Indonesian Wildlife Markets Over a 25-Year Period: Fewer Apes and Langurs, More Macaques, and Slow Lorises." *American Journal of Primatology* 79: 22517.

Noerjito, M., and I. Maryanto. 2001. *Jenis-Jenis Hayati Yang Dilindung Perundang-Undang Indonesia*. LIPI.

Novanda, S., and E. Rosnawati. 2021. "Law Enforcement Against the Crime of Trading in Protected Animals (Case Study Decision Number: 3295/Pid. B/Lh/2019/Pn. Sby)." *Indonesian Journal of Law and Economics Review* 13: 10–21070.

Osuka, K., J. A. Kawaka, and M. A. Samoilys. 2021. "Evaluating Kenya's Coastal Gillnet Fishery: Trade-Offs in Recommended Mesh-Size Regulations." *African Journal of Marine Science* 43, no. 1: 15–29.

Pertiwi, N. P. D., M. D. Suhendro, N. L. A. Yusmalinda, et al. 2020. "Forensic Genetic Case Study: Species Identification and Traceability of Sea Turtle Caught in Illegal Trade in Bali, Indonesia." *Biodiversitas* 21: 4276–4283.

Phelps, J., D. Biggs, and E. L. Webb. 2016. "Tools and Terms for Understanding Illegal Wildlife Trade." *Frontiers in Ecology and the Environment* 14: 479–489.

Phelps, J., and E. L. Webb. 2015. ""Invisible" Wildlife Trades: Southeast Asia's Undocumented Illegal Trade in Wild Ornamental Plants." *Biological Conservation* 186: 296–305.

Phelps, J., E. L. Webb, D. Bickford, V. Nijman, and N. S. Sodhi. 2010. "Boosting CITES." *Science* 330, no. 6012: 1752–1753.

ProFauna. 2005. *Hawksbill Trade in Indonesia*. ProFauna.

Rehman, A., S. Jafar, N. A. Raja, and J. Mahar. 2015. "Use of DNA Barcoding to Control the Illegal Wildlife Trade: A CITES Case Report From Pakistan." *Journal of Bioresource Management* 2, no. 2: 19–22.

Reksodihardjo-Lilley, G., and R. Lilley. 2007. "Towards a Sustainable Marine Aquarium Trade: An Indonesian Perspective." *SPC Live Reef Fish Information Bulletin* 17: 11–19.

Rosyadi, I., A. Rudiyanto, H. S. Abdurrahman, H. Siswanto, W. S. Pamuji, and U. Suhendar. 2019. "Conservation of Java Sparrow *Lonchura oryzivora* in Gn Sewu Geopark, Yogyakarta Province, Java, Indonesia." *Birding Asia* 32: 34–37.

Rush, E. R., E. Dale, and A. A. Aguirre. 2021. "Illegal Wildlife Trade and Emerging Infectious Diseases: Pervasive Impacts to Species, Ecosystems and Human Health." *Animals* 11, no. 6: 1821.

Sachs, J. D., G. Schmidt-Traub, M. Mazzucato, D. Messner, N. Nakicenovic, and J. Rockström. 2019. "Six Transformations to Achieve the Sustainable Development Goals." *Nature Sustainability* 2: 805–814.

Sadanandan, K. R., G. W. Low, S. Sridharan, et al. 2020. "The Conservation Value of Admixed Phenotypes in a Critically Endangered Species Complex." *Scientific Reports* 10: 15549.

Sari, D. A., C. Margules, H. S. Lim, et al. 2022. "Performance Auditing to Assess the Implementation of the Sustainable Development Goals (SDGs) in Indonesia." *Sustainability* 14, no. 19: 12772.

Shepherd, C. R. 2010. "Illegal Primate Trade in Indonesia Exemplified by Surveys Carried Out Over a Decade in North Sumatra." *Endangered Species Research* 11, no. 3: 201–205.

Shepherd, C. R., V. Nijman, K. Krishnasamy, J. A. Eaton, and S. C. Chng. 2016. "Illegal Trade Pushing the Critically Endangered Black-Winged Myna *Acridotheres Melanopterus* Towards Imminent Extinction." *Bird Conservation International* 26: 147–153.

Sherman, J., M. Voigt, M. Ancrenaz, et al. 2022. "Orangutan Killing and Trade in Indonesia: Wildlife Crime, Enforcement, and Deterrence Patterns." *Biological Conservation* 276: 109744.

Squires, T. M., N. J. Collar, C. Devenish, et al. 2022. "Controlling Trapping, Overgrazing and Invasive Vegetation Is Key to Saving Java's Last Population of the Black-Winged Myna." *Ornithological Applications* 124, no. 2: 004.

Squires, T. M., A. N. Kepakisan, H. Kusumanegara, et al. 2024. "The Road to Recovery: Conservation Management for the Critically Endangered Bali Myna Shows Signs of Success." *Oryx* 58: 367–377.

Stafford-Smith, M., D. Griggs, O. Gaffney, et al. 2017. "Integration: The Key to Implementing the Sustainable Development Goals." *Sustainability Science* 12: 911–919.

Sun, J., B. Liu, H. Rustiami, H. Xiao, X. Shen, and K. Ma. 2024. "Mapping Asia Plants: Plant Diversity and a Checklist of Vascular Plants in Indonesia." *Plants* 13: 2281.

UNEP-WCMC, JNCC. 2021. *Zoonotic Potential of International Trade in CITES-Listed Species*. Joint Nature Conservation Committee.

UNWTO. 2001. *Global Code of Ethics for Tourism*. United Nations World Tourism Organisation.

UNWTO. 2009. *Statues of the World Tourism Organisation*. United Nations World Tourism Organisation.

Van Balen, S. B., and N. J. Collar. 2021. "The Vanishing Act: A History and Natural History of the Javan Pied Starling *Gracupica Jalla*." *Ardea* 109, no. 1: 41–54.

Van Balen, S. B., I. W. A. Dirgayusa, I. M. W. A. Putra, and H. H. Prins. 2000. "Status and Distribution of the Endemic Bali Starling *Leucopsar Rothschildi*." *Oryx* 34: 188–197.

White, A. 2021. "How China's Wildlife Trade Legislation Permits Commercial Trade in Protected Wild Animal Species." *China Quarterly* 248: 1212–1225.

Wibisana, A. G., and W. P. Nuning. 2018. "The Implementation of Indonesia's Penal Sanctions to the Increased Illegal Trade of Endangered Species." In *Law and Justice in a Globalized World*, 195–202. Routledge.

Widodo, W. 2005. "Perdagangan Burung-Burung Paruh Bengkok di Bali." *Berkala Penelitian Hayati* 11: 31–37.

Wijnstekers, W. 2018. *The Evolution of CITES*. 11th ed. CITES Secretariat.

Witno, W., Y. Yumna, E. Rifaldo, and A. U. B. Putri. 2023. "Community Knowledge About Human Activities That Potential as a Disturbance of the Ponda-Ponda Natural Reserve, East Luwu Regency." *Jurnal Penelitian Kehutanan* 5, no. 1: 1–8.

Ye, Y. C., W. H. Yu, C. Newman, et al. 2020. "Effects of Regional Economics on the Online Sale of Protected Parrots and Turtles in China." *Conservation Science and Practice* 2: 161.